

# CIVIL SUPERSONIC AIRCRAFT DEVELOPMENT (SST)

---

---

## HEARINGS BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON APPROPRIATIONS HOUSE OF REPRESENTATIVES NINETY-SECOND CONGRESS FIRST SESSION

---

SUBCOMMITTEE ON DEPARTMENT OF TRANSPORTATION AND RELATED  
AGENCIES APPROPRIATIONS

**JOHN J. McFALL, California, *Chairman***

EDWARD P. BOLAND, Massachusetts

SIDNEY R. YATES, Illinois

TOM STEED, Oklahoma

SILVIO O. CONTE, Massachusetts

WILLIAM E. MINSHALL, Ohio

JACK EDWARDS, Alabama

THOMAS J. KINGFIELD, *Staff Assistant*

---

Printed for the use of the Committee on Appropriations

**Continuing Appropriations, 1971**



U.S. GOVERNMENT PRINTING OFFICE

WASHINGTON : 1971

## COMMITTEE ON APPROPRIATIONS

GEORGE H. MAHON, Texas, *Chairman*

JAMIE L. WHITTEN, Mississippi	FRANK T. BOW, Ohio
GEORGE W. ANDREWS, Alabama	CHARLES R. JONAS, North Carolina
JOHN J. ROONEY, New York	ELFORD A. CEDERBERG, Michigan
ROBERT L. F. SIKES, Florida	JOHN J. RHOLES, Arizona
OTTO E. PASSMAN, Louisiana	WILLIAM E. MINSHALL, Ohio
JOE L. EVINS, Tennessee	ROBERT H. MICHEL, Illinois
EDWARD P. BOLAND, Massachusetts	SILVIO O. CONTE, Massachusetts
WILLIAM H. NATCHER, Kentucky	GLENN R. PAVIS, Wisconsin
DANIEL J. FLOOD, Pennsylvania	HOWARD W. ROBISON, New York
TOM STEED, Oklahoma	GARNER E. SHRIVER, Kansas
GEORGE E. SHIPLEY, Illinois	JOSEPH M. McDADE, Pennsylvania
JOHN M. SLACK, West Virginia	MARK ANDREWS, North Dakota
JOHN J. FLYNT, Jr., Georgia	LOUIS C. WYMAN, New Hampshire
NEAL SMITH, Iowa	BURT L. TALCOTT, California
ROBERT N. GIAIMO, Connecticut	CHARLOTTE T. REID, Illinois
JULIA BUTLER HANSEN, Washington	DOUGALD W. RIEGLE, Jr., Michigan
JOSEPH P. ADDABBO, New York	WENDELL WYATT, Oregon
JOHN J. McFALL, California	JACK EDWARDS, Alabama
W. R. HULL, Jr., Missouri	DEL CLAWSON, California
EDWARD J. PATTEN, New Jersey	WILLIAM J. SCHERLE, Iowa
CLARENCE D. LONG, Maryland	ROBERT C. McEWEN, New York
SIDNEY R. YATES, Illinois	JOHN T. MYERS, Indiana
BOB CASEY, Texas	
DAVID PRYOR, Arkansas	
FRANK E. EVANS, Colorado	
DAVID R. OBEY, Wisconsin	
EDWARD R. ROYBAL, California	
WILLIAM D. HATHAWAY, Maine	
NICK GALIFANAKIS, North Carolina	
LOUIS STOKES, Ohio	
J. EDWARD ROUSH, Indiana	
K. GUNN MCKAY, Utah	

PAUL M. WILSON, *Clerk and Staff Director*

### STAFF ASSISTANTS

WILLIAM GERALD BOLING	GARY C. MICHALAK	SAMUEL R. PRESTON
SAMUEL W. CROSBY	DEMPSEY B. MIZELLE	DONALD E. RICHBOURG
GEORGE E. EVANS	ENID MORRISON	EARL C. SILSBY
ROBERT B. FOSTER	ROBERT M. MOYER	G. HOMER SKARIN
JOHN M. GARRITY	PETER J. MURPHY, Jr.	CHARLES W. SNODGRASS
AUBREY A. GUNNELS	HENRY A. NEIL, Jr.	HUNTER L. SPILLAN
JAY B. HOWE	BYRON S. NIELSON	GEORGE A. URIAN
THOMAS J. KINGFIELD	ROBERT C. NICHOLAS III	EUGENE B. WILHELM
KEITH F. MAINLAND	JOHN G. PLASHAL	
MILTON B. MEREDITH		

### ADMINISTRATIVE SUPPORT

GERARD J. CHOUINARD	GEMMA M. HICKEY	DALE M. SHULAW
PAUL V. FARMER	LAWRENCE C. MILLER	AUSTIN G. SMITH
DANIEL V. GUN SHOWS	FRANCIS W. SADY	RANDOLPH THOMAS

# CIVIL SUPERSONIC AIRCRAFT DEVELOPMENT

MONDAY, MARCH 1, 1971

## WITNESSES

HON. JOHN A. VOLPE, SECRETARY OF TRANSPORTATION  
W. M. MAGRUDER, DIRECTOR, SUPERSONIC TRANSPORT DEVELOPMENT  
MENT  
ROBERT McLELLAN, ASSISTANT SECRETARY FOR DOMESTIC AND  
INTERNATIONAL BUSINESS, DEPARTMENT OF COMMERCE  
HON. WILLIAM RUCKELSHAUS, ADMINISTRATOR ENVIRONMENTAL  
PROTECTION AGENCY  
HON. JAMES BEGGS, UNDER SECRETARY OF TRANSPORTATION  
JOHN P. OLSSON, DEPUTY UNDER SECRETARY OF TRANSPORTATION  
LAURENCE J. BURTON, DIRECTOR, OFFICE OF CONGRESSIONAL  
RELATIONS, DOT  
WALTER R. BOEHNER, DIRECTOR, OFFICE OF BUDGET, DOT  
B. J. VIERLING, DEPUTY DIRECTOR, OFFICE OF SUPERSONIC TRANSPORT  
DEVELOPMENT, DOT  
R. E. PARSONS, ACTING DEPUTY DIRECTOR, OFFICE OF SUPERSONIC  
TRANSPORT DEVELOPMENT, DOT  
RICHARD E. COHEN, DIRECTOR, AEROSPACE INDUSTRY OPERATIONS,  
BUREAU OF DOMESTIC COMMERCE, U.S. DEPARTMENT OF  
COMMERCE

Mr. McFALL. The committee will come to order. This morning we begin our hearings on continuing fiscal year 1971 appropriations for the Department of Transportation and related agencies.

To summarize what has happened to date with respect to Transportation appropriations, on May 27, 1970, the House passed H.R. 17755, the Department of Transportation and related agencies appropriation bill for fiscal year 1971. On December 3, an amended bill passed the Senate. The conferees met on December 10 and the House adopted the conference report on the bill on December 15. This report was tabled by the Senate on December 29. That action led to the introduction and passage of House Joint Resolution 1421 under which the Department of Transportation is currently operating.

Under this resolution, the rate of operations for each activity of the Department of Transportation and related agencies is the funding level in the bill H.R. 17755 as it was passed by the Senate and as further modified by the conference agreements ratified by the House on December 15.

With respect to the SST, the rate of operation is \$210 million (plus any carryovers from previous years, of course), the level provided for in the conference report on the Department of Transportation and

related agencies appropriations bill for 1971. Under the current and prior fiscal year 1971 continuing resolutions approximately \$156 million will be obligated for the SST through March 30, 1971.

ORIGINAL CONFERENCE AGREEMENT ON FISCAL YEAR 1971 APPROPRIATIONS

We shall include in the record at this point a copy of the Transportation appropriation bill as modified by the House of Representatives on December 15, 1970, and a table showing a comparison of the amounts provided in that bill with budget estimates.

(The documents follow :)

DEPARTMENT OF TRANSPORTATION AND RELATED AGENCIES APPROPRIATION ACT, 1971

[Figures based on H.R. 17755, as modified by the House on Dec. 15, 1970. Bill died with the expiration of the session. See Interim continuing appropriation provision, Public Law 91-645]

TITLE I.—DEPARTMENT OF TRANSPORTATION

Agency and item	Estimates of new (obligational) authority, 1971 <sup>1</sup>	New budget (obligational) authority appropriated, 1971 <sup>1</sup>	Increase (+) or decrease (-), appropriations compared with estimates
<b>OFFICE OF THE SECRETARY</b>			
Salaries and expenses.....	\$19,510,000	\$17,535,000	-\$1,975,000
Transportation planning, research, and development.....	22,000,000	14,500,000	-7,500,000
Grants-in-aid for natural gas pipeline safety.....	1,000,000	500,000	-500,000
Consolidation of departmental headquarters.....	4,845,000	4,845,000	
Civil supersonic aircraft development.....	289,965,000	210,000,000	-79,965,000
<b>Total, Office of the Secretary.....</b>	<b>337,320,000</b>	<b>247,380,000</b>	<b>-89,940,000</b>
<b>COAST GUARD</b>			
Operating expenses.....	426,740,000	423,500,000	-3,240,000
Appropriation for debt reduction.....	-137,063	-137,063	
Subtotal, operating expenses.....	426,602,937	423,362,937	-3,240,000
Acquisition, construction, and improvements.....	100,000,000	94,000,000	-6,000,000
Retired pay.....	64,530,000	64,530,000	
Reserve training.....	10,000,000	25,900,000	+15,900,000
Research, development, test, and evaluation.....	24,000,000	22,500,000	-1,500,000
Oil pollution fund.....	35,000,000	20,000,000	-15,000,000
<b>Total, Coast Guard.....</b>	<b>660,132,937</b>	<b>650,292,937</b>	<b>-9,840,000</b>
<b>FEDERAL AVIATION ADMINISTRATION</b>			
Operations.....	951,885,000	951,885,000	
Facilities and equipment.....	190,000,000	190,000,000	
Research and development.....	47,500,000	45,000,000	-2,500,000
Operation and maintenance, National Capital airports.....	10,600,000	10,500,000	-100,000
Construction, National Capital airports.....	11,000,000	4,000,000	-7,000,000
Grants-in-aid for airports: Limitation on obligations.....	7 (100,000,000)	(250,000,000)	(+150,000,000)
<b>Total, Federal Aviation Administration.....</b>	<b>1,210,985,000</b>	<b>1,201,385,000</b>	<b>-9,600,000</b>
<b>FEDERAL HIGHWAY ADMINISTRATION</b>			
Office of the Administrator, salaries and expenses: Appropriation.....	525,000	512,500	-12,500
Trust fund limitation (transfer).....	(14,956,000)	(14,773,500)	(-182,500)
Bureau of Public Roads: Limitation on general expenses.....	9 (77,913,000)	(69,460,500)	(-8,452,500)
Federal-aid highways (trust fund—appropriation to liquidate contract authorization).....	(4,360,000,000)	(4,351,365,000)	(-8,635,000)
Right-of-way revolving fund (trust fund—appropriation to liquidate contract authorization).....	(35,000,000)	(35,000,000)	
Highway beautification: Appropriation.....	800,000	500,000	-300,000
Appropriation to liquidate contract authorization.....	(20,000,000)	(16,500,000)	(-3,500,000)
Limitation on obligations.....	10 (8,552,000)	(8,500,000)	(-52,000)

See footnotes at end of table.

## DEPARTMENT OF TRANSPORTATION AND RELATED AGENCIES APPROPRIATION ACT, 1971—Continued

[Figures based on H.R. 17755 as modified by the House on Dec. 15, 1970. Bill died with the expiration of the session. See Interim continuing appropriation provision, Public Law 91-645]

## TITLE I.—DEPARTMENT OF TRANSPORTATION—Continued

Agency and item	Estimates of new (obligational) authority, 1971	New budget (obligational) authority appropriated, 1971 <sup>1</sup>	Increase (+) or decrease (-), appropriations compared with estimates
Motor carrier safety.....	\$4, 118, 000	\$3, 580, 500	—\$537, 500
Forest highways:			
Appropriation to liquidate contract authorization.....	(20, 000, 000)	(17, 500, 000)	(-2, 500, 000)
Limitation on obligations.....	<sup>10</sup> (533, 000, 000)	(27, 750, 000)	(-5, 250, 000)
Public lands highways:			
Appropriation to liquidate contract authorization.....	(15, 000, 000)	(14, 000, 000)	(-1, 000, 000)
Limitation on obligations.....	<sup>10</sup> (16, 000, 000)	(13, 000, 000)	(-3, 000, 000)
Total, Federal Highway Administration.....	5, 443, 000	4, 593, 000	-850, 000
<b>NATIONAL HIGHWAY SAFETY BUREAU</b>			
Traffic and highway safety:			
Appropriation.....	<sup>11</sup> 53, 075, 000	42, 935, 000	-10, 140, 000
By transfer.....	(2, 611, 000)	(2, 611, 000)	
State and community highway safety:			
Appropriation to liquidate contract authorization.....	(61, 000, 000)	(51, 000, 000)	(-10, 000, 000)
Limitation on obligations.....	<sup>10</sup> (80, 000, 000)	(75, 000, 000)	(-5, 000, 000)
Total, National Highway Safety Bureau.....	53, 075, 000	42, 935, 000	-10, 140, 000
<b>FEDERAL RAILROAD ADMINISTRATION</b>			
Office of the Administrator, salaries and expenses.....	1, 600, 000	1, 395, 000	-205, 000
Bureau of Railroad Safety.....	4, 550, 000	4, 500, 000	-50, 000
High-speed ground transportation research and development.....	21, 688, 000	18, 000, 000	-3, 688, 000
Railroad research.....	1, 500, 000	950, 000	-550, 000
Total, Federal Railroad Administration.....	29, 338, 000	24, 845, 000	-4, 493, 000
<b>URBAN MASS TRANSPORTATION ADMINISTRATION</b>			
Salaries and expenses.....	4, 000, 000	3, 325, 000	-675, 000
Research, development, and demonstration.....		6, 000, 000	+6, 000, 000
Urban mass transportation fund:			
Limitation on commitments.....	(850, 000, 000)	(600, 000, 000)	(-250, 000, 000)
Total, Urban Mass Transportation Administration.....	4, 000, 000	9, 325, 000	+5, 325, 000
<b>ST. LAWRENCE SEAWAY DEVELOPMENT CORPORATION</b>			
Limitation on administrative expenses.....	(700, 000)	(700, 000)	
Total, title I, Department of Transportation.....	2, 300, 293, 937	2, 180, 755, 937	-119, 538, 000

## TITLE II—RELATED AGENCIES

<b>NATIONAL TRANSPORTATION SAFETY BOARD</b>			
Salaries and expenses.....	\$6, 120, 000	\$6, 000, 000	—\$120, 000
<b>CIVIL AERONAUTICS BOARD</b>			
Salaries and expenses.....	11, 134, 000	11, 134, 000	
Payments to air carriers.....	27, 327, 000	50, 000, 000	+22, 673, 000
Total, Civil Aeronautics Board.....	38, 461, 000	61, 134, 000	+22, 673, 000
<b>INTERSTATE COMMERCE COMMISSION</b>			
Salaries and expenses.....	25, 600, 000	27, 000, 000	+1, 400, 000
Payment of loan guarantees.....	<sup>12</sup> 3, 313, 500	3, 216, 668	-96, 832
Total, Interstate Commerce Commission.....	28, 913, 500	30, 216, 668	+1, 303, 168

See footnotes at end of table.

## DEPARTMENT OF TRANSPORTATION AND RELATED AGENCIES APPROPRIATION ACT, 1971—Continued

[Figures based on H.R. 17755, as modified by the House on Dec. 15, 1970. Bill died with the expiration of the session. See interim continuing appropriation provision, Public Law 91-645]

## TITLE I.—DEPARTMENT OF TRANSPORTATION—Continued

Agency and item	Estimates of new (obligational) authority, 1971 <sup>1</sup>	New budget (obligational) authority appropriated, 1971 <sup>2</sup>	Increase (+) or decrease (—), appropriations compared with estimates
<b>WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY</b>			
Federal contribution.....	<sup>13</sup> \$368,039,000	<sup>14</sup> \$330,028,000	—\$38,011,000
Total, title II, related agencies.....	441,533,500	427,378,668	—14,154,832
Grand total, titles I and II, new budget (obligational) authority.....	2,741,827,437	2,608,134,605	—133,692,832
Consisting of—			
1. Appropriations:			
Fiscal year 1971.....	(2,553,816,437)	(2,458,134,605)	(—95,681,832)
Fiscal year 1972.....	(188,011,000)	(150,000,000)	(—38,011,000)
2. Appropriations to liquidate contract authorizations.....	(4,511,000,000)	(4,485,365,000)	(—25,635,000)
3. Appropriation for debt reduction.....	(137,063)	(137,063)	

<sup>1</sup> Conference action as agreed to by the House on Dec. 15, 1970.

<sup>2</sup> Reflects reduction of \$610,000 in H. Doc. 91-333.

<sup>3</sup> Includes \$595,000 in H. Doc. 91-333.

<sup>4</sup> Rate for operations for 9 months to Mar. 30, 1971.

<sup>5</sup> Contained in S. Doc. 91-104.

<sup>6</sup> Includes \$28,000,000 in S. Doc. 91-103.

<sup>7</sup> No limitation proposed. February 1970 budget document indicated an estimated \$220,000,000 obligational level. This estimate was subsequently revised to \$100,000,000.

<sup>8</sup> Excludes \$2,225,000 considered under "Traffic and highway safety" (H. Doc. 91-333).

<sup>9</sup> Includes \$289,000 by transfer from "State and community highway safety" (H. Doc. 91-333).

<sup>10</sup> No limitation proposed.

<sup>11</sup> Includes \$2,225,000 transferred from "Office of the Administrator" (H. Doc. 91-333).

<sup>12</sup> Contained in S. Doc. 91-95.

<sup>13</sup> Includes \$188,011,000 advance for 1972.

<sup>14</sup> Includes \$150,000,000 advance for 1972.

**DEPARTMENT OF TRANSPORTATION AND  
RELATED AGENCIES APPROPRIATION  
ACT, 1971**

H.R. 17755 as modified by the House on December 15, 1970

**AN ACT**

Making appropriations for the Department of Transportation and related agencies for the fiscal year ending June 30, 1971, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be appropriated, out of any money in the Treasury not otherwise appropriated, for the Department of Transportation and related agencies for the fiscal year ending June 30, 1971, and for other purposes, namely :*

**TITLE I**

**DEPARTMENT OF TRANSPORTATION**

**OFFICE OF THE SECRETARY**

**SALARIES AND EXPENSES**

For necessary expenses of the Office of the Secretary of Transportation, including not to exceed \$27,000 for allocation within the Department for official reception and representation expenses as the Secretary may determine; \$17,535,000.

\$17,535,000

**TRANSPORTATION PLANNING, RESEARCH, AND DEVELOPMENT**

For necessary expenses for conducting transportation planning, research, and development activities, including the collection of national transportation statistics; \$14,500,000, to remain available until expended.

14,500,000

**GRANTS-IN-AID FOR NATURAL GAS PIPELINE SAFETY**

For grants-in-aid to carry out a pipeline safety program as authorized by section 5 of the Natural Gas Pipeline Safety Act of 1968 (49 U.S.C. 1674) \$500,000.

500,000

**CONSOLIDATION OF DEPARTMENTAL HEADQUARTERS**

For necessary expenses in connection with the consolidation of departmental activities into the Southwest Area of Washington, District of Columbia, \$4,845,000.

4,845,000

**CIVIL SUPERSONIC AIRCRAFT DEVELOPMENT**

For an additional amount for expenses, not otherwise provided for, necessary for the development of a civil supersonic aircraft, including the construction of two prototype aircraft of the same design, and advances of funds without regard to the provisions of section 3648 of the Revised Statutes, as amended (31 U.S.C. 529).<sup>1</sup> \$210,000,000, to remain available until expended.

<sup>1</sup> 210,000,000

[Total, Office of the Secretary, \$247,380,000]

<sup>1</sup> Rate of operations for 9 months to March 30, 1971.

## COAST GUARD

## OPERATING EXPENSES

For necessary expenses for the operation and maintenance of the Coast Guard, not otherwise provided for, including services as authorized by 5 U.S.C. 3109; purchase of not to exceed sixteen passenger motor vehicles for replacement only; and recreation and welfare; \$423,500,000, of which \$137,063 shall be applied to Capehart Housing debt reduction: *Provided*, That the number of aircraft on hand at any one time shall not exceed one hundred and seventy-three exclusive of planes and parts stored to meet future attrition: *Provided further*, That, without regard to any provisions of law or Executive order prescribing minimum flight requirements, Coast Guard regulations which establish proficiency standards and maximum and minimum flying hours for this purpose may provide for the payment of flight pay at the rates prescribed in section 301 of title 37, United States Code, to certain members of the Coast Guard otherwise entitled to receive flight pay during the current fiscal year (1) who have held aeronautical ratings or designations for not less than fifteen years, or (2) whose particular assignment outside the United States or in Alaska, makes it impractical to participate in regular aerial flights: *Provided further*, That amounts equal to the obligated balances against the appropriations for "Operating expenses" for the two preceding years, shall be transferred to and merged with this appropriation, and such merged appropriation shall be available as one fund, except for accounting purposes of the Coast Guard, for the payment of obligations properly incurred against such prior year appropriations and against this appropriation: *Provided further*, That, except as otherwise authorized by the Act of September 30, 1950 (20 U.S.C. 236-244), this appropriation shall be available for expenses of primary and secondary schooling for dependents of Coast Guard personnel stationed outside the continental United States at costs for any given area not in excess of those of the Department of Defense for the same area, when it is determined by the Secretary that the schools, if any, available in the locality are unable to provide adequately for the education of such dependents: *Provided further*, That not to exceed \$15,000 shall be available for investigative expenses of a confidential character, to be expended on the approval and authority of the Commandant and his determination shall be final and conclusive upon the accounting officer of the Government: *Provided further*, That not to exceed \$100,000 shall be available for expenses, not otherwise provided for, necessary to enable the Coast Guard to discharge its responsibilities in connection with the meeting of the 11th International Lifeboat Conference, including transportation and entertainment of official representatives.

\$423,362,937  
(137,063)  
(debt reduction)

## ACQUISITION, CONSTRUCTION, AND IMPROVEMENTS

For necessary expenses of acquisition, construction, rebuilding, and improvement of aids to navigation, shore facilities, vessels, and aircraft, including equipment related thereto; and services as authorized by 5 U.S.C. 3109; \$94,000,000, to remain available until expended.

94,000,000

## RETIRED PAY

For retired pay, including the payment of obligations therefor otherwise chargeable to lapsed appropriations for this purpose, and payments under the Retired Serviceman's Family Protection Plan, \$64,530,000.

64,530,000

## RESERVE TRAINING

For all necessary expenses for the Coast Guard Reserve, as authorized by law, including repayment to other Coast Guard appropriations for indirect expenses, for regular personnel, or reserve personnel while on active duty, engaged primarily in administration and operation of the reserve program; maintenance and operation of facilities; and supplies, equipment, and services; \$25,900,000; *Provided*, That amounts equal to the obligated balances against the appropriations for "Reserve training" for the two preceding years shall be transferred to and merged with this appropriation, and such merged appropriation shall be available as one fund, except for accounting purposes of the Coast Guard, for the payment of obligations properly incurred against such prior year appropriations and against this appropriation.

\$25,900,000

## RESEARCH, DEVELOPMENT, TEST, AND EVALUATION

For necessary expenses, not otherwise provided for, for basic and applied scientific research, development, test and evaluation; services as authorized by 5 U.S.C. 3109; maintenance, rehabilitation, lease, and operation of facilities and equipment, as authorized by law; \$22,500,000, to remain available until expended, including \$13,000,000 for the national data buoy development project.

22,500,000

## OIL POLLUTION FUND

For the revolving fund authorized to be established pursuant to section 11(k) of the Water Pollution Control Act, as amended, \$20,000,000, to remain available until expended.  
[*Total, Coast Guard, \$650,292,937.*]

20,000,000

## FEDERAL AVIATION ADMINISTRATION

## OPERATIONS

For necessary expenses of the Federal Aviation Administration, not otherwise provided for, including administrative expenses for research and development and for establishment of air navigation facilities, and carrying out the provisions of the Public Law 91-258; purchase of three passenger motor vehicles for replacement only; and purchase and repair of skis and snowshoes; and arms and ammunition; \$951,885,000; *Provided*, That \$28,000,000 of the foregoing amount shall be derived from the Airport and Airway Trust Fund for combating hijacking, sabotage and other activities endangering the security of civil aviation: *Provided further*, That there may be credited to this appropriation, funds received from States, counties, municipalities, other public authorities, and private sources, for expenses incurred in the maintenance and operation of air navigation facilities.

951,885,000

## FACILITIES AND EQUIPMENT

For an additional amount for the acquisition, establishment, and improvement by contract or purchase and hire of air navigation and experimental facilities, including the initial acquisition of necessary sites by lease or grant; the construction and furnishing of quarters and related accommodations for officers and employees of the Federal Aviation Administration stationed at remote localities where such accommodations are not available, but at a total cost of construction of not to exceed \$50,000 per housing unit in Alaska; \$190,000,000, to remain available until expended: *Provided*, That there may be credited to this appropriation funds received from States, counties, municipalities, other public au-

190,000,000

thorities, and private sources, for expenses incurred in the establishment of air navigation facilities: *Provided further*, That no part of the foregoing appropriation shall be available for the construction of a new wind tunnel, or to purchase any land for or in connection with the National Aviation Facilities Experimental Center.

#### RESEARCH AND DEVELOPMENT

For expenses, not otherwise provided for, necessary for research, development, and service testing in accordance with the provisions of the Federal Aviation Act (49 U.S.C. 1301-1542), including construction of experimental facilities and acquisition of necessary sites by lease or grant, \$15,000,000, to remain available until expended.

\$45,000,000

#### OPERATION AND MAINTENANCE, NATIONAL CAPITAL AIRPORTS

For expenses incident to the care, operation, maintenance, improvement and protection of the federally owned civil airports in the vicinity of the District of Columbia, including purchase of eight passenger motor vehicles for police use, for replacement only, which may exceed by \$450 the general purchase price limitation for the current fiscal year; purchase, cleaning and repair of uniforms; and arms and ammunition; \$10,500,000.

10,500,000

#### CONSTRUCTION, NATIONAL CAPITAL AIRPORTS

For necessary expenses for construction at the federally owned civil airports in the vicinity of the District of Columbia, \$4,000,000, to remain available until expended.

4,000,000

#### AVIATION WAR RISK INSURANCE REVOLVING FUND

The Secretary of Transportation is hereby authorized to make such expenditures, within the limits of funds available pursuant to section 1306 of the Act of August 23, 1958 (49 U.S.C. 1536), and in accordance with section 104 of the Government Corporation Control Act, as amended (31 U.S.C. 849), as may be necessary in carrying out the programs set forth in the budget for the current fiscal year for aviation war risk insurance activities under said Act.

[Total, Federal Aviation Administration; \$1,201,385,000.]

#### FEDERAL HIGHWAY ADMINISTRATION

##### OFFICE OF THE ADMINISTRATOR

##### SALARIES AND EXPENSES

For necessary expenses, not otherwise provided, as authorized by law, of the Office of the Administrator and staff offices of the Federal Highway Administration, including services as authorized by 5 U.S.C. 3109, \$512,500, together with not to exceed \$14,773,500, to be transferred from the appropriation for "Federal-Aid Highways (trust fund)."

512,500

##### BUREAU OF PUBLIC ROADS, LIMITATION ON GENERAL EXPENSES (TRUST FUND)

For necessary expenses, not otherwise provided, for administration, operation, and research of the Bureau of Public Roads, as authorized by law, not to exceed \$69,460,500 shall be paid, in accordance with law, from the appropriation "Federal-Aid Highways (trust fund)" (including advances and reimbursements): *Provided*, That appropriations available to the Bureau of Public Roads shall be available for hire of passenger motor vehicles; uniforms or allowances therefor authorized by law (5 U.S.C. 5901-5902); and services as authorized by 5 U.S.C. 3109.

## FEDERAL-AID HIGHWAYS (TRUST FUND)

For carrying out the provisions of title 23, United States Code, which are attributable to Federal-aid highways, to remain available until expended, \$4,351,365,000, or so much thereof as may be available in and derived from the "Highway trust fund"; which sum is composed of \$1,891,234,036, the balance of the amount authorized for the fiscal year 1969, and \$2,445,785,950 (or so much thereof as may be available in and derived from the "Highway trust fund"), a part of the amount authorized to be appropriated for the fiscal year 1970, \$12,011,809 for reimbursement of the sum expended for the repair or reconstruction of highways and bridges which have been damaged or destroyed by floods, hurricanes, or landslides, as provided by title 23, United States Code, section 125, \$158,053 for reimbursement of the sums expended for the design and construction of bridges upon and across dams, as provided by title 23, United States Code, section 320, \$2,046,492 for reimbursement of sums expended pursuant to the provisions of section 2 of the Pacific Northwest Disaster Relief Act of 1965 (79 Stat. 131), and \$128,660 for reimbursement of the sums expended pursuant to the provisions of section 21 of the Alaska Omnibus Act, as amended (78 Stat. 505).

*4,351,365,000*  
*(trust fund)*  
*(liquidation of*  
*contract*  
*authorization)*

## RIGHT-OF-WAY REVOLVING FUND (LIQUIDATION OF CONTRACT AUTHORIZATION) ◀ TRUST FUND

For payment of obligations incurred in carrying out the provisions of title 23, United States Code, section 108(c), as authorized by section 7(c) of the Federal-Aid Highway Act of 1968, to remain available until expended, \$35,000,000 to be derived from the "Highway trust fund" at such times and in such amounts as may be necessary to meet current withdrawals.

*35,000,000*  
*(liquidation of*  
*contract*  
*authorization)*  
*(trust fund)*

## HIGHWAY BEAUTIFICATION (LIQUIDATION OF CONTRACT AUTHORIZATION)

For payment of obligations incurred in carrying out the provisions of title 23, United States Code, sections 131, 136, and 319(b), to remain available until expended, \$16,500,000, together with \$500,000 for necessary administrative expenses for carrying out such provisions of title 23, United States Code, as authorized by section 6(g) of the Federal-Aid Highway Act of 1968.

*500,000*  
*16,500,000*  
*(liquidation*  
*of contract*  
*authorization)*

## MOTOR CARRIER SAFETY

For necessary expenses to carry out motor carrier safety functions of the Secretary, as authorized by the Department of Transportation Act (80 Stat. 939-40) : \$3,580,500.

*3,580,500*

## FOREST HIGHWAYS (LIQUIDATION OF CONTRACT AUTHORIZATION)

For payment of obligations incurred in carrying out the provisions of title 23, United States Code, section 204, pursuant to contract authorization granted by title 23, United States Code, section 203, to remain available until expended, \$17,500,000, a part of that amount authorized to be appropriated for the fiscal year 1969: *Provided*, That this appropriation shall be available for the rental, purchase, construction, or alteration of buildings and sites necessary for the storage and repair of equipment and supplies used for road construction and maintenance but the total cost of any such item under this authorization shall not exceed \$15,000.

*17,500,000*  
*(liquidation*  
*of contract*  
*authorization)*

**PUBLIC LANDS HIGHWAYS (LIQUIDATION OF CONTRACT  
AUTHORIZATION)**

For payment of obligations incurred in carrying out the provisions of title 23, United States Code, section 209, pursuant to the contract authorization granted by title 23, United States Code, section 203, to remain available until expended \$14,000,000, a part of the amount authorized to be appropriated for the fiscal year 1939.  
*\$14,000,000*  
*(liquidation of*  
*contract*  
*authorization)* [Total, Federal Highway Administration, \$4,593,000.]

**NATIONAL HIGHWAY SAFETY BUREAU**

**TRAFFIC AND HIGHWAY SAFETY**

For expenses necessary to discharge the functions of the Secretary with respect to traffic and highway safety, including services authorized by 5 U.S.C. 3109; \$42,935,000, together with \$2,611,000 to be transferred from the appropriation for "State and community highway safety (Liquidation of contract authorization)."  
 42,935,000

**STATE AND COMMUNITY HIGHWAY SAFETY**

**(LIQUIDATION OF CONTRACT AUTHORIZATION)**

For the payment of obligations incurred in carrying out the provisions of title 23, United States Code, section 402, to remain available until expended, \$51,000,000, of which not to exceed \$2,611,000 may be advanced to the appropriation "Traffic and highway safety" and not to exceed \$289,000 may be advanced to the appropriation "Federal-Aid Highways (trust fund)" for administration of this program.  
*51,000,000*  
*(liquidation of*  
*contract*  
*authorization)* [Total, National Highway Safety Bureau, \$42,935,000.]

**FEDERAL RAILROAD ADMINISTRATION**

**OFFICE OF THE ADMINISTRATOR**

**SALARIES AND EXPENSES**

For necessary expenses of the Federal Railroad Administration, including services as authorized by 5 U.S.C. 3109;  
 1,395,000 \$1,395,000.

**BUREAU OF RAILROAD SAFETY**

For necessary expenses of the Bureau of Railroad Safety, not otherwise provided for, including services as authorized by 5 U.S.C. 3109; \$4,500,000.  
 4,500,000

**HIGH-SPEED GROUND TRANSPORTATION RESEARCH AND  
DEVELOPMENT**

For necessary expenses for research, development, and demonstrations in high-speed ground transportation, \$18,000,000, to remain available until expended.  
 18,000,000

**RAILROAD RESEARCH**

For necessary expenses for conducting railroad research activities, \$950,000, to remain available until expended, of which not less than \$230,000 shall be available for freight car utilization studies.  
 950,000

**ALASKA RAILROAD**

**ALASKA RAILROAD REVOLVING FUND**

The Alaska Railroad Revolving Fund shall continue available until expended for the work authorized by law, including

operation and maintenance of oceangoing or coastwise vessels by ownership, charter, or arrangement with other branches of the Government service, for the purpose of providing additional facilities for transportation of freight, passengers, or mail, when deemed necessary for the benefit and development of industries or travel in the area served; and payment of compensation and expenses as authorized by 5 U.S.C. 8146, to be reimbursed as therein provided: *Provided*, That no employee shall be paid an annual salary out of said fund in excess of the salaries prescribed by the Classification Act of 1949, as amended, for grade GS-15, except the general manager of said railroad, one assistant general manager at not to exceed the salaries prescribed by said act for GS-17, and five officers at not to exceed the salaries prescribed by said act for grade GS-16.

[*Total, Federal Railroad Administration, \$24,845,000.*]

## URBAN MASS TRANSPORTATION ADMINISTRATION

### SALARIES AND EXPENSES

For necessary expenses of the Urban Mass Transportation Administration, including services as authorized by 5 U.S.C. 3109; \$3,325,000.

\$3,325,000

### RESEARCH, DEVELOPMENT, AND DEMONSTRATION

For necessary expenses for research, development, and demonstration projects as authorized by the Urban Mass Transportation Act of 1964, as amended (49 U.S.C. 1605); \$6,000,000 to remain available until expended.

6,000,000

[*Total, Urban Mass Transportation Administration, \$9,325,000.*]

## SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION

The Saint Lawrence Seaway Development Corporation is hereby authorized to make such expenditures, within the limits of funds and borrowing authority available to such Corporation, and in accord with law, and to make such contracts and commitments without regard to fiscal year limitations as provided by section 104 of the Government Corporation Control Act, as amended, as may be necessary in carrying out the programs set forth in the budget for the current fiscal year for such Corporation, except as hereinafter provided.

### LIMITATION ON ADMINISTRATIVE EXPENSES, SAINT LAWRENCE SEAWAY DEVELOPMENT CORPORATION

Not to exceed \$700,000 shall be available for administrative expenses which shall be computed on an accrual basis, including not to exceed \$3,000 for official entertainment expenses to be expended upon the approval or authority of the Secretary of Transportation, hire of passenger motor vehicles, uniforms, or allowances therefor for operation and maintenance personnel, as authorized by law (5 U.S.C. 5901-5902) and \$15,000 for services as authorized by 5 U.S.C. 3109.

#### *Total, title I:*

[ <i>Definite appropriations</i> -----	\$2,180,755,937]
[ <i>Appropriations to liquidate contract authorizations</i> -----	(4,485,365,000)]
[ <i>Appropriation for debt reduction</i> -----	(137,063)]
[ <i>Total, new budget (obligational) authority, Department of Transportation</i> -----	2,180,755,937]

## TITLE II—RELATED AGENCIES

## NATIONAL TRANSPORTATION SAFETY BOARD

## SALARIES AND EXPENSES

For necessary expenses of the National Transportation Safety Board, including employment of temporary guards on a contract or fee basis; hire, operation, maintenance, and repair of aircraft; hire of passenger motor vehicles; services as authorized by 5 U.S.C. 3109; and uniforms, or allowances therefor, as authorized by law (5 U.S.C. 5901-5902);

\$6,000,000 \$6,000,000.

## CIVIL AERONAUTICS BOARD

## SALARIES AND EXPENSES

For necessary expenses of the Civil Aeronautics Board, including hire of aircraft; hire of passenger motor vehicles; services as authorized by 5 U.S.C. 3109; uniforms, or allowances therefor, as authorized by law (5 U.S.C. 5901-5902); and not to exceed \$1,000 for official reception and representation expenses, \$11,134,000.

11,134,000

## PAYMENTS TO AIR CARRIERS

For payments to air carriers of so much of the compensation fixed and determined by the Civil Aeronautics Board under section 406 of the Federal Aviation Act of 1958 (49 U.S.C. 1376), as is payable by the Board, \$50,000,000, to remain available until expended.

50,000,000 [Total, Civil Aeronautics Board, \$61,134,000]

## INTERSTATE COMMERCE COMMISSION

## SALARIES AND EXPENSES

For necessary expenses of the Interstate Commerce Commission, including services as authorized by 5 U.S.C. 3109, \$27,000,000, of which \$300,000 additional shall be available for the employment of car service agents, and \$150,000 shall be available for valuation of pipelines: *Provided*, That Joint Board members and cooperating State commissioners may use Government transportation requests when traveling in connection with their duties as such.

27,000,000

## PAYMENT OF LOAN GUARANTEES

For payments required to be made as a consequence of loan guaranties made by the Interstate Commerce Commission under section 503 of the Interstate Commerce Act, as amended (49 U.S.C. 1233), \$3,216,668, together with such amounts as may be necessary to pay interest.

3,216,668

[Total, Interstate Commerce Commission, \$30,216,668.]

WASHINGTON METROPOLITAN AREA TRANSIT  
AUTHORITY

## FEDERAL CONTRIBUTION

To enable the Department of Transportation to pay the Washington Metropolitan Area Transit Authority, as part of the Federal contribution toward expenses necessary to design, engineer, construct, and equip a rail rapid transit system, as authorized by the National Capital Transportation Act of 1969 (Public Law 91-143), including acquisition of

330,028,000

rights-of-way, land and interests therein, to remain available until expended \$180,028,000 for the fiscal year 1971, and \$150,000,000 for the fiscal year 1972.

[*Total, title II:*

[*Definite appropriations:*

[1971 ----- \$277, 378, 668]

[1972 ----- 150, 000, 000]

[*Total, new budget (obligational) authority, related agencies*

*----- 427, 378, 668]*

#### TITLE III—GENERAL PROVISIONS

SEC. 301. During the current fiscal year applicable appropriations to the Department of Transportation shall be available for maintenance and operation of aircraft; hire of passenger motor vehicles and aircraft; and uniforms, or allowances therefor, as authorized by law (5 U.S.C. 5901-5902).

SEC. 302. Funds appropriated under this Act for expenditure by the Federal Aviation Administration may be expended for reimbursement of other Federal agencies for expenses incurred, on behalf of the Federal Aviation Administration, in the settlement of claims for damages resulting from sonic boom in connection with research conducted as part of the civil supersonic aircraft development.

SEC. 303. None of the funds provided in this Act shall be available for administrative expenses in connection with commitments for grants-in-aid for airport development aggregating more than \$250,000,000 in fiscal year 1971.

SEC. 304. None of the funds provided under this Act shall be available for the planning or execution of programs the obligations for which are in excess of \$8,500,000 for "Highway Beautification" in fiscal year 1971, plus the additional amounts appropriated therefor.

SEC. 305. None of the funds provided under this Act shall be available for the planning or execution of programs the obligations for which are in excess of \$75,000,000 in fiscal year 1971 for "State and Community Highway Safety."

SEC. 306. None of the funds provided under this Act shall be available for the planning or execution of programs the obligations for which are in excess of \$27,750,000, exclusive of the reimbursable program, in fiscal year 1971 for "Forest Highways".

SEC. 307. None of the funds provided under this Act shall be available for the planning or execution of programs the obligations for which are in excess of \$13,000,000 in fiscal year 1971 for "Public Lands Highways".

SEC. 308. None of the funds provided in this Act shall be available for administrative expenses in connection with commitments for grants for Urban Mass Transportation aggregating more than \$600,000,000 in fiscal year 1971.

SEC. 309. No part of any appropriation contained in this Act shall remain available for obligation beyond the current fiscal year unless expressly so provided herein.

SEC. 310. None of the funds provided under this Act shall be available for the planning or execution of programs for any further construction of the Miami jetport or of any other air facility in the State of Florida lying south of the Okeechobee Waterway and in the drainage basins contributing water to the Everglades National Park until it has been shown by an appropriate study made jointly by the Department of the Interior and the Department of Transportation that such an airport will not have an adverse environmental effect on the ecology of the Everglades and until any site selected on the basis of such study is approved by the Department of the Interior and the Department of Transportation: *Provided,*

That nothing in this section shall affect the availability of such funds to carry out this study.

This Act may be cited as the "Department of Transportation and Related Agencies Appropriation Act, 1971".

#### LEGISLATIVE HISTORY

HOUSE REPORTS: No. 91-1115 (Committee on Appropriations) and No. 91-1730 (Committee of Conference).

SENATE REPORT: No. 91-1372 (Committee on Appropriations).  
CONGRESSIONAL RECORD, volume 116 (1970):

May 27: Considered and passed House.

December 3: Considered and passed Senate, amended.

December 15: House agreed to conference report.

December 29: Senate tabled conference report.

Grand total:

Appropriations, definite:

1971 -----	\$2, 458, 134, 605
1972 -----	150, 000, 000

Appropriations to liquidate contract authorizations -----	(4, 485, 365, 000)
-----------------------------------------------------------	--------------------

Appropriation for debt reduction -----	(137,063)
----------------------------------------	-----------

Total, new budget (obligational) authority, Department of Transportation and Related Agencies Appropriation Act, 1971 -----	2, 608, 134, 605
-----------------------------------------------------------------------------------------------------------------------------	------------------

Mr. McFALL. During the next 3 days our hearings will deal primarily with the controversial matter of the supersonic transport. This committee is very fortunate to have such distinguished witnesses on both sides of this controversial issue.

We are pleased to have as our first witness this morning the Secretary of Transportation, John A. Volpe. Mr. Secretary, good morning.

#### STATEMENT OF THE SECRETARY OF TRANSPORTATION

Secretary VOLPE. Good morning, Mr. Chairman and members of the committee. As usual, it is a delight to come before your committee. I am sure it would be redundant to say that the subject we are discussing here today is not new to any of us here in this room. The SST development program has been progressing for nearly 10 years and is now nearing its final stage which will culminate in two flying prototype or experimental aircraft. All of us have been deeply involved in the serious analysis and debate which has been such an important part of this program. I believe that our discussions have served the purpose of insuring that the final outcome of this program will be in line with the desires of this Nation.

The appeal I make to you today is as sincere an appeal as I have ever made in the 20 years since I entered public service. I want you to know that what I say here comes from the heart and the soul, as well as the mind. It represents my deepest convictions. It is devoid of politics. It comes from my concern for the future of my country and its position in the world of nations.

Today, I want to come to grips with the real issues before us. I am here to seek your approval for the continued funding of this program for the development of two supersonic transport experimental test planes—two prototype aircraft against which performance claims can be measured and environmental concerns weighed. I request your

approval of a funding level for fiscal year 1971 which will allow completion of the program on its planned schedule at minimum cost.

When I appeared before this committee a year ago, I was convinced that the continuation of the SST program was of critical importance to the future of our country.

Today, that conviction is stronger than ever. Events of the past year have fortified my belief that American technology and American know-how and determination are equal to the task of building a supersonic transport which is compatible with the world's environment—a transport which must be built if this great nation of ours is to keep pace with the future. Bill Magruder, our Director of Supersonic Transport Development, and other highly expert witnesses will go into the details of our technical progress during the past 12 months. But let me say here that problems which some said were insurmountable just a year ago now are being solved. We are moving ahead in complete accord with the faith most of us have had in the American ability for progress.

Our past discussions have raised many questions concerning various aspects of this program. Questions concerning economic feasibility, effect on the environment and national priorities are perhaps among the most important in our minds. I sincerely believe that we are now in a position to answer each of these questions, based on factual data, so that there should remain no doubt as to the wisdom of proceeding with this prototype development phase to its conclusion. I am confident that the Congress will reach this decision on the basis of facts to be presented here, rather than on the basis of unsupported charges and what has become at times almost hysterical sloganeering.

#### ENVIRONMENTAL ISSUES

It has seemed to me that I could hardly pick up a newspaper these last few months without reading about some new charge of the dire consequences to our planet which would result from the flight of supersonic transports. It is charged that they would blot out the sun, melt the ice caps, shatter our eardrums, cause skin cancer, and disturb animal life to the extent that some species would cease reproduction. Now, let me state categorically that this program will cause none of these things to occur. This program will, in fact, provide the best means for determining whether large numbers of supersonic transports will cause such problems and also provide us the opportunity to prevent any possible damage to this planet.

I have spent enough years in public life to know that charges of this type are inevitable in any new program which stretches man's abilities to exist on this earth. And, history is replete with similar situations. There were cries of disaster or economic upheaval whenever new devices were introduced into our society. The sewing machine, the steamboat, the automobile, the airplane—they all brought out similar opposition. Cries of "get a horse" greeted the drivers of our first automobiles as they chugged down our streets. There is some of that "get a horse" philosophy in today's opposition to the SST as some critics say they want to stop the SST in order to preserve our natural environment.

That is not to say that some of the concerns expressed are not legitimate and valid. We have recognized these. As a matter of fact, our entire SST research program is designed to test such concerns under the scrutiny of our best research and technology.

As you know, I have taken and will continue to take strong positions against any transportation program or project which I feel would cause irreparable damage to our citizens, either on environmental, social, or economic grounds. I am not one to pursue progress simply for the sake of progress. What we have is a well-balanced program of progress which is planned to prevent any adverse side effects.

Now, let me point out specifically why I feel this to be the case.

#### PRODUCTIVITY

First, there is no question that the SST will be the most productive aircraft ever built. It will do the work of three of the new tri-jets or two of the big 747's. Let me repeat that. This plane will do the work of three of the new tri-jets or two of the big 747's. This will have the very real effect of providing our airlines with a more efficient aircraft to meet the continuously increasing demand for air transportation. The operation of an aircraft which will do more more per unit of cost can only result in a more solid financial base for the airline industry as a whole. I might add here that this same attribute of higher productivity will also make a major contribution towards reducing the crowding of our skies. It will take fewer planes to meet the air travel demands and thus have a favorable impact on the reduction of air congestion and the resulting side effects caused by this situation.

Suppose for a moment we had stopped building bigger and faster planes 30 years or so ago and had decided to go along with the DC-3. It was a good plane. It would go fast enough.

For example, we now have about 3,000 transports in our air passenger fleet. To do with DC-3's the job that is being done today would require 47,000 planes instead of 3,000. By 1980 we would need 145,000 DC-3's, and by 1985 we would need nearly 200,000. Just think of the additional noise and pollution we would have.

#### TECHNOLOGICAL LEADERSHIP

Second, the SST development program represents the advance cutting edge of civilian flight technology. In this field, you either win or you're not in the race at all. You stay out in front or you drop far behind. The United States is currently leading in aerospace technology. It is just inconceivable to me that this country would purposely forfeit first place in the area of civil aviation.

#### ECONOMIC VIABILITY

The technological leadership leads directly to my third point. And that is the economic viability of the SST and, in fact, our entire airframe industry. Unless we maintain our lead, our competitors will quickly take the market away from us. I would remind you that the Russians and the British and French are breathing down our necks. The British-French Concorde is flying. A second generation Concorde may already be on the drawing boards. The Russian TU-144 is flying.

What more warning do we need than the two-page ad in a recent issue of Aviation Week magazine. This ad, as you can see, shows the Russian "family of airplanes"—led by the supersonic TU-144.

In the upcoming March 8 issue of the same magazine the Russians again have a two-page ad on the TU-144 alone. And the caption reads "If you are doing business in the worldwide aerospace market, do not make a purchasing decision before contacting us."

I assure you they mean business. They intend to sell these planes in the world market. The TU-144 will be on display this summer at the Paris air show and you can bet they will be taking orders, and Aviation Daily reported just this last Friday that the Soviets will be introducing their SST into regular commercial service this coming October, flying a domestic route between Moscow and the Pacific. Aeroflot plans an international route also with service between Moscow and Calcutta scheduled tentatively to begin the week of October 23, and for those that don't know what Aeroflot is, it is the Russian national airline.

Similarly, the British and French are fully intent upon entering the world aviation market. Yet, the president of a foreign airline told me recently in my office that he would not buy the British-French Concorde unless we fail to build our own SST. And the reason was simple. He wanted to be able to buy the whole family of planes for his airline and he wanted them from one nation, and for that he is willing to wait for the American SST. If we do not build the SST, however, that foreign airline president, and I am sure many others, know that other families of airplanes will be available from other nations.

Without the SST, this country will be unable to provide a complete family of planes. Our share of the world aircraft market will deteriorate. It is hardly necessary for me to repeat what this will mean in terms of jobs and balance of payment—50,000 direct jobs and a \$22 billion impact on balance of payments over a 12-year period spanning the 1980's.

#### LETTER FROM THE CHAIRMAN OF THE COUNCIL OF ECONOMIC ADVISERS

This is not my opinion alone, Mr. Chairman. I received just this past week a letter from the chairman of the Council of Economic Advisers, Mr. Paul W. McCracken, the pertinent parts of which I would like to read at this time. Mr. McCracken says, and I quote him in part:

A commitment now to carry through the testing of the prototypes is desirable on economic grounds. . . .

It appears, on the basis of information presently available, that the SST has a reasonable probability of being commercially viable and able to repay its research and development costs to the Federal treasury.

He goes on to say:

We recognize, however, that there is considerable uncertainty about many of the crucial factors related to the SST's commercial viability, in particular about its construction and operating costs and the way that these will be affected by any modifications necessitated by concern over noise levels and other environmental effects. These uncertainties can best be resolved by actual testing of prototype aircraft. Once such a testing is completed, the economic viability of the SST can be more definitively assessed, and the burden of the decision on whether to proceed to full-scale development of the SST can then properly be shifted to the private sector.

He makes another very key point :

It should be borne in mind that our aircraft industry has been an important source of exports for many years. Moreover, this strong position has been based on technological superiority in the industry which has been adequate to offset cost advantages that exist for many foreign aircraft producers. We should, therefore, be particularly careful not to weaken technological superiority in this industry where we have had a strong comparative advantage.

And signed "Sincerely, Paul W. McCracken."  
(Mr. McCracken's letter follows:)

THE CHAIRMAN OF THE  
COUNCIL OF ECONOMIC ADVISERS  
WASHINGTON

February 26, 1971

Dear Mr. Secretary:

The purpose of this letter is to pass along to you the Council's assessment of economic considerations pertinent to the issue of continuing with the completion and testing of two prototype SST planes. A commitment now to carry through this stage is desirable on economic grounds. There is, of course, a risk that continuing through the prototype stages would turn out to have wasted resources if the SST were found to be infeasible. There is also a risk, if the project were terminated now, that later we would find that we should have carried forward. In our judgment the former is the prudent risk to assume.

It must be realized that the SST is the only important civil aircraft program which did not have a comparable military aircraft development experience on which to draw research experience. The SST is not, therefore, unique in its reliance upon Federal expenditures for the research and development phase. It appears, on the basis of information presently available, that the SST has a reasonable probability of being commercially viable and able to repay its research and development costs to the Federal treasury. We recognize, however, that there is considerable uncertainty about many of the crucial factors related to the SST's commercial viability, in particular about its construction and operating costs and the way that these will be affected by any modifications necessitated by concern over noise levels and other environmental effects. These uncertainties can best be resolved by actual testing of prototype aircraft. Once such a testing is completed, the economic viability of the SST can be more definitively assessed, and the burden of the decision on whether to proceed to full scale development of the SST can then properly be shifted to the private sector.

It is worth emphasizing that the Federal commitment extends only to this crucial research and development effort, an effort that was financed in part out of the defense budget in the case of other civil aircraft programs. No subsidy for the production phase of the program is being sought. As in the case of other

civil aviation programs, financing of the production phase would have to stand the test of the market if the testing indicated the plane's viability. When viewed in the perspective of the whole SST program, therefore, the appropriation for prototype construction and testing is not large compared to the probable value of the information it will provide. If this research and development program indicates that production of the SST is economic, we will have saved the substantially higher costs of re-starting a program that would have to duplicate much of the work which would already have been done once. If the production and testing of prototype planes show them not to be feasible, the resources thus expended are still not large for our economy.

There has been much discussion about the effects of the SST program on employment and the balance of payments. Such weight as is given to the employment and balance of payments effects of the SST must be based on consideration of alternative policies to provide employment and solve balance of payments problems generally. While those unemployed if the SST were terminated would eventually find new jobs as programs to expand the economy take hold, there would be real loss in national production while they search for new jobs. And in this connection, of course, we must bear in mind that termination of the SST would enlarge unemployment in areas where the level of unemployment is already high.

Assuming that there is a viable Anglo-French SST, termination of the SST program would aggravate our balance of payments situation. The SST will have no effect on the balance of payments until the late 1970's or early 1980's, and it is too early to say what our international economic position will require at that time. It should, however, be borne in mind that our aircraft industry has been an important source of exports for many years. Moreover, this strong position has been based on technological superiority in the industry which has been adequate to offset cost advantages that exist for many foreign aircraft producers. We should, therefore, be particularly careful not to weaken technological superiority in this industry where we have had a strong comparative advantage.

Sincerely,



Paul W. McCracken

Honorable John Volpe  
Secretary of Transportation  
Washington, D. C.

## CONTINUATION OF GENERAL STATEMENT

Secretary VOLPE. Our SST, incidentally, is designed to fly 400 miles per hour faster than the Concorde or the TU-144 and to carry more than twice as many passengers. Our aircraft is a more economically viable machine than either of our competitors' and would therefore maintain U.S. leadership not only for this plane but for the entire family of planes. I would emphasize that our design does not face the same questions of economic viability which have been raised regarding the Concorde. Our design will produce the kind of air transport which the airlines need. For this reason, the recent questions about the Concorde are relevant to our program only insofar as a delay in the Concorde program would have a favorable impact on increased demand for our own SST.

## INTERNATIONAL TRAVEL

I also wish to point out what this airplane will accomplish in terms of bringing the world closer together—from the standpoint of trade, education, and social interchange. The old description of the "jet-set" as the only international travelers just does not apply any more. The international jet market is as large as it is diversified. As a matter of fact, projections show that by 1985 as many people will fly the North Atlantic as flew everywhere in the free world last year, 1970. That's a mighty big jet-set.

International travel is now a matter of necessity in the conduct of business. Companies today are international in scope and must hop oceans and continents to remain competitive. The SST will provide the added ability to make international business and trade as quick and efficient as that within our own borders.

Beyond these economic interests, the SST will have dramatic effects on the educational and social structures of the world. Consider that with the SST no point on the earth will be longer than 12 hours away from any other point. Our young people, who are increasingly world citizens, will have the cheapest and fastest transportation available to travel easily throughout the world. Hopefully, the nations of the world will be brought together as never before through peaceful social interchange, made convenient and acceptable by SST flight.

## ENVIRONMENTAL ASPECTS

My next point concerns the environmental aspects of this program which have generated perhaps the most heated controversy. First, let me put our program in perspective. We plan to build exactly two test planes—not a fleet of SST planes, as some would have you believe. This is a prime example of the "fly-before-you-buy principle." These two aircraft will in no way cause harm to our environment.

Secondly, at the same time we have an ongoing program of environmental research. Bill Magruder will detail these programs for you later. They are aimed at evaluating and determining before the facts, not afterward—any adverse effects on our environment that might occur from extensive supersonic flight operations.

As you know, FAA rulemaking and congressional legislation, both now pending, would prevent flight overland at boom-producing speeds. Already we know that the SST will be less noisy to the human ear on takeoff and landing than current intercontinental jets. And this past week our noise abatement committee was able to announce that sideline noise—the noise generated while the plane is on the ground at the airport—can be brought within the noise limitations required for new subsonic jets—a significant reduction from the noise levels typical of jet operations today, and I couldn't have made that statement just a year ago.

Thus, we have already overcome what until recently was a major concern. We are confident that if Congress enables us to move forward with the program we will resolve the remaining concerns just as successfully. Needless to say, if we stop the program we will never know the answers to these pressing questions.

Never in the history of aviation, or for that matter, any other mode of transportation, has a new machine been subjected to the amount of preflight study, research, planning, and evaluation as our two SST prototypes. We are confident that enlightened American technology can overcome any problems that might develop. After all, a country which can send men to the moon at the same time it preserves the Everglades, a country that transmits color TV pictures from space at the same time it says no to superhighways through historic sites, can be counted on to overcome possible problems with the SST.

But I want to reiterate one thing I've said again and again. And I mean it. If testing of the two prototypes or the concurrent environmental research show that the SST will do irreparable harm to our environment, I will do everything possible to insure, and the President has asked me to say that he would do everything possible to insure, that a U.S. SST does not fly in commercial service. This is a commitment I make, as I say, on behalf of this administration.

All evidence indicates that our SST's now in development can fly within our increasingly stringent environmental limits. But we must complete the two prototypes and conduct the tests to be sure.

To stop the prototype development now would leave to foreign interests the experimentation and the final decision on whether SST fleets can be put into the air without serious damage to the earth's environment. It seems strange to me that those persons in this country who oppose the supersonic transports would be content to leave such an important decision to foreign countries interested in supersonic flight.

Mr. Chairman, 34 eminent American scientists agreed with Dr. Edward E. David, Jr., the President's Science Adviser, when he said last December, and I quote him:

Instead of canceling work on the SST we should mount a vigorous program of experimentation aimed not only at solving the technical problems of economic supersonic transportation but also at assuring no undesirable effects.

#### PERCENTAGE OF PROGRAM COMPLETION

Finally, the last major point that must be emphasized is that this program is now two-thirds complete. We are nearing our goal of providing two flying prototypes which will verify for us as nothing else can the technical, economic, and environmental viability of the super-

sonic transport. The final answers in all these areas simply cannot be determined by more study, more component testing, or more ivory tower discussions. The only way to tell what needs to be known before such an aircraft can be flown commercially is to fly the prototypes and conduct an extensive test program. We are 10 years along this path. The U.S. Government has invested more than \$860 million out of a total investment of \$1.3 billion. Private industry—contractors and airlines—has presently invested more than \$246 million out of its committed total investment of \$403 million. We have gone too far, invested too much, and are too near our goal to let this all go down the drain with no tangible results.

This year we are asking for \$290 million, which represents approximately 3 percent of our total Department of Transportation budget. Funding at lesser levels will increase total costs and increase development time. With significantly decreased funding, the experienced teams of scientists, designers, and engineers working on this program would be disbanded. Thus, the program would suffer irreparable damage. The team of subcontractors would undoubtedly be dissolved and the U.S. Government would be faced with contract termination costs. To save probably \$80 million this year would, in my opinion, be counterproductive. It could mean an additional cost next year or the following year of between \$150 to \$200 million. This is a program which, unlike many others, is on schedule, within cost, and faces no insurmountable technical problems. We cannot and should not disrupt it by shaving off a few dollars in the name of economy. This, Mr. Chairman, is truly false economy.

Mr. Chairman, with your concurrence I would like to ask Bill Magruder to elaborate on some of the more recent developments and achievements in our program. But let me close with this final thought. This is the moment of decision for this program and, in a larger sense, for this Nation's entire attitude toward the advancement of technology. As we stand on the threshold of commercial supersonic flight, we can decide either to keep or throw away this country's aviation leadership. We can decide to shrink from our responsibility to find the real answers on environmental effects, or we can proceed to conduct the necessary flight tests to find solutions. And this decision rests with you in the Congress.

Your decision will not be judged by those who harbor some sort of national death wish which seeks to destroy this country's technology and profitmaking free enterprise.

Instead, gentlemen, the final judgment of your decision will be made a decade from now—in the 1980's, the decade of supersonic flight. Hopefully, the basis for that judgment will be the final findings of American research and development during the 1970's.

The choice is yours. And history will judge the course which this Congress takes during the next 30 days. This administration has not wavered in its support of the SST. We are supporting, in the strongest way possible, a bipartisan decision made by four U.S. Presidents, a decision to build and test two experimental planes. We do not shrink from our responsibilities. We look forward to finding answers, not withdrawing from our search.

These two prototype aircraft will help us find answers to many questions about civil supersonic flight. They will put performance

and economic objectives to the test. And in concert with an intensive program of environmental research, exchange comprehension for apprehension and answer fears with facts.

Even at current scheduling rates, no commercial SST's will be moving down the runways until 1978. We cannot afford to further delay this program. We already know, for example, that stoppage of this program now would result in work force reduction totaling nearly a half million persons by 1990. The annual adverse impact on balance of trade would total \$1 to \$1.5 billion a year.

#### SUMMARY

To sum up—we are in the process of building two of the best airplanes ever conceived by the most capable aeronautical experts in history. We are well down the road to construction of prototypes. A large segment of the American economy is at stake. A key segment of our future transportation system is at stake. The American aviation industry is at stake. U.S. technology is being called to account, yet may not be allowed to find answers if the prototypes are not built.

Mr. Chairman and members of the committee, I submit that this committee, and this Congress, should support progress, should encourage logical and reasonable testing, and should support the continuation of the SST program at the most efficient pace practical.

This ends my prepared statement, gentlemen. I would be happy to answer questions now or have Bill Magruder go on and then answer questions together, at your pleasure.

#### SST PROGRAM PRIORITY

Mr. McFALL. Mr. Secretary, we thank you for an excellent and comprehensive statement. Prior to Mr. Magruder's testimony, I am sure the members of the committee will have some question concerning your statement.

There are a number of high priority programs, Mr. Secretary, in the Department of Transportation which you head. With the urgent need to improve urban mass transportation, to provide additional safety on our highways and in our airways, why do you feel that it is essential to continue with the development of a supersonic transport?

I know you have touched upon this in your statement, but perhaps you would like to expand upon it.

Secretary VOLPE. I certainly would be happy to, Mr. Chairman. All of the programs that we have in our own department, whether they be mass transportation, for which you know we have fought very hard, and the Congress on a bipartisan basis has approved that legislation, or whether they be railroad passenger service legislation or many other pieces of legislation or with education programs in this country, welfare programs, public safety programs, all have to be funded by taxes that the U.S. Government collects from corporations, firms, and individuals. I believe that if we are to finance these other programs we have got to be sure that we don't kill off one of the large industries in our Nation. The taxes that are paid by both the

airframe industry and all the subcontractors, in some 44 of our 50 States, together with the individual income taxes by the wage earners, scientists, engineers, and all kinds of people in this industry, would not be available to finance other programs. We might find ourselves trying to spend additional millions or hundreds of millions of dollars in trying to provide manpower training programs and a few other things to find other jobs for these people.

So I don't think that in terms of priorities a project which can do as much by way of employment and furnishing tax funds to the U.S. Treasury is one that needs to take a back seat insofar as priority is concerned.

#### CONCORDE ECONOMIC VIABILITY

Mr. McFALL. Mr. Secretary, in your statement you mentioned the British/French Concorde. Last week it was reported that both the British Overseas Airways Corp. and Air France have indicated that there is some doubt as to whether or not the Concorde could operate economically. In view of these reported conclusions, do you still believe that the Concorde is a serious threat to our Nation's commercial air supremacy?

Secretary VOLPE. Mr. Chairman, may I say that, first of all, the thoughts that you have just expressed were expressed in a British newspaper which has opposed the Concorde from the very beginning. Second, may I say that the very next day after that article appeared, BOAC issued a denial and noted that the Concorde is here and Britain's flag airline expects to buy it and fly it. I might, incidentally, add that while the studies I am familiar with show the Concorde can be profitable, the U.S. SST is better, so, in any event, the market for our plane should be a substantial one.

We have never attached a label of any kind to the Concorde. It will be a good plane. From everything we know about it, it will be economically viable and the British Overseas Airways Corp. which is their flag line, disputed that statement and corrected it the very next day.

#### WHITE HOUSE OFFICE MEMO ON SST

Mr. McFALL. Mr. Secretary, there has been considerable controversy about the SST, as you mentioned in your statement. One of the statements which reportedly was critical of the program was prepared at the specific request of Dr. DuBridge, former Director of the President's Office of Science and Technology. This report has not been released. Could you tell us why this was not released? Why shouldn't this report, if it contains information about any possible environmental dangers of the SST, be made available to those who are being asked to vote for funds for this program?

Secretary VOLPE. I would be happy to, Mr. Chairman. Let us remember, first of all, that this was an interoffice memo at the White House level. The President asked a great many people about their thoughts and their recommendations with regard to the SST not too long after he came aboard and after I had indicated to him that I believed a review of this program was essential.

I will say that the report at the present time is considerably out of date. Its details you might say ought to be considered academic at this

time. It should be noted, however, that one of the individuals consulted by Dr. DuBridge, Dr. Richard Garwin, has since testified on his calculations on the noise characteristics of the SST and it must be presumed that these opinions, now well known to the Congress and circulated liberally to the public, were included in Dr. DuBridge's memo.

The misleading nature of Dr. Garwin's pronouncement on SST noise is revealed in a letter from Dr. Branscomb, Director of the National Bureau of Standards, and I would be happy to make a copy of that letter available.

In any event, the scientific and technical appraisals of SST, the climate and noise characteristics, conducted since February 1969 supersede, in my opinion, an earlier opinion. There is, therefore, no purpose to be served on releasing an interoffice working paper which, good or bad, certainly has been overtaken by events since then.

#### ALTERNATE METHOD OF FINANCING

Mr. McFALL. Let's go, then, to the financing of the SST. Is your Department or any other organization in the administration working on any possible alternative method of financing the prototype development which could be used in the event that Congress does not vote to continue to fund the program with direct appropriations?

Secretary VOLPE. Mr. Chairman, I have, of course, given great thought to that possibility. I think that we have to consider the fact after I have studied this at some length, what our competition is. Our competition is 100 percent Government-financed. For both the French and British the entire investment is Government-financed. The Russians', I don't have to tell anyone here, is entirely Government-financed. And, frankly, we have not been able to come up with any alternatives that would finance the completion of the prototype development phase.

#### LIMIT OF LEGISLATIVE AUTHORITY

Mr. McFALL. Do you feel that the present basic legislative authority for the SST is limited to the construction of the two prototypes and 100 hours of test flying?

Secretary VOLPE. I believe that our present authority is limited to developmental work and testing, and the purchase of experimental aircraft and engines. Anything beyond this would require new authorizing legislation by Congress.

Mr. McFALL. That is as far as you can go on the present legislation?

Secretary VOLPE. That is correct, sir.

#### GOVERNMENT SUPPORT DURING PRODUCTION

Mr. McFALL. The President of the Boeing Co., Mr. T. A. Wilson, reportedly stated that he thinks some kind of strong Government support will be required during the production phase. What kind of Government support do you feel will be required during the production phase? And would financing the production phase with federally guaranteed loans require additional legislative authorization?

Secretary VOLPE. Let me answer the last part of your question first. It would require Federal legislation if guarantee of loans were deemed necessary. I think Mr. Wilson, and I am sure he can speak for himself, was probably looking at all possibilities. There is a possibility, although I doubt it very much, that the economic situation in our Nation and in the airline industry in particular, as well as the airframe industry, might be the same 8 years from now as it is today when the airlines will be buying the SST.

The fact is that I think as Americans we look forward to the continuation of the leadership we have enjoyed and I would foresee that within the next year or two we would see a definite turnaround in the American industry insofar as the airlines are concerned and perhaps the airframe industry as well, provided that we stay in the leadership insofar as the civilian aviation technology is concerned.

Now, I would say this: Within a year, possibly less, I think we will start to see a turnaround in the airline investment picture which has been disturbed by the fact that there were not the increases in percentages of travel which they had estimated and were enjoying up until a year and a half or 2 years ago, maybe two and a half years ago. But the fact is, and I don't suppose I could blame the airlines alone—I think Government through some of its regulations together with industry may have caused some of the problems now existing.

It is my personal belief, as a result of investigations that this administration has made, as a result of some evidence and testimony which has been submitted to the Congress by the administration with regard to the regulatory agencies governing transportation, together with the improvements in the economy and other measures, that the airlines and the airframe industry will be in a position to finance the construction of the commercial fleet without Government assistance.

#### AIRLINES ABILITY TO BUY SST

Mr. McFALL. You touched on this in your answer, Mr. Secretary, the state of the airline industry today, which is low. Do the airlines really have the ability to buy another new plane and/or will that situation change by the time we have the SST ready?

Secretary VOLPE. There are two parts to my answer to that question. First, let me say unless the airlines of America are able to compete with the foreign airlines they will just go down the drain, anyway, and that would happen because the other airlines would have the supersonic transport manufactured by other nations.

Second, I would certainly feel that the airline industry has learned a lesson during the last year or two, perhaps a few lessons. And I think, between what Government does by way of some deregulation and improvement in the regulatory authorities, together with the fact that they will be utilizing a great deal more of the seat capacity in their planes than they have been utilizing during the last 2 years, that the airlines will become profitable again and be in a position to buy the SST's. As I indicated in my testimony, it is a much more productive plane than the others and, if anything, would help them to stay on their feet.

## LEGAL ACTION TO BAN SST

Mr. McFALL. Would you care to comment, Mr. Secretary, on the legal action contemplated by the States of Maryland and New York to ban the SST due to noise?

Secretary VOLPE. I have talked to both the Governors of these two States and other Governors, and I have indicated to them that I would hope that they would wait to find out what the SST is going to do by way of noise, before they start passing laws. We don't generally pass laws, or we don't generally prohibit something until we know what that something is going to do. It seems to me, and I have urged the Governors of both these States—and I think I at least got a receptive ear, although I can't commit them to any program, or their legislatures for that matter—that I would hope they would wait and find out what the prototypes show and what we are going to get by way of noise. It could be less than what we are getting now. I know it is going to be less than the 707's, which they are taking into Kennedy and Friendship, so that I would hope that they would await the final actions and the final results, before legislation is passed.

## DR. GARWIN'S RELATIONSHIP TO THE SST

Mr. McFALL. Dr. Garwin has been very outspoken about the SST. What is his relationship to the SST program? Is he the President's adviser on the SST?

Secretary VOLPE. Let me say as specifically and as strongly as I can, Dr. Garwin has never been and is not now the personal adviser to the President on the question of the SST. An impression has been permitted to develop, based upon his activity as a member of the Science Advisory Committee, which undertakes tasks under assignment from the President's science adviser, and the President's science adviser in return reports to and advises the President. Both Mr. David, the President's present science adviser, and Dr. DuBridge, his predecessor, have strongly urged that the SST program continue, and, as a matter of fact, in a letter of April 22, 1970, last year, to Senator Proxmire, Dr. DuBridge says that:

This is in response to your inquiry in regard to the view of the Office of Science and Technology with regard to the matter of the supersonic transport.

and he closes with the admonition:

Thus on the whole, I would strongly recommend that your committee endorse the President's proposal that the United States proceed with the SST project.

## AIRLINES NEED FOR SST

Mr. MAHON. I would like to ask one question.

Mr. McFALL. Yes, Mr. Chairman.

Mr. MAHON. Mr. Secretary, the airlines apparently made a mistake in buying the 747, because apparently the economy of the country wasn't ready for it. In view of this, is it fair to assume that they would be ready to buy a more advanced plane? In other words, will the country be ready for the SST when the SST is ready for the country?

Secretary VOLPE. If the SST were to be ready in a year or two or

even possibly 3 years, Mr. Chairman, I would say that the answer could well be that the airlines would not be ready, and the airframe industry might be hurt, because it would not have had the opportunity to produce the number of 747's that are required in order to make it economically viable.

The fact is that the SST will not be available for a minimum of 7 years, and possibly a little more, and as I explained to you in my opening statement, the fact is that the supersonic transport that is now planned will be twice as productive, or will be as productive as two 747s. Airlines or any other firm prospers only so long as it is able to operate efficiently, and the more efficient the plane that is produced, the more apt those airlines are to stay in business. I would say that within 7 years from now, they will have utilized the 747s to the point where the country and the airlines will be ready for the SST.

#### ENVIRONMENTAL ISSUES

Mr. CONTE. Mr. Secretary, I want to join the chairman in congratulating you for a very thorough statement. You have certainly done your homework, done it well and made a very fine presentation here.

Mr. Secretary, some of the environmentalists see a major principle at stake in the SST controversy. They say that the time has come when private citizens should not have to prove that government projects are harmful to the environment. Rather the government should prove to the people that the projects are not harmful to the environment. What is your philosophy on this, with regard to the SST program?

Secretary VOLPE. I think, Congressman Conte, that the people are entitled to have all the facts, and our program that we have enunciated here this morning, and the program we have been working on, will enable us to actually answer all of the questions which our citizens have raised.

They have raised many, far beyond what are on the record, as a matter of fact. The reason that we are spending as much additional money as we are on research, even before testing the planes which will provide all of the answers we need, beyond what environmental studies will do. These are going on concurrently, both the environmental studies as well as the production of the two SST prototype planes. My answer is I believe the people are entitled to every piece of information we can give them, to assure them that environmentally this will be more than just an acceptable plane, but a better plane as a matter of fact than most that we built in recent years.

Mr. CONTE. Mr. Secretary, if it could be shown that flying a fleet of SST jet liners would indeed create a significant health environmental danger, would you still think it advisable to proceed with the prototype program, and if so, why?

Secretary VOLPE. If I felt that we could get the answer to your question without the construction of the two prototypes, I would say stop it right now. But we cannot get all the answers we need, until we construct the two experimental planes. Once we have produced the two experimental planes, once we have tested those planes thoroughly and just as thoroughly as it is humanly possible, at the altitudes they will

fly, and in every other way, taking the bugs out of them, if you will, then and then only will I be willing to put my name on the line and recommend to the President that this country should proceed with the development of a fleet of SST's. I would be the very first one to recommend to the President, "Look, we have spent quite a little money, four Presidents have gone through this, they have all approved this, but we have come to the point where we now have the answer, and this plane can't be produced so that environmentally it will be acceptable."

Now I don't think that is going to happen, because I don't think the airframe industry, as well as the airlines in this country, would have put up some \$400 million, which is the amount they will have put in when the prototypes are completed, unless they had a pretty good idea that this was going to be successful.

They have had to work awfully hard, because we have really put the stick to them, as far as really getting down the line on noise and pollution, but it seems to me that the big point to remember here is that if such an eventuality should come about, namely that for whatever reasons we should find that it could not be produced so that it would be acceptable environmentally. I would recommend to the President we scrap it. It would also give us this added advantage, if I may add this, Congressman. It would give us the additional advantage of having the answers to those other foreign airlines who fly internationally, to be able to give them specific answers as to why we would not accept their planes for landing in our country, because we would have tested out everything we possibly could.

If we stop the program at this particular time, we could start a rather serious international debate as to whether or not our stopping of their landing in this country was based on economic factors because we hadn't proceeded with a SST, or whether it was really based on environmental grounds. If we have fully tested the plane, we would have all of the answers.

#### AIR TRAVEL FORECASTS

Mr. CONTE. You speak of an increasing demand for air transportation. Do you have any figures comparing future demands for domestic air travel with future demands for foreign air travel?

Secretary VOLPE. I happen to have that in numbers, Congressman. The forecast for airline passengers over the next decade indicates a tripling. Today almost 45 million Americans fly domestic airlines, 22 percent of the population. Six million Americans fly international flights, about 3 percent of the population. That is today.

Our best prognostications and estimates show that by 1985 126 million Americans will fly domestic airlines, 50 percent of the population estimated at that time, and 25 million Americans are projected to fly international, some 10 percent of the population.

#### NATIONAL PRIORITY

Mr. CONTE. Thank you very much. But in view of the many pressing social problems that face this country, so much money and energy has been diverted to the war in Vietnam, is maintaining first place in civilian technology really a crucial national priority?

Secretary VOLPE. If that were the only reason, Congressman, for our progress with this plane, I would say that I would not be a very wise man to recommend it, and I don't think the Congress would be very wise to accept my recommendations, if that were the only reason for it.

As I indicated, the president of this airline from overseas sat in my own office just about 3 weeks ago, and he said it publicly, not in this country, but outside of this country, outside of his own country, that he would not buy the Concorde unless an American SST was not built. That is the reason why I believe that as far as priorities are concerned, we want to stay in the position of keeping employed anywhere from a half million people, in the airframe, engine, and the associated industries, rather than put them on welfare rolls. That isn't going to happen tomorrow or the next day or 2 years from now, but we could foresee it happening 7 or 8 years down the line. They could be put into some other employment, if other employment was available and trained for it, if that was necessary. It just seems to me that when you think in terms of priorities, we are thinking today in terms of trying to keep people employed.

Now I don't mean keep them employed under any circumstances, regardless of how much noise or how much pollution a plane or another vehicle might cause. I mean to keep them gainfully employed in an industry which has brought about such a great leadership in this industry, in the world on the part of our Nation, and an industry which will continue to do this, provided we maintain leadership. If we don't maintain leadership, we lose not just leadership, we lose jobs, and we will be exporting unemployment instead of planes.

#### TECHNOLOGICAL FALL-OUT

Mr. CONTE. In relation to that question, many critics have responded to the technological fall-out argument by pointing out the Defense Department officials have found the systems similar to those going on in the supersonic transport are already under development for military and commercial application. If this is the case, do we really need the SST program to advance our technological knowledge?

Secretary VOLPE. I would like to ask Mr. Beggs, my Under Secretary, to answer that question. I think I have the answer, but I am sure that he can do it better than I can.

Mr. BEGGS. Congressman Conte, the issue of the advance of technology is, of course, I believe a secondary issue here, however, a highly important one. This program, when it was initiated, built upon technology that had been developed by the Department of Defense, in such programs as the B-70, the SR-71, and so forth.

It is, however, at the present time, and has been for about the last 6 years or 7 years, the only program working toward a supersonic cruise type machine. As such, it represents a very large advance in many areas of technology; technology in the aerodynamic field, which is very important not only for the construction of this aircraft, but which will advance the general state of the art throughout the industry; technology on materials, such as titanium and other high strength materials, which will be used in the construction.

I might add that this technology, the materials technology, has consistently and throughout the history of the aeronautical industry,

been a case where the materials technology developed by the aerospace industry has moved across the entire economy, so it has become very important. Aluminum, of course, has been the outstanding example. However, there have been many, many others.

The technology that will come out of the program is not only important for the industry, it is important, I might add, for the future of the defense program, and Dr. Foster has so indicated to us in a letter, that he believes the technology will be useful, and will be a basis that the Defense Department can use for the future. It will also have important fall-out and important application in the civil sector. The application of the new materials and some of the new technology in industry generally will undoubtedly have a very, very broad and highly beneficial effect.

#### CONCORDE AND TU-144 COMPETITION

Mr. CONTE. Mr. Secretary, you mentioned the Concorde and the Russian TU-144, but thus far the prototypes of the Concorde really haven't come up to expectations. The noise level, they tell me right now, could not meet FAA regulations, under present standards. They are still working on this. That is the lateral noise. Seat capacity is small, about 110, 112, or 114 seats. I don't know whether economically it will be feasible.

In regards to the Russian TU-144, it is very unlikely that any Western democratic country would purchase a Russian-made plane, because the airlines would be dependent for spare parts and replacement models on a totalitarian country, which in turn would make it very, very difficult for them to obtain these parts. Therefore, is the Concorde, or the Russian TU-144 breathing down our backs as much as some people say that it is?

Secretary VOLPE. The fact is, Congressman, No. 1, as far as the Concorde is concerned, they already have specific options. There are some people who say it is not meeting all of the objectives that they started out to try to meet. From every indication we have, they have met the objectives they started out to meet. The fact is that we have become more strict, severe, call it what you will, in the noise standards that we decided we were going to try to employ in our own SST, and this is now below what the British and the French started out to meet. They are at the levels which they started out to meet, and are working very hard right now to reduce those.

There is ample evidence that, even though it is a smaller plane and will naturally cost less, it can be an economically viable plane. We don't believe it will be as economically viable as our own SST, but nevertheless an economically viable plane, and we think that it will have customers for purchase.

As far as the Russians are concerned, we should not, in my opinion, discount their ability to compete in the world market. They have quite a few carrots they can hold out for the purchase of their SST. Permission of flight over the Soviet Union is No. 1. No. 2, the interest rates that they can offer on orders for their SST is far below the rates that we can afford to give, and the fact is that they also can subsidize, because it is entirely a Government-operated proposition, and if they desire to, they could sell a \$35 million plane for \$27 million, to start to get a hold on this market.

The fact is, I would also like to add, that the Soviet Union has now joined the International Civil Aviation Organization, something which they had not done until just this past year. They even sent representatives to the international conference we had just a few weeks ago on air piracy and antihijacking procedures, so they are in this ball game to stay. I don't think that we should take it for granted that they are going to be a very minor competitor.

#### GOVERNMENT'S COMMITMENT

Mr. CONTE. Mr. Secretary, I am told that I have trespassed my time limits. I have about 50 more questions. I will get back to you later on. Thank you.

Mr. MCFALL. We will come back to you, Mr. Conte. Mr. Boland.

Mr. BOLAND. Mr. Secretary, I want to compliment you on your statement. I have known you for a great number of years. I am convinced from what you are saying here today, and the manner in which you have said it, that this does come from your heart, and it does represent your deepest convictions.

I am delighted that we have this public hearing, this open hearing, with all the press, radio, and television, and with people who are terribly concerned about this problem. It does give an opportunity for the Department to have its day and for the proponents of the SST to have their say, so that their words and feelings can get into the press and the media.

I have been on this subcommittee since its birth 5 years ago, and on the Independent Offices Subcommittee on Appropriations that previously handled the funding of the SST. As you indicated, this is not something new at all. It goes back perhaps 10 years to 1963 or 1964. It was the judgment of the President at that time, after a consultation with an ad hoc committee, that he appointed, to evaluate whether this Nation should go ahead with the development of the SST.

The committee members that formed that committee came from in and outside of the Government, and after many hearings, after much testimony and volumes of information on the subject, the report was made to President Kennedy. At that time his judgment was that this Nation should go ahead and develop the SST.

It will be said here that his caveat was that we ought to spend only 700 and some odd million dollars, that the Government's commitment ought to stop at that time. Inflation, of course, has moved ahead by leaps and bounds since that time, and our commitment now has gone to \$1,200 million. That was the figure a few years ago. Today you used the figure of \$1,300 million. Now what is it? What is the Government's commitment for the research and development program?

Secretary VOLPE. Up to \$1,300 million.

Mr. BOLAND. Why has there been an increase from \$1.2 billion to \$1.3 billion plus over the past few years?

Secretary VOLPE. I can answer that question, Congressman. Knowing a little bit about construction and the price of merchandise, steel, titanium, which is one of the fallouts from this program, I can say that the increase in cost in this program, when compared with many other programs that the Federal Government and private industry have undertaken, is probably the lowest percentage increase of any program I know.

## PROGRAM MANAGEMENT

Mr. BOLAND. I have noted in the testimony that Mr. Magruder is going to give to this committee, after your testimony, that the oversight in this program has probably been as close and as good as any program that the Government has been engaged in, that the program is almost on target with respect to costs, that the costs have not escalated.

Let me say that this committee here can take some pride in this. It was this committee that insisted that there be better oversight with the contractors, people from the Government looking over the shoulder of Boeing and looking over the shoulder of GE, to be sure that the Government is getting its money's worth and that we are not going to have the kind of cost overruns that developed with the C-5A and some other programs of the Government.

Secretary VOLPE. That was in 1969, Congressman, that this committee addressed itself to that question.

## ECONOMIC CONCERN

Mr. BOLAND. You have addressed yourself to a number of problems here that the SST has had. There has been a shifting or there will now be a shifting of the emphasis, I think from the environmental attack on the program to the profits—whether the SST is a plane that ought to be built because when it is built, it is going to be a white elephant. Some commentators and some columnists and many who oppose this program feel the environmental argument is not very convincing and so attack it on its economic feasibility.

We are building SST prototypes as you have indicated, and I take it this is so, to find out precisely what the problems are. Is there really an attack upon the environment, as some of the physicists, mathematicians, environmentalists, and conservationists say? If there is, I am delighted that you point out in your statement today that if the research and development program indicates that this is so, you will stop it.

Secretary VOLPE. That is correct.

Mr. BOLAND. You have also indicated that this is not alone your thinking on it, but it is the thinking of the President of the United States. It is the feeling let me say, of this member of this committee, who has supported this program.

Let me point to an article which was in the New York Times today, Monday, March 1, written by Christopher Lydon, who has been close to this program for some time. He is the Washington-based transportation writer for the New York Times. He is a good writer—factual and objective.

He indicates in today's story that "a critical question illustrating the shift from an environmental to economic concern is how much the manufacturers of the American supersonic craft have sacrificed in performance to achieve their reported gains against noise."

You can feel at liberty to answer that, or Mr. Magruder can, if you would desire that he do so.

Secretary VOLPE. Let me say, Congressman, that we don't intend to unduly sacrifice performance for environment, or vice versa. This

committee instructed us in 1969 to watch this program much more closely than it had been watched prior to that time. We were very fortunate, first to have as an Under Secretary, Jim Beggs, who was Associate Administrator of NASA, and who was extremely familiar with these programs, having spent 15 years with Westinghouse before that.

Second, we were particularly fortunate to be able to get the services of Bill Magruder on my left, who has been director of our SST program. Since his coming aboard, it has made it possible for us to have a team stay on top of this project night and day, and I mean literally night and day, because Bill is one of those fellows who doesn't mind calling the Secretary at 1 o'clock in the morning. Not very many do that, but Bill can and does.

He has stayed on top of this program. He has seen what is going on, and we do not intend to unduly sacrifice performance for environment or vice versa. From a point of view of cost, let me say that there is no increase, and I know of no other program that can say this. There is no change in the amount of money we needed to complete the construction of the prototype phase of this development between last year and this year. Practically any program that you can look at has had a substantial increase. I don't sit and speak glowingly about Democratic administrations on all occasions, but on this occasion I am very happy to say that the contract that was made by the administration, under President Johnson, on this SST program—I know a little bit about contracts—probably is one of the finest contracts that I have ever seen written. It does as much by way of return to the Government for its investment as any contract I have ever seen written.

If we do not slip, if we do not allow this program to go backward, so that there will have to be a reopening of subcontracts that have been made with subcontractors and suppliers all across this country, and if we do not delay so that prices of materials and wages continue to go up, then I think we will have achieved something which hardly any other program has been able to do in recent years.

#### PUBLIC INFORMATION

Mr. BOLAND. Thank you, Mr. Secretary. With respect to some other matters which Mr. Lydon's article raises here, I will propound some questions to Mr. Magruder. They are technical and he is better able to respond to them. But let me ask this question:

Is there any report that the administration or the Department has, with respect to the SST, that has not been made public to either this committee or to any committees of the Congress or to the public at large? Is there any report now pending which has not been made public? Is there any secret, hidden, confidential interoffice communication, interdepartmental communication that has not been made available to this committee, or to any committees of the Congress?

Secretary VOLPE. Except for the interoffice memo that the chairman referred to in the very early part of my testimony, there isn't a single thing that I know about the SST that has not been made available to this committee or anybody else who asked about it.

Mr. BOLAND. Is that a report that this committee ought to have? It is simple for this committee to get it, Mr. Secretary, because all we would do, at least as one member, I would deny funds to the Department for the SST, if I felt that this committee was not getting all of the information that it ought to have to resolve his problem, to judge whether we ought to go ahead with the SST.

It is a science report, Mr. Yates tells me, and I understand that it is. It was made as a result of an inquiry made by Dr. DuBridges to a scientific panel to study this matter. Now what about that report? Will you make that report available to this committee, if this committee desires it, or have the findings of this report been made public?

Secretary VOLPE. The findings of this report have not been made public. It is a Presidential report. I could not have it released. The President of the United States would be the only one who could release it, and there is a lawsuit pending, I might add, Congressman. Therefore I would question whether or not it could be released at this time, inasmuch as a lawsuit is pending.

Mr. BOLAND. Let me ask this question, Mr. Secretary, Mr. Beggs, Mr. Magruder, Mr. Parsons or Mr. Vierling who would know the answers to that. The name of one of those who served on that panel has been mentioned at this committee hearing today. He was a witness before this committee last year. Can you tell this committee whether or not the testimony which he gave to this committee at the hearings last year, when he was invited to come as an outside witness, and to give his own testimony, his own views of the SST, whether or not his testimony is information which is in that scientific panel, that report?

Secretary VOLPE. I believe that I can say without a question of doubt that there isn't anything that is in that report which this committee at one time or another hasn't already heard, Congressman Boland.

#### AIRLINES NEED FOR SST

Mr. BOLAND. Do the airlines really want this plane, not now, but in 1978? Isn't there a problem of foisting upon the commercial airlines industry a new generation aircraft too soon upon the 747? The jets go back to about what, 1958, 1956, somewhere in there. The jets came about as a result of the desire of the people to fly faster, and have proved to be a better productive plane than the piston driven. We have had succeeding new generation jets, and now we have the 747, reputedly to be one of the finest flying machines ever built.

This plane costs some \$23 to \$25 million. The supersonic transport is going to cost some \$60 million, \$50 to \$60 million for one aircraft. Can the airlines really afford to buy this plane in 1978, with the 747 being as productive as they say it is at the present time, and with its continuing to be productive, with more people flying in the years to come?

Secretary VOLPE. Congressman, Bill Magruder will address himself to that question. Let me just say briefly that if the capacity today, or the capacity needed in 1978 and 1980 for passenger travel in this Nation and abroad were the same, then I would say to you, Congressman, that the need for an SST at that time would not be proven, except that it would be a better plane.

The fact is that every prognostication we have indicates a very substantial increase in the amount of capacity required, and even if you discount those, so that you don't get in the position that they did this past year, where they overestimated the amount of business they would have, you would still have a very substantial increase. It is my opinion that the airlines will be in a position to buy the plane. As a matter of fact they won't be in a position where they can afford not to buy it. Other airlines will be buying it, and they will be getting the additional efficiency and productivity that the supersonic transport will provide.

#### NEWSPAPER CRITICISM

Mr. BOLAND. Thank you very much, Mr. Secretary.

Mr. MINSHALL. Mr. Secretary, in view of the limited time that has been placed upon us, I don't, of course, have time to ask all of the questions I should like, but I would like to commend you on the excellent testimony you have given here today. If there is one person in the Government that I respect most highly for his integrity, his sincerity and his knowledge about a subject, it is you who are now serving as Secretary of Transportation.

Mr. VOLPE. Thank you so much, sir.

Mr. MINSHALL. I, of course, sat on this committee since its origin and prior to that sat on the Independent Offices Subcommittee. Our hearings first began on this SST program way back in the early 1960's. I have a file here that goes back to 1965, and it is filled with all sorts of facts, figures, data and comments, technological and otherwise, going back to when we first had the competition with Lockheed and Boeing. At that time Boeing said, look, we can do it this way, and then they had to change their design concept.

These are the things that have raised doubts in the minds of many people about this entire program. Rather than go into a lot of specific questions about specific subjects, which you have all heard before, I would like to just quote and paraphrase, if I might, a columnist who writes for one of the Washington papers. He is not an expert in this particular field of aviation, but he does in my mind express the view of many, many people throughout this broad land of ours.

I would like to just read part of it if I may, and I would like to have your comments on it. It goes back to last June 9, 1970. In quoting part of this article, he said:

It is too much for a plane of such limited value, serving so small a segment of the public, and the distorted priorities are only part of the picture. The SST promises to be the noisiest aircraft ever flown. At supersonic speeds, it will lay down a destructive path of sonic booms 50 miles wide. Waiting for takeoff, it will create an ear-shattering racket that some experts have equated with the sideline noise of 50 ordinary jets.

If the SST represented a genuine breakthrough in kind, rather than merely an advancement in degree—which you mentioned—probably we would have to go ahead. If this were a matter of steam against sail or locomotives as opposed to horses, or even jets as opposed to propeller-driven aircraft, the prospect of a genuine new age might compel a different decision.

None of this applies—it is this writer's opinion—to the SST. The plane offers greater speed. That is all. No other advantage is claimed. It will not be as comfortable as the new 747's now entering the international market. The SST will cost more to begin with; it will carry fewer passengers for shorter distances; it will demand favored treatment in traffic patterns wherever it is permitted to land.

Then he continues :

No wonder the airline industry itself is lukewarm. No rush has developed to place firm orders for the Anglo-French Concorde. The 122 reported reservations for the SST—that is the British and French version, are highly tentative and the prospect, actually of selling 500 of these planes, at \$60 million each, is pie in the sky.

One day, perhaps when technology conquers sideline noise and sonic boom, the SST's hour may come. Seeing a profit, the industry will ante up its own capital and build the plane. But that hour is not yet.

Then he carries on. I would like to ask you, sir, what your comments are on this article. This was written by one who you wouldn't think his political philosophy would promote such an article. It is James J. Kilpatrick, whom I admire, and the article was in the Evening Star newspaper. If I had read this in the Post or if it had been written by some of the other writers, I might have understood it, but here is a individual writing for the Evening Star whom I know you hold in high regard, as I do.

Secretary VOLPE. Congressman Minshall, I hope you don't think I am too provincial if I were to say to you that if Christopher Columbus had had all of the argument and all of the debate and the analysis that has been given to the SST, none of us might be here today, and I will quote, as a matter of fact, from history. It says :

At the direction of King Ferdinand and Queen Isabella a panel of Spanish sages looked at Columbus' plan for a voyage to the Indies, and in 1490 came up with six good reasons why it was impossible.

In 1829, I might state——

Mr. MINSHALL. That just shows the foresight of your forebears, Mr. Secretary.

Secretary VOLPE. Thank you. Why do you suppose I used it? Congressman, in 1829 the then Governor of New York, Martin Van Buren, wrote a letter to President Andrew Jackson, expressing his belief that the Government should "protect the American people from the evils of railroads."

Van Buren explained :

Railroad carriages are pulled at the enormous speed of 15 miles per hour by engines which snort their way through the countryside setting fire to crops, scaring the livestock, and frightening women.

Now I could go on and give you a few other things that have happened through history, but let me just say that since that article was written, which had the version that the SST is fifty times noisier than the 747, we have proof of what we can do as far as noise is concerned. Greater speed is not the only thing that this plane is going to produce. It is going to create more productivity than any plane built in the United States or elsewhere. It will be able to carry passengers, once it gets moving at a more productive rate, and at a lesser cost, forgetting what may happen to the value of the dollar, the mark, or anything else, than at any time in history.

Although I respect the gentleman you have quoted and read his column quite frequently, I disagree with him on this issue.

## CONCORDE TEST DATA

Mr. MINSHALL. Mr. Secretary, in a great part of your statement you emphasized the fact that you were only going to have two prototypes and that you were going to learn everything from these prototypes. You also stated that if there was any possibility of polluting the atmosphere, you wouldn't go ahead with the production. I just wonder how much the British and French version is ahead of us. They are already in a testing phase. How much can you extrapolate perhaps from their programs?

You know, we learned a lot when the Comet program came through. It was the first commercial jet, and they had many problems with it. Maybe we can learn from the British-French Concorde, if you would analyze their testing program.

I have here a copy of "Aviation Week and Space Technology." It is written by experts in this field, and they discuss at great length a special report on the Concorde. I know Aviation Week. I have many good friends over there. They are very much for the SST program, and they say the Ministry has paid only one claim involving livestock. You mentioned these other matters. This one is a payment for \$297.60 to a farmer who complained that a cow had aborted her calf. Of the total payment, \$216 was for the loss of milk. They go on and on, but there have been many other damage cases.

I remember full well, serving on the Defense Appropriations Subcommittee, we had testimony before that subcommittee about the damage caused by supersonic flights of the B-58 hustler bomber, and so forth. I just wonder whether or not we shouldn't just hold back a bit, and see how this testing program is going, before we plunge headlong, full speed ahead, into our own program. Maybe we would save money in the long run.

Secretary VOLPE. Congressman, if we were building an exact or almost exact duplicate plane, I would say that probably I might concur with you. We are not.

First of all, our plane is twice as big. Secondly, it flies at a speed approximately 400 miles per hour greater than the Concorde does. Also the Concorde doesn't fly as high as our plane will fly. There have been some exchanges, which Bill Magruder can tell you more about, between the English, the French and ourselves, insofar as our programs are concerned. You can rest assured we are not duplicating anything that has been done by others.

Also may I say that although I have said that the construction of these two experimental planes is absolutely essential for us to draw all the final conclusions, this is going to be done concurrently with the additional environmental studies that are now on-going as well as others that are being undertaken. We will have these answers, both the environmental that can be produced on paper, through studies, and all of the other surveys and so forth, together with the answers that you get from the actual production. Then primarily the testing of those two planes, which will not be the same as the Concorde's, or your point would be well taken.

## PUBLIC RELATIONS

Mr. MINSHALL. I thank you, sir. I don't want to belabor this, but we have been through this so many, many times, starting back with my good friend Najeeb Halaby, and continuing with General Maxwell, Jack Shaffer, etc. We have been through this for years and years. I just begin to wonder whether or not the ecologists' public relations program is much better than yours?

Secretary VOLPE. I can say that the ecologists' public relations program has been much better than ours. But it will not be better than ours in the next 30 days, I can tell you, because I think the public ought to get both sides of this story. That is why I congratulate this committee in opening these hearings.

Mr. MINSHALL. Previously, the technology wasn't there. They were sure of that. Now we agree that the technology is here. But now they have cranked in ecology. They have also cranked in the economic factors, and all of these things that have changed the picture in the minds of a lot of people. I think these open hearings are a good opportunity for you to get your story to the public, and of course, tomorrow we will have more of the opposition.

Secretary VOLPE. We can assure you we will be getting our story to the public just as strongly as we know how, and I congratulate the committee on opening these hearings today.

Mr. MINSHALL. Thank you very much for your wonderful testimony.

## SCIENCE ADVISORY GROUP REPORT

Mr. McFALL. Mr. Yates.

Mr. YATES. Mr. Secretary, I would, like my colleagues, like to welcome you to this committee. I would like to refresh your recollection, however. You said that both Dr. DuBridge and Dr. David, the President's science advisers, favor this program. May I read to you from page 343 of the hearings of this committee for the year 1970, a letter dated March 20, 1969, at a time when Dr. DuBridge was a free agent in his opinion, before the President had made up his mind on going ahead with the SST, and in that letter he said this:

On the whole, I come out negative on the desirability for further Government subsidy for the development of this plane, and would suggest that the possibility be explored of turning the remainder of the development, and of course, all of the production expenditures, over to private enterprise. Any technological benefits which would accrue from its further development, either for civilian or military purposes, would seem to be minimal. Granted that this is an exciting technological development, it still seems best to me to avoid the serious environmental and nuisance problems, and the Government should not be subsidizing a device which has neither commercial attractiveness nor public acceptance.

That is signed by Lee A. DuBridge, the Director. I should also like to say to you that it is my impression that every kind of pamphlet, every kind of statement, every kind of report that is favorable to the SST, has been made available to this committee. The report of the Science Advisory Group, which was a report to the President, has not been made available to this committee, and I can only assume from that that the report is not friendly to the SST. As a matter of fact, talking to one of the people in the White House, I learned that that report is not favorable to the SST; and I join my colleague, Mr.

Boland, in advancing the thought that it would be a very good thing for the White House and for the SST administration to make that report available to the committee, so that neither your interpretation nor my interpretation of the report is all we have, but let the report speak for itself.

The Cabinet Committee report, which was made available to this committee as a result of the insistence of Mr. Boland as chairman, was also a report to the President. It was a privileged document. It was made clear to the SST Administrator at that time that if that report were not made available to this committee, your appropriation would not be forthcoming. There is a great deal to be said in favor of what Mr. Boland has suggested. That report ought to be made available to this committee. The fact it is the subject of a lawsuit is not really pertinent. The fact that it is the subject of a lawsuit doesn't mean that it cannot be made available to this committee. I think it ought to be. Let us judge whether everything that is in that report has ever been made available to this committee. I suggest, sir, it would be a good idea for you to recommend to the President that he make this available to this committee.

Secretary VOLPE. Congressman, may I say that the letter you referred to, of course, is dated March.

Mr. YATES. That is right. You mean the DuBridge letter?

Secretary VOLPE. Yes.

Mr. YATES. Right.

Secretary VOLPE. May I suggest also—

Mr. YATES. March 1969.

Secretary VOLPE. That is correct, sir. May I suggest that at that time there had been a very short amount of time available for either Secretary Volpe or Dr. DuBridge or others to make a complete analysis of all of the factors involved. As a matter of fact, on April 22, 1970, another letter was written by Dr. DuBridge to Senator Proxmire, in which he expressed views contrary to the views expressed in his letter of March, the previous year.

Mr. YATES. I will tell you, Mr. Secretary, that I called Dr. DuBridge subsequent to the decision of the President in deciding to go ahead with the SST, hoping I could get him to testify; and I said, "Dr. DuBridge, is your opinion still the same as it was in that original letter?" and he said, "Congressman, I am a soldier. The President has made up his mind, and I am going to support the President's decision." This is what Dr. DuBridge told me personally.

Mr. CONTE. If you will yield, I think he should be called before the committee.

Mr. YATES. It is all right with me. Do you want to call Dr. DuBridge?

Secretary VOLPE. Congressman, may I say insofar as the release of the report: That report was to the President, and the President alone can make that available. I shall talk with him about it.

#### LIMIT OF GOVERNMENT COMMITMENT

Mr. YATES. I will say to you, Mr. Secretary, that the report of the Cabinet Committee was addressed to the President alone. It was addressed to you, and you submitted it to the President, and you and the President decided to make it available.

Now, Mr. Secretary, let me say there is something that does not meet the eye in the presentation of the program. I find it to be a will-'o-the-wisp. In one breath you talk about the fact that all that this administration is interested in is the development and funding of two prototypes. Yet every effort, every push, every breath in connection with this presentation looks to the construction of a commercial SST.

Who will determine the question as to whether or not the Government continues to fund this program into phases 4 and 5?

Secretary VOLPE. Congressman, all I can suggest to you is that this is the limit of the Government's commitment, the limit of the Congress' commitment.

Mr. YATES. Is it the limit of the Government's authority?

Secretary VOLPE. Yes, I believe it is the limit of the Government's authority at this time.

Mr. YATES. Are you telling this committee, then, that in order for this program to go beyond phase 3 and in phase 4, the production version of the plane, that the SST director would have to come before Congress, that you, as the Secretary of Transportation, would have to come to the Congress with the request not only for funds but for authority. It was my impression you claimed the authority under the original vague NASA authority plus the legislation that created the Department of Transportation. If you do not have that authority, if you are saying you do not have that authority, I would like you to say so now.

Secretary VOLPE. We have ample authority not to certify the plane through our Federal Aviation Administration if we do not feel environmentally or from a safety point of view, or any other point of view, it should be certified. It is the intention of the program that at that time the commercial interests proceed with production.

Mr. YATES. I am not asking you that question, Mr. Secretary. I am asking you whether you have the authority under law to proceed without the necessity for coming to Congress again.

Secretary VOLPE. We do not have authority to spend money for anything for production purposes, only for development, test, and experimentation.

Mr. YATES. Does that mean you do not have the authority in law to not spend money for the production version of the plane? As of now you have an appropriation only for development of the prototypes.

Secretary VOLPE. Of course, we have the right to come to Congress and ask for anything that I think makes sense. At this moment, however, I have no intention of coming up here for such a request because I do not believe it will be necessary. We do not have the authority at the present time to spend any money on production aircraft, nor do I see the desirability or necessity of that authority at this time.

#### PRODUCTION AIRCRAFT IMPROVEMENTS

Mr. YATES. May I point out to you that throughout the testimony that has been taken, and the testimony has been voluminous, there is reference to the production version of the plane, that you are looking beyond the development of the prototype and that there will be included in the production version of the plane certain improvements. One thing that comes readily to mind is the new engine. I understand

that you have now issued a statement to the effect that you have breakthroughs which will permit the SST, when completed, to have a sideline noise that will be no greater than that of a subsonic plane.

That is correct; is it not?

Secretary VOLPE. That is right.

Mr. YATES. As one part of the program that will reduce that sideline noise, you propose to build a new engine.

I see Mr. Magruder shaking his head. Are you saying that the prototype engine will result in reduction of the noise to 108 PMDB?

Mr. MAGRUDER. I think you misunderstand the definition of a prototype. A prototype is a means of getting to the end product which will be the production airplane. If the production and prototype were identical, then by definition the prototype would be a very unsuccessful prototype.

Mr. YATES. I don't follow that.

Mr. MAGRUDER. So the prototype will not have the same engine as the production airplane but will prove the feasibility of the engine in production that will meet the noise requirements.

Mr. YATES. Are you saying that based upon the engine that will be in the prototype which will not be the engine in the production model you will be able to go to private sources of investment to obtain the funds that are necessary to build the production version of the plane?

Mr. MAGRUDER. I am saying that based on having a proven article, with the kind of noise levels and lack of pollution and the kind of economic viability that the prototype will offer proof of, you then can go to the financial institutions and say to them we have a proven article. We always have willing buyers. We have some 26 of the free world airlines that have put up \$81 million of their money 10 years prior to receipt of the airplane to show their need and desire for the airplane. The only thing that is missing to get private financing for the entire production program is a healthy aviation industry.

If you have those three things, I have the assurance of the financial institutions they will indeed be able to finance the SST production program from 1974 through its time period.

Mr. YATES. Do you have that assurance if private industry knows the things that were reported in the letter from National Aeronautics and Space Administration to one of the clerks of the committee at my request. This letter is dated February 12, 1971, and part of it said that the Department of Transportation has advised me significant progress in the last 7 months has been realized in certain technical areas. I quote:

For the production version of the SST, Boeing is considering such aerodynamic improvements as increased stress, size and leading edge sweep, increased sweep of outer wing panels and optimum twist design of the horizontal tail. These will make significant improvements in the B-2707-300 design.

When I received this letter I called Neil Armstrong, the astronaut, the first man on the moon, and I asked him about this, I said:

Mr. Armstrong, aren't these major changes in the design of the plane? These are major changes that will not be incorporated in the prototype.

Mr. Armstrong, who is with the program, said, "Congressman, they certainly are not trivial changes."

We know the prototype is not going to have the new engine, the new noise-reducing engine. We know the prototype is not going to have

the same configuration of wing, there will be a different kind of wing that is built. That also is contained in this letter. We know that the prototype will not have a number of the various parts of the airplane, that is, the production version of the plane, as for example the braking system, the fuel line length. I mentioned the engine design. It will have a different environmental control system and landing gear.

Are you telling this committee that even though the prototype will not have any of these things, based upon what the prototype shows private industry will be willing to advance the \$2 billion or more necessary to build the production version of the plane?

Mr. MAGRUDER. Yes; I am. I do not know whether you know it or not, but you are flying in 707's today that have virtually no relationship to the first 707 that went into service. I mean almost none—control system, metals, engines, none of them are the same.

#### TECHNOLOGY FALLOUT FROM MILITARY

Mr. YATES. They were financed by private industry.

Mr. MAGRUDER. Just a moment. They were not. All the technology that went into the 707 program came willy-nilly, scotfree from the B-52 program. You paid the bill. You just did not know it. You put \$2 billion into two prototypes for the B-52, of which I was the test task force director. I flew them for 6 years as an engineer and pilot. Every bit of technology in aerodynamics, the control system, the wheels, brakes, tires, spoiler system, the gages the pilots read, the actual engines that were on the first 707 came off that B-52. The Government got not one nickel back.

Mr. YATES. Do you know your testimony differs from that of General Maxwell?

Mr. MAGRUDER. I have not finished my point. The point is that in the case of the SST program you have a remarkable effort. Here is the first time in the history of aviation where commercial is diverging from the military. The demands on the state of the art for commercial aircraft, short haul, medium and long haul demand a greater advance in the state of the art than the military. There is no military airplane on the drawing board that even competes with the SST in technology. B-1, F-15, F-14 are aluminum or variable sweep, fly close to the ground and have only dash supersonic capability. So for the first time you are going to get advanced technology from commercial aviation.

Mr. YATES. Who is going to pay for it?

Mr. MAGRUDER. You will get all the money back. This is a loan. The taxpayers will put up \$1.3 billion and starting with the sale of the first airplane when 300 airplanes are sold in a successful production program all that money will come back. Nothing came back on the B-52. Nothing came back on all the technology that built the DC-3, DC-4, Connie, 707, DC-7, and DC-8, and 707.

I might say I am the designer of the Lockheed 1011. We did not have to advance any technology on the L-1011. It all came free from the B-52 and B-47 fleets. The engines were new. That technology came right off the C-5.

Mr. YATES. May I interrupt you?

Mr. MAGRUDER. I might say all the low noise technology came out of the C-5.

Mr. YATES. What you said was that the taxpayers paid for it through the B-52.

Mr. MAGRUDER. Yes.

Mr. YATES. General McKee and General Maxwell both said it came from the KC-135 at that time.

Mr. MAGRUDER. The KC-135 was part of the B-52 fleet.

Mr. YATES. You said the taxpayers paid through the military planes. Does that mean the taxpayers will pay for the production version of this plane too?

Mr. MAGRUDER. No, sir. I said very clearly the taxpayers will get all of their investment back. When the 500th airplane is sold they will get a billion dollar profit. The taxpayers will get \$6 to \$10 billion in tax revenue.

Mr. YATES. Who will put the money up in the first instance?

Mr. MAGRUDER. The private industry will put up the production money in the production program. All the Government is putting up is a loan for the first time in history that allows the proof of the pudding so we can attract private financing into the program at the proper time.

Mr. YATES. I will have more questions later. I have already exceeded my time.

Mr. MAHON. I would like to know if he completed his answer.

Mr. McFALL. Have you finished your answer?

#### RETURN ON INVESTMENT

Mr. MAGRUDER. No, I would like to say one final thing. We do not seek prestige or leadership for their sake alone in this country. This is a long look-ahead program as Mr. Minshall and Mr. Conte pointed out. This program when it goes into production will have been, in effect, in research 18 years, twice as long as the whole effort to get on the moon. It is probably the most demanding, advanced research program I have ever heard of.

Out of that the taxpayer gets back the \$1.3 billion investment, plus \$1 billion in direct profits which we haven't got out of any other mode of transportation. Royalties go on the price of the airplane and in turn are charged to the people who buy tickets to return the billion dollar profit. You get \$6 to \$10 billion in tax revenue from 150,000 jobs. If you are willing to add those, that is a 17-percent return on investment. That is better than you get most of the time today. If that were not enough you get \$22 to \$50 billion in favorable trade balance. Those numbers that I have just quoted I have checked out with appropriate agencies of the Government. I have very little influence with any of the Secretaries, and I have used up all mine with my boss by calling him at 1:00 o'clock in the morning. The Treasury Department, Council of Economic Advisers, Commerce Department, Export-Import Bank all agree with the basic balance of trade numbers I have given you. Those are the national benefits as to why this program is good for the taxpayer. As a matter of fact, if we do not have those kind of national resources I do not know where we are going to get the financial wherewithal to take on these very necessary social reforms that I have heard Mr. Conte and Mr. Minshall speak to on national priorities. This is why I think Mr. James Kilpatrick

for whom I have the utmost respect, is incorrect. He does not know what he is talking about when it comes to aviation technology. He is a delightful man. I spent a whole afternoon with him. However he does not understand technology in the air transport industry.

Mr. McFALL. I would say to the committee that Mr. Magruder has a 55-page statement together with charts in which he will answer many of these questions.

#### PRIVATE FINANCING

Mr. YATES. I have just one more point relating to what Mr. Boland said respecting the price of the program and something I did not understand when I went over these previous hearings. It relates to an answer by Mr. Beggs, to a question by Mr. Conte. It appears on page 555 of the hearings for 1971. Mr. Conte asked this question:

You state that a number of privately financed plans have been proposed for phase III, but that they result in a higher program cost than the appropriation route. Specifically, how much more would a privately financed plan cost? Could you describe the privately financed plans that have been proposed? How much would the Government, not the total program, save under a privately financed phase III plan?

Mr. BEGGS. The basic considerations which any private financing arrangement for phase III must cover would include (1) the magnitude of the effort, some \$1.6 billion through construction and test of two prototypes.

In other words, \$300 million more than the Government's program.

Mr. BEGGS. That is correct, sir.

Mr. YATES. Can you tell us why later on? I will ask the question later on. It seems to me it might even be cheaper for private industry to go through phases I, II and III rather than for the Government to do it.

Mr. McFALL. The committee will adjourn for lunch and we will reconvene at 1:30.

#### AFTERNOON SESSION

Mr. McFALL. The committee will come to order. Mr. Edwards?

#### PROGRAM FINANCING

Mr. EDWARDS. Thank you, Mr. Chairman. Mr. Secretary, as I understand it, the \$1.3 billion we have been talking about takes the SST up through the construction of the prototypes; is that correct?

Secretary VOLPE. Yes, sir.

Mr. EDWARDS. Does the Federal Government have any commitment financially after that at this point?

Secretary VOLPE. At this point we have not.

Mr. EDWARDS. In the event there was ever an effort made to put more money into the SST after that point there would have to be further action by the Congress?

Secretary VOLPE. That is correct, sir.

Mr. EDWARDS. I want to get clear in my own mind the breakdown on money spent and what is yet to be spent. You say in your statement that you are asking for \$290 million. I presume that you are talking about fiscal year 1971.

Secretary VOLPE. Yes, that is correct.

Mr. EDWARDS. And you already have some of that up through March 30; is that correct?

Secretary VOLPE. That is correct, by way of the continuing resolution at a \$210 million rate, however.

Mr. EDWARDS. The \$860 million, then, that you say has been appropriated and spent goes up through what date?

Secretary VOLPE. March 30, 1971.

Mr. EDWARDS. That includes everything that has been appropriated until the end of this month?

Secretary VOLPE. That is correct, sir.

Mr. EDWARDS. And the difference, then, between the amount received under the continuing resolution and \$290 million is what you would hope to get between March 30 and July 1?

Secretary VOLPE. That is correct, sir.

Mr. EDWARDS. And then we will have another ball game starting with fiscal year 1972?

Secretary VOLPE. I am afraid so.

Mr. EDWARDS. How much is in the budget for fiscal year 1972?

Secretary VOLPE. For fiscal 1972 we have asked for \$235 million. The figure which the Congress would be asked to approve I would say would hinge on what is appropriated for fiscal 1971. In other words, that \$235 million, if the \$290 million were not appropriated, would probably have to be enlarged in order to try to make up in part for the loss that would be sustained if we did not get the full \$290 million.

Mr. EDWARDS. If you get the full \$290 million for fiscal year 1971 and the \$235 million for fiscal 1972, what is left after that?

Secretary VOLPE. Pardon me, Congressman. There is a difference of opinion as to figures here and I want to make sure to give a correct answer.

Mr. EDWARDS. We want the record straight.

Secretary VOLPE. Yes. I think we are in agreement now on the right figure, sir. If we get the \$290 million for fiscal year 1971, and we get the \$235 million, for fiscal year 1972, then the balance of the testing program et cetera, will require \$92.2 million, for fiscal year 1973 and \$16.2 million for fiscal year 1974.

Mr. EDWARDS. \$16.2 million?

Secretary VOLPE. For 1974, yes, sir.

Mr. EDWARDS. And that should more or less equal \$1.3 billion; is that correct?

Secretary VOLPE. \$1,342 billion.

Mr. EDWARDS. \$1,342 billion?

Secretary VOLPE. That is correct.

Mr. EDWARDS. Which would conclude the prototype work and conclude—

Secretary VOLPE. Building and testing.

Mr. EDWARDS. The Federal Government's commitment?

Secretary VOLPE. At this moment, yes.

Mr. BOLAND. Does it also include the 100 hours of test flying?

Mr. EDWARDS. Does it include the 100 hours of test flying?

Secretary VOLPE. Yes, it does. That is what the 1973 and 1974 amounts primarily are for.

Mr. EDWARDS. Now, then, Mr. Secretary, if you don't get the \$290 million, that is to say, if after March 30 of this year there is no more

money forthcoming, what will this Congress have to appropriate in order to let you close out this project?

Secretary VOLPE. Well, first of all, Congressman, you would have the \$156 million to cover the joint resolution. You would have \$85 million, the contractor shares. You would have \$12 million in additional Government expenses. So you would have minimum appropriations of \$253 million, but in addition to that there are \$22 million that the airlines have placed in escrow with the Treasury Department. That has to be repaid. That is a minimum Treasury outlay for fiscal year 1971 of \$275 million. Then there is the airline R. & D. which they put in at risk which is \$59 million. That is something which I suppose we could say shouldn't be included, but if that were considered there would be a total of \$334 million.

Now, if the Government walks away from the program after the over \$1 billion expenditure on both the part of the industry and the Government, a royalty return that could be at least \$1 billion and could go substantially higher would be lost. There are also taxes that would be involved here, and it is estimated that they would be in the range of \$6 billion to \$10 billion.

We would have 150,000 jobs involved, to say nothing of the export picture, the balance of trade and also the ability of those countries who today do not have the ability to sell as many airplanes on the world market. They sell only 16 percent or 17 percent of the world market. We have sold 84 percent of the free world's jet fleet. We would be in a position where that would certainly have to diminish, so that we would lose our technological leadership as well as the profits, the balance of payments, and so forth, but in direct costs you are talking about a minimum of \$275 million.

#### EMPLOYMENT

Mr. EDWARDS. How many people are working on the SST now?

Secretary VOLPE. 13,000 direct on the SST at the present time.

Mr. EDWARDS. That is in the airframe as well as the engine end of it?

Secretary VOLPE. Yes, sir.

Mr. EDWARDS. In your statement on page 13 you refer to the fact that the work force reductions would total about 150,000 persons per year, but when you gave your statement you said a half million. I wonder if you might explain what you mean.

Secretary VOLPE. Yes; the 150,000, of course, is a figure for the number of people working on this plane, together with all the components at the peak of the production. The half million figure is a figure based on what we believe, after talking with not only the president of one foreign airline but other foreign airlines as well, together with what we know the airlines of America would be spending overseas for products. It is our belief that a half a million or more jobs—as a result of the desire of our airlines to buy a family of planes from one nation—our aviation industry in this country would suffer badly. So it would not just be the people on the SST because by that time—I am not talking about a year or two or three from now; I am talking about 7 or 8 or more years from now—you would be in a position where you could lose a half million or more jobs in the total industry.

## DR. DUBRIDGE'S POSITION

Mr. EDWARDS. Finally, Mr. Secretary, there has been a lot of talk about Dr. DuBridge. He is supposed to have written this letter in March of 1969 where he questioned the project. What is the date of the DuBridge interoffice memo that has also been discussed?

Secretary VOLPE. The date of it was March.

Mr. YATES. That was the date of the first one.

Secretary VOLPE. That is what I thought he was asking.

Mr. YATES. That was the Cabinet Committee letter.

Secretary VOLPE. Oh, I beg your pardon. I will have to get that date for you, Congressman. It was, I think, in May of 1969.<sup>1</sup> The first letter, which was purely an interoffice memo between Dr. DuBridge and the President, was in March. I think the letter you are referring to was in May of 1969.

Mr. EDWARDS. At what date did Dr. DuBridge advise the President or you that he found the SST acceptable?

Secretary VOLPE. April 22, sir. He wrote a letter to Senator Proxmire.

Mr. YATES. What year is that?

Mr. EDWARDS. What year?

Secretary VOLPE. 1970. He made that position public on April 22 of 1970.

Mr. EDWARDS. Thank you, Mr. Chairman.

## PROTOTYPE TESTING

Mr. McFALL. Mr. Steed.

Mr. STEED. Mr. Secretary, first let me say that I think you have made a very comprehensive and informative and persuasive statement, and I concur in the conclusions that you have stated here today.

In your statement you gave some attention to the fact that it seemed strange to you, and it does to me, why those who oppose the SST are not willing to permit this program to go through the prototype and testing stage so that these controversies and unanswered questions could be determined in a scientific and believable and workable manner. Now, we know that the British, French, and the Russian SST's are here. We know that they are going to use it. What we don't know is whether it is going to pollute the world.

If we are to assume that the opposition from the environmental standpoint has validity and if the development and use of this type of aircraft by these countries that now have it did threaten the world, how on earth could the United States ever have the type of scientific information it would need to help world opinion, compel these countries to retract or to change their operations of these planes, unless we first have made these prototypes, made these tests, and gotten these answers?

Secretary VOLPE. Well, that is a question which I certainly hinge a great deal of my testimony on; namely, that we would be in a much better position. As a matter of fact, we would be in a very solid position to answer any inquiries with certainty of judgment by completing

<sup>1</sup> The correct date is March 20, 1969.

the two prototypes and testing them. If we do not, we would not have all of the information on which to base a judgment as to whether or not we should allow foreign airlines who did buy a Concorde or a TU-144 to fly into this country.

Mr. STEED. We wouldn't be able to advise the other countries of the world that have traditionally looked to us for scientific leadership and knowledge in this industry if we didn't make these tests?

Secretary VOLPE. That is correct, sir.

#### RUSSIAN COMPETITION

Mr. STEED. You also made mention of the fact that the Russians are currently running advertisements and trying to gather the market for the sale of Russian-made aircraft.

Secretary VOLPE. Yes, sir.

Mr. STEED. Is this something new the Russians are doing?

Secretary VOLPE. Relatively new. As I indicated this morning, in the past they had not even seen fit to join the International Civil Aviation Organization. They now are very much interested. The fact is that in the past they have not had a full family of planes and the United States has. This has enabled the United States to sell planes to many nations who look to us and buy our planes because they feel we manufacture a good product, a fine product. If the Russians put their mind to it they can do what they set their mind to do. I agree that probably a great many nations might not care about purchasing from the Soviet Union immediately. However, if their production of SST's, together with the other family of planes, were such that other nations could be sure of performance and sure of getting their parts, and particularly if their credit factors involved in the purchase of that plane are such that they can become available more easily, then I could see other foreign countries buying the plane. It is only, I think, within the last 6 weeks or so they have run four ads, two on conventional jets, one on the family of jets, and on the 8th of March they will be running an ad, two-page spread, on the supersonic transport itself.

Mr. STEED. Is there any doubt in your mind that if we now decide to quit work on our SST that that will not react to the economic and world leadership advantage of Russia?

Secretary VOLPE. No question about it in my mind at all, sir.

Mr. STEED. Some weeks ago Senator Goldwater made a speech in which he listed a number of organizations that have joined in this outcry against the American SST and it is just coincidental that, although some of these organizations are very fine, public-spirited groups, also in that list were a number of the well-known Communist-front organizations in this country. Do you see any significance in the fact that most of the outcry against the American SST is just coincidentally started about the time the Russians decided to go in the world market for the sale of their SST?

Secretary VOLPE. I would like to leave that to those who are in the intelligence field and can more accurately assess that. I would like to believe that those Americans who oppose the SST basically are good

Americans, and I do not have sufficient information to question either their patriotism or loyalty. Now, intelligence people might reach a different decision but I don't have that information, sir.

PROGRAM COMPLETION VS. CANCELLATION COSTS

Mr. STEED. Mr. Secretary, it is not unusual that sometimes the good guys in a movement find themselves with some strange bedfellows, and I am not going to ask you to comment on it but I suspect that you feel, as I do, that there is, to say the least, a strange coincidence here.

Now, there is one final thing that I would like to try to put in a nutshell or have you do for us. This subcommittee today, being at the first stage of action as this matter approaches the Congress, just has two decisions to consider. We can either quit or we can go ahead. Now, if we go ahead, you have outlined we will have finished the commitment of \$1.342 billion to build and test two prototypes and to give this country the knowledge, know-how, and all the scientific information that flows therefrom. Including what we have already spent and what the cancellation costs will be, what will be the total figure involved in the SST experience if we decide now to quit?

Secretary VOLPE. It will cost the Government and industry approximately \$1.109 billion.

Mr. STEED. So what we are really considering, then, when we decide whether this request will be granted or not, is whether it is better to throw away \$1.109 billion of the taxpayers' money and have nothing to show for it, or for the sake of an additional \$233 million we can get two prototype planes, make tests, and give our country an opportunity to have a future in the field of aviation. Isn't that a fair assumption?

Secretary VOLPE. You have stated that a great deal better than I have, and I congratulate you for it, Congressman.

Mr. STEED. Thank you, Mr. Secretary.

BALANCE OF TRADE

Mr. McFALL. Now we will go back to Mr. Conte who was unable to finish his questions.

Mr. CONTE. I will try to be very brief, Mr. Chairman.

Mr. Secretary, you state throughout the SST faces the loss of 50,000 direct jobs at a \$22 billion impact on our balance of payments. Will you provide us with a precise breakdown of these figures?

Secretary VOLPE. Yes, sir; happy to.

(The information follows:)

The \$22 billion swing in the balance-of-trade breakdown as follows:	
With a U.S. SST program:	<i>Billions</i>
270 U.S. SST's exported.....	\$11.5
Less 60 Concorde's imported.....	-1.4
Net exports.....	10.1
Without a U.S. SST: 380 Concorde's I and II imported.....	12.0
Total swing.....	22.1

The following data is a breakout of the 50,000 jobs :

Function :	Number of employees	Function—Continued :	Number of employees
Research, design, and development .....	8,000	Finance .....	750
Sales and service.....	1,500	Computing .....	1,700
Assembly and fabrication..	27,500	Quality .....	3,800
Material procurement.....	1,500	General services.....	2,000
Facilities service.....	2,500	Total .....	50,000
Personnel services.....	750		

#### SST SURCHARGE

Mr. CONTE. You state that the SST people will have the cheapest, fastest transportation available to travel easily throughout the world. How will passenger fares on the SST compare with the 747 and the 707?

Secretary VOLPE. When you are projecting 7 or 8 years away, it is difficult to say precisely what will happen. There could be a small surcharge in the very beginning of the program. However, that surcharge probably would be eliminated as more of the jet fleet was retired by supersonic transports.

Bill Magruder would like to speak to that if he may.

Mr. MAGRUDER. I think, just so there is no misunderstanding about that, you should reflect back into the 1960 time period, that there was a surcharge I believe of some 16 percent on first class fares on jets and some 6 percent on coach fares. Yet during that time period, for example, Pan American passenger payloads averaged between 70 and 75 percent. The Secretary is simply pointing out that you may put on a surcharge to prevent early obsolescence of what will then be the older and more obsolete equipment, the jumbo and the tri-jet aircraft. Then later on, as the total operating costs overtake these jumbo jets, you remove the surcharge and again the faster, more productive equipment will provide the lowest operating cost, highest revenue and lowest fares, and the SST will fit that description.

#### OVERLAND FLIGHTS

Mr. CONTE. Mr. Secretary, when can we expect the issuance of FAA rules to prevent overland flights at boom-producing speeds?

Secretary VOLPE. They are in the final stages. The Federal Aviation Administration is in the final stages of the proposed rulemaking process and it should not be very long before that definitely will be proposed.

Mr. CONTE. Do you expect it within this fiscal year?

Secretary VOLPE. Oh, definitely; very definitely. I would say probably within the next 60 to 90 days.

#### ENVIRONMENTAL CONCERNS

Mr. CONTE. Aside from the noise problem which you say now is corrected, at least on the lateral takeoff, what other environmental concerns do you believe have to be resolved?

Secretary VOLPE. Well, the fact is that there are those who feel that there is very little to resolve. On the other hand, I am one of those who

like to see the specific confirmation of every single item, and that is the reason that we are spending the additional money right now in the climatic and other research areas. None of them, as I see it, is insurmountable. What we want to do is produce the very best plane that the human mind can devise.

Based on what we know now, we are going to be able to produce this kind of a plane. We found that 124 decibels was more noise than a great many people cared to take. We started to push and stretch and last fall were down to the 112 and we are now down to 108. At the same time the answers to climatic, atmospheric and other questions will be answered.

#### EMPLOYMENT

Mr. CONTE. Let me ask, how many scientists, engineers, and designers are now working on the program and what level of reduced spending would disband this team?

Secretary VOLPE. Including technicians and beyond the actual types, scientists, engineers—

Mr. CONTE. I am not talking about laborers now.

Secretary VOLPE. Well, they don't employ many laborers in the prototype phase, but there are approximately 13,000 people. You could lower this or if you continued, for instance, at the \$210 million there is absolutely no question in my mind that Boeing would have to reopen all of their subcontracts. Boeing would have a right to say "We want to reopen our contract."

The fact is that we made a contract. I didn't make it. It was made some time back, and I said this morning I thought it was a fine contract. The fact is that if we don't keep our end of the bargain in that contract it is like any contract; the other parties to the contract can say "Well, you didn't keep your end of the bargain. Therefore, I desire to have my end of it reopened." If we reopen it, and the subcontractors particularly would have a perfect right to say "We want it reopened," it could cost, as I indicated earlier, anywhere from \$150 million to \$200 million for subcontractor renegotiations alone. So if you got down much below \$290 million that is the kind of situation you would be facing. Additionally you would be allowing the production of the plane to slip another 6 months, another year, and we are on a catchup basis right now.

The quicker we can produce the plane after a Concorde or a TU-144 starts to fly, the more of that market we will capture. The fact that we are going to be 3 or 4 years behind doesn't disturb me particularly because many of the foreign airlines have indicated they would prefer to wait for the American SST.

The situation is proven by the fact that American jet planes weren't available for almost 2 years after our competition produced the first jet planes. So the fact that these other planes, SST's, may fly before ours, even 3 or 4 years before ours, doesn't bother me too much, but if we were to slip another year, year and a half, and particularly if we were to lose that team of scientists, that team of engineers, it would be just one tremendous job to reassemble them.

I like to draw a parallel between the construction of this building, for instance. If a contractor is building this building, he organizes a crew, selects the best general superintendent he can, assistant superin-

tendents, foremen, all the way down the line, gets subcontracts and everything else. Then halfway through the job something happens. Maybe it is a strike or maybe the owner runs out of money—but for whatever reason the contractor is told, “Look, we don’t have any more funds. Stop the job.” Then 3 months later—I am not talking about a year or a year and a half later but only 3 months later—if the contractor should be told “OK, we have the money now. Go ahead,” or “The strike is settled. Go ahead,” the momentum needed to get the job rolling again is just beyond belief.

Here in this situation you have an even more intensified picture because these are men that are not easy to come by. Some would be unemployed, and would be easy to come by. But many of them, the best of them, will find something else to do. Trying to reassemble that team and start the program going again would be a giant job and I think it would be very, very costly to the American Government.

#### WORK FORCE REDUCTION RESULTING FROM STOPPAGE OF THE SST

Mr. CONTE. Mr. Secretary, in order to move this along, on pages 12 and 13 you state:

“\* \* \* stoppage of this program by 1978 would result in work force reductions totaling almost a half million persons.”

Secretary VOLPE. That is the total number of people that would not have employment in this industry.

Mr. CONTE. Give us the basis for your estimate. Put it in the record.

Secretary VOLPE. Yes, we can do that. We can do that very easily. (The information follows:)

#### BASIS FOR ESTIMATED WORK FORCE REDUCTION RESULTING FROM STOPPAGE OF THE SST

It has generally been accepted that continuing the SST program will result in employment of 50,000 jobs per year. In addition, the multiplier effect of the SST jobs in related industries results in at least 150,000 jobs affected in the 1980's or 1990's. However, the problem could be much greater than this. The SST's of the future will be the fleet leaders and the country that does not have the fleet lead will also lose sales of subsonic and other aircraft due to the “family of aircraft” concept, as explained in the Secretary's statement.

Accordingly, it is considered likely that, if the SST program is stopped, not only will we lose the 150,000 jobs associated with the SST but also a sizable additional number of jobs associated with subsonic aircraft that will probably go to the country having the fleet lead. But it does not stop here. As has already been shown in the prototype phase, there will be hundreds of million dollars in new facilities purchased throughout the country in order to produce aircraft of the future, such as electron beam welders, new forming equipment, etc. Thus, another new industry that would be affected, the machine tool industry. We could mention other industries such as construction, raw materials, electronics, etc. Consequently, it is our opinion that, in addition to the jobs related to the SST construction, there will be a wide range of additional jobs created in the aircraft and related industries. It is estimated that all of these, when totaled, could affect an estimated 500,000 jobs in this country if we lose the leadership in this most important technical field.

#### CONTRACT OVERRUNS

Mr. CONTE. In view of the precarious financial condition—you touched on this earlier—of so much of the aerospace industry, how can we be sure that we won't need a much more higher level of Federal assistance in this program than was originally anticipated?

Secretary VOLPE. Well, as I tried to explain this morning, I think that we probably have, during the last year and a half, stayed closer to this project than most projects. The fact that we are able to be here today and tell you that we are just at about the same figure we were a year ago and that there has been little change in the picture is an indication of the firmness with which we have grasped the controls here and are overseeing this contract. Also another reason is that the contractors have a great deal to lose if we keep our end of the bargain on time schedules and money. If these are held firm, the contractors start to share 25 cents on the dollar when they start to exceed the contract incentive points. That is an awfully good reason for a contractor to go ahead just as efficiently as he possibly can in order to avoid that additional cost, a part of which he would have to make up.

#### GOVERNMENT SUBSIDIES

Mr. CONTE. One last question, and this is a question that troubles me the most about this whole program. I read and studied everything that I could in regards to the SST. I don't think that there is a black and white area here. I think that there is a gray zone. I think that strong arguments can be made for the program and strong arguments can be made against the program, but in the 12 years I have been in the Congress I have been in the forefront of many a fight against subsidies, farm subsidies, and other subsidies.

You and your team come in here and say that we have been in the aviation field. We have been in the forefront. All of it has been developed thus far through the military, none prior to this by direct appropriations, such as this one. What troubles me is that there are other industries in the United States which have been leaders in their fields and have been in the forefront in the world.

Taking it right back home to my back yard, the United States has been the leader in the transformer and in the heavy transformer field, and right now that field is being threatened by dumping by France, England, Italy, Sweden, and now even Japan, and if something isn't done real soon these companies, General Electric, Westinghouse, and other transformer companies, can't afford any more money in research and development to keep pace with these countries because they can't even sell their transformers to the Federal Government. For instance, TVA has purchased 95 percent of its transformers from offshore. They can't compete with the foreign governments because they have a two-price market, low price market here and a high price market at home. They won't give a license to our corporations to go and sell in their countries so our corporations are at a disadvantage. Why can't we appropriate \$1.3 billion for the transformer industry of the United States in order to stay in the forefront in this field? This bothers me a great deal and this can go on and on and on in many other industries.

Secretary VOLPE. Congressman, let me say that coming from the same State I can certainly appreciate your grave thoughts about keeping Massachusetts employees occupied and working together with employees across the Nation. However, I would say that first of all you have to look at your competition, which is what you just analyzed. Our competition is 100 percent government in England and France, and 100 percent government in the Soviet Union.

Mr. CONTE. Likewise in the transformer industry exactly.

Secretary VOLPE. No; in the transformer industry it is 100 percent private industry.

Mr. CONTE. You are wrong—most of the countries I mentioned own their transformer industries.

Secretary VOLPE. We subsidize to the extent that we do a lot of the purchasing, of course.

Mr. CONTE. I am talking about France. They own their own transformer industry. England owns its own transformer industry. The government does.

Secretary VOLPE. Yes; I am one of those who happens to hope our country won't have to go to nationalization, whether it be railroads or transformers or anything else. I think by building a better mousetrap, or a better transformer, we are going to still be able to compete in the world market.

Now, the fact is that in this particular situation our competition, as you also indicated in the transformer field, is entirely government subsidized. Here at least there is a substantial input on the part of industry which will have spent some \$403 million when this program is over. This will enable us to stay in the market and retain a tremendous number of people employed in an industry where we now have the advantage. We could easily lose this advantage if we do not continue with the technological know-how that has been developed in this country.

If this were just another plane that was going to give us a few jobs that would be one thing, but this is a plane of the future. It is the next generation airplane. I don't hear of any 757's being planned or other planes. I hear of supersonic transports. They are the next generation. And if we don't get into this market, Congressman, we just will be out of the market and our people will just not have jobs.

Mr. CONTE. I can appreciate that, but I don't want to pursue it any further. You didn't answer my question. You didn't answer the question at all. The parallel here is just two straight lines. These people are hurting right now. The transformer industry is hurting. They are not coming to the Government. They want to produce a better transformer. They want to produce a transformer for the seventies and eighties, but they are not coming to the Federal Government and saying "Look, we are up against it. We are hurt by competition. We are hurt by"—these five governments that I have mentioned—"and, therefore, we want the Government to come in and give us \$1 billion to produce this transformer so that we can compete with these foreign countries."

In fact, they get it both ways. They can't even get the Federal Government to buy their own transformers; 95 percent of all the transformers that were bought in the last 5 years by the Federal Government have been bought offshore.

Secretary VOLPE. I think that would perhaps be a good question to ask the Assistant Secretary of Commerce whom you will have on later.

Mr. CONTE. I have a few more when he comes up here. Thank you. Thank you again, Mr. Secretary, and I again want to compliment you for a fine job.

## PRIVATE FINANCING

Mr. McFALL. Mr. Boland.

Mr. BOLAND. Mr. Secretary, what is the net worth of Boeing?

Secretary VOLPE. Net worth of Boeing?

Mr. BOLAND. Yes.

Secretary VOLPE. \$790 million.

Mr. BOLAND. What is the net worth of GE?

Mr. CONTE. You better take every company that are making transformers and put their net worth in there. What is the net worth of Central Transformer in Arkansas?

Mr. BOLAND. What is exciting you?

Mr. CONTE. I can see the argument you are going to make is that they can take care of themselves. There are a lot of small companies that are making transformers that aren't large and much smaller than Boeing.

Mr. BOLAND. I am not talking about transformers.

Mr. CONTE. You are talking about General Electric.

Mr. BOLAND. The question or the information I am looking for is whether or not either one of these companies or any company in America could go ahead with this kind of a program and finance it?

Secretary VOLPE. That is the reason why I believe, Congressman Boland, that President Eisenhower, President Kennedy, President Johnson, and President Nixon have felt it was essential for the Federal Government to go into this program. I think each one of them felt that this was an area that was just too big for any one firm or combination of firms to proceed with alone.

Mr. BOLAND. It has been said that the Federal Government never gets into this kind of proposition, that is, never really subsidized transportation, construction of mechanisms that give us transportation—Ships, for instance. Have we ever been in this area before?

Secretary VOLPE. We have been and are now. One of the reasons we are not the leaders in maritime today is because we allowed the leadership to go elsewhere. I for one would hate to see the leadership in this field go elsewhere. It is now being subsidized by a bill the Congress just passed this last year. And I might say we have done something for the railroads, too.

## AIRPORT NOISE

Mr. BOLAND. Mr. Chairman, I don't want to prolong the questioning of the Secretary. Most of the questions I am interested in will be directed to Mr. Magruder because some of them are technical and some of them are with reference to the program itself.

I would just like one answer to this question, and this is a statement that was raised by Dr. Garwin. Dr. Garwin has gotten more publicity on the SST than I think any other individual in the United States. That is fine. He has taken his position on it and he feels deeply concerned about it. I am delighted we have people with his dedication and with his spirit. I believe his questions ought to have to be answered and I think some of the statements that are made by those who oppose the program and those who favor the program have to be answered, too. I would just like to know from you, Mr. Secretary, or from Mr. Ma-

gruder whether or not this statement is correct because this is a statement which was made last year and it was a statement which got headlines in practically every newspaper around the United States and from many of the columnists who have been covering this very controversial subject, and I quote Dr. Garwin :

It should be emphasized that at 125 PNdB of airport noise the SST will produce as much noise as a simultaneous takeoff of 50 Jumbo Jets satisfying the 108 P&NdB subsonic requirement.

Secretary VOLPE. I will ask Mr. Magruder to give you the answer.

Mr. MAGRUDER. Senator Proxmire and also Senator Magnuson submitted that same question to Dr. Lewis Branscomb, the Director of the Bureau of Standards, as a disinterested source that would provide a technical answer. The answer came back that the 50-to-1 simile is misleading. It is not even the same thing. It is involved in noise, unwanted sound, or what we sometimes call airport noise.

Further, we have already made the point clear that the 50-to-1 comparison and sometimes 100 to 1, was not only misleading; it was scientifically, engineeringly, and technically incorrect. I have pointed that out on numerous occasions. That is the essence of what the Bureau of Standards sent back to Senator Proxmire and it is in the record. Senator Magnuson's letter and the Bureau's response to him was also placed in the record.

Our Noise Advisory Committee, after almost a year's review has publicly stated that the production airplane can and will meet the new noise levels for the subsonic jets of the future. Now, that is not only not 50 times as noisy as the present jet; it is one-half as noisy as the present jet. It is twice as good. And I think Dr. Garwin has done a great disservice to the scientific community by perpetuating that piece of scientific nonsense. I call it "mischief."

Mr. BOLAND. And in your testimony I would like some information on what has been sacrificed to arrive at the reduction of the noise—both airport and community noise. That question has been raised in some articles I have read.

Mr. MAGRUDER. I will get into that.

#### PROTOTYPE COST

Mr. BOLAND. I have here an issue of Common Cause. Incidentally, I am a member of Common Cause. I think it is a great organization and serves a very useful purpose in this Nation. But Common Cause is making this one of its central issues. They are tying on to a cause, of course, which has great popular appeal, and it is possible they might win this one. They have won some. I hope they win a lot in the years to come. And I quote from the Common Cause report, from volume 1, No. 3, February 1971, and the article is "No Need for the SST," and under the paragraph "Why the SST?" it has this statement. I wonder whether or not this statement is correct :

Just to develop one prototype will cost a minimum of \$1.5 billion, of which the U.S. Government will provide \$1.3 billion.

Is that a correct statement ?

Secretary VOLPE. That is absolutely incorrect, Congressman, and let me further add that the Common Cause, if they wanted to get both sides of the story as this committee is attempting to do, would have at

least had the courtesy to call the Department of Transportation. Neither the Under Secretary, the Secretary, or the Director of the Supersonic Transport program, or anybody else that I know of has heard from Common Cause as to our side of the story. I have great respect for John Gardner, but I would hope that they would also get our side of the story so that they could print something that would be a balanced case.

Mr. YATES. Correct for two, not for one.

Mr. BOLAND. Just to develop one prototype.

Secretary VOLPE. What he quoted was one.

Mr. YATES. But it is correct for two.

Mr. BOLAND. But it is not correct for one. I am sure Common Cause under the able direction of John Gardner would not want information put out that is not correct and I thought it would be a nice place to correct it.

Mr. MAGRUDER. I would like to point out also that you used the word "cost" and I think it is very important when you are trying to straighten out the record to keep clear in front of the Congress and the public that this is an investment. It is not a subsidy. We don't plan on failure in the United States any more, I hope. We are going to get the \$1.3 billion investment back.

Mr. BOLAND. Let me continue with just a couple more statements.

Mr. BOW. Mr. Boland, would you yield for just a minute?

Mr. BOLAND. I yield.

Mr. BOW. I would like to make sure we are clear on this now. I am a little confused as to how the record now stands. Is it \$1.3 billion for two prototypes and are they wrong on the one prototype?

Secretary VOLPE. The \$1.3 billion is for two prototypes. That is why I said that the statement was incorrect.

Mr. BOW. Right. Thank you. I just wanted the record to be clear because I was a little confused.

Mr. MINSHALL. I would like to make one statement, if I may.

Mr. Magruder, I have a very high regard for you, sir, but you keep saying that we are going to get this \$1.3 billion back. That is based on the assumption that we can go ahead with the production, which, in turn, assumes that the President and Secretary Volpe won't say it is going to pollute the atmosphere and have other unacceptable side effects?

Mr. MAGRUDER. That is correct, and that is a pretty good assumption. There is not one scientific fact available anywhere in the free world today that says a fleet of SST's is going to pollute anything.

Mr. MINSHALL. That is why we are having this hearing today. There is much controversy over this very question.

Mr. MAGRUDER. I intend to get into that.

Mr. MINSHALL. That is why we are here.

Mr. BOLAND. There are other statements in the Common Cause statement that I would like to pursue with Mr. Magruder when we get through with this testimony. Thank you, Mr. Chairman.

#### LINDBERGH LETTER

Mr. McFALL. Mr. Yates.

Mr. CONTE. Will you yield for one fast observation?

Mr. YATES. I will later, as soon as I get my first question answered. I read the Secretary's statement and on page 3 it sort of dismisses those who are opposed to the SST by talking about charges that it would blot out the sun, melt the icecaps, shatter our eardrums, cause skin cancer, and disturb animal life.

I suppose those of us who are opposed to the program can live with that even though they are not true. Now Mr. Steed comes along and tries to tie those who are opposed to the program into some sort of a Communist movement.

Mr. Secretary, may I read you a letter dated February 3, 1971, saying this:

DEAR CONGRESSMAN YATES: Replying to your letter of January 20, my impression is that the supersonic transport is within the state of the art technically but not economically or environmentally. Seat-mile costs are too high, and the pollution of the upper atmosphere too dangerous on the basis of present knowledge. I believe it would be a mistake to become committed to a multibillion dollar supersonic transport program without reasonable certainty that SST's will be practical economically and acceptable environmentally.

I do not now see any practical way to avoid the disturbance that would be caused by regular sonic booms. As a citizen, I feel we are already subjected to more than enough technological noises, and my vote will be against adding to the present noise level in any unnecessary way. I do not accept as practical or lasting the idea that supersonic transports would be flown at supersonic speeds only over water.

Please accept my apology for the lateness of this reply to your letter. I have been traveling almost constantly, and have been unable to keep in close contact with my mail.

Sincerely,

CHARLES A. LINDBERGH.

Would you consider General Lindbergh to be pro-Communist?

Secretary VOLPE. First of all, I don't believe Congressman Steed indicated that all those opposed were pro-Communist. He indicated that some people may have joined the movement who were pro-Communist, and I do not, as you remember, personally feel that I can point the finger at anyone. There may be some, but I can't point the finger. As I said, I would leave that to the intelligence experts.

Mr. YATES. Well, now, don't you think it unfortunate to even make it a part of this discussion?

Secretary VOLPE. I think that is something you will have to ask the Congressman.

Mr. YATES. Have you any comment to make on Mr. Lindbergh's letter?

Secretary VOLPE. Yes, I do.

Mr. YATES. I would like to have your statement.

Secretary VOLPE. Let me say, as a youngster, I probably thought just as greatly of Charles Lindbergh as any American did because of his great feat. It was the first crossing of the Atlantic. In my mind that letter he has written to you was written with dedication as a great American. However, I have to disagree with him. I believe that there are at this table men who have stayed much, much closer to the present day situation of technology, and environmental concerns, than has Mr. Lindbergh. I still respect him as a great American but I don't believe he has spent the amount of time that these gentlemen have spent on this matter. Although I don't consider myself a technological or environmental expert, I will debate with any American my feeling as to the environment and preservation of the environment.

I feel just as strongly as Mr. Lindbergh does about environment and that is why I want to prove to the American public that we can build these two prototypes and if we find that they are not environmentally acceptable, and that chance is only one in a hundred or less, then I will be the first one to say "Throw the sponge in." I don't look forward to America saying "Throw the sponge in." however.

Mr. YATES. Would your reply be the same if I were to tell you that John Glenn, the astronaut, is opposed to the SST program?

Secretary VOLPE. Yes, it would be.

Mr. YATES. Would your reply be the same if I were to tell you that Walter Schirra, the astronaut, is opposed to the SST program?

Secretary VOLPE. You could go on with other names. I will give you the name of one astronaut who will be before one of your committees in the next few days, Neil Armstrong, who was the first man to set foot on the moon, and he will be testifying in favor of the SST. So, where do you want to get the information? Bill Anders, who was very closely associated with the NASA program, will testify in favor.

It is just a question of whether you want to really get at all the facts, which is all we are trying to say we ought to do. Let's get all the facts and then make the determination, which the Congress is going to have to make.

#### NEIL ARMSTRONG LETTER

Mr. YATES. I am glad you brought up the name of Neil Armstrong. In a letter to Dr. Paine on July 29 he signed a letter in which these phrases appear:

1. The high risk category problems, including engine noise, suppression of sideline noise, actual achievement of specified FAA performance margins, and specified engine durability, excessive structural weight, and certain aerolastic and flutter problems resulting from the use of titanium.

Those are what are included according to Mr. Armstrong's statements to the head of NASA. He goes on to say:

There are aerodynamic, propulsion, structural and operational efficiency factors which must be pushed to the limit to attain the required SST range/payload characteristics.

3. There appears to be little potential for further aerodynamic improvement for the B2707 configuration without a major change in the basic wing fuselage configuration.

4. A major technical effort by Boeing—as well as the NASA—will probably be required to attain the production SST performance goals now projected.

And I intend to ask Mr. Magruder about those when Mr. Magruder is on the stand but I just want you to know the points Mr. Armstrong was making. I will tell you, in all frankness, that I spoke to Mr. Armstrong and was very much impressed with his technical knowledge. I want to ask Mr. Magruder about some of the things he raises.

Secretary VOLPE. May I ask the chairman if it is possible to have the entire letter put in the record?

Mr. McFALL. If you would like to include it, put it in the record at this point.

(The letter follows:)

FEBRUARY 12, 1971.

Mr. G. HOMER SKARIN,  
*Staff Assistant, Subcommittee on HUD-Space-Science, Committee on Appropriations, House of Representatives, Washington, D.C.*

DEAR MR. SKARIN: In response to your request on behalf of Congressman Yates, I am enclosing for your information a copy of a report with attachments, dated July 29, 1970, of Mr. Neil A. Armstrong, NASA's Deputy Associate Administrator (Aeronautics) to NASA Administrator Thomas O. Paine on the U.S. Supersonic Transport Program.

This report was prepared in response to Dr. Paine's request for a technical assessment of the national supersonic transport program by NASA's Office of Advanced Research and Technology. This assessment provided the basis for NASA's letter to the President of July 30, 1970, signed by Deputy Administrator George M. Low, giving NASA's current views on aspects of the supersonic transport program that relate to NASA's responsibilities. We understand that this letter was made public by the White House some time ago. A copy is enclosed for your information.

As indicated in the letter to the President, the successful development of an advanced aeronautical vehicle, such as the SST, normally requires the identification and solution of a number of technical problems in the course of the development program. Mr. Armstrong's report addresses the technical problems as seen at the time of the reviews by his office about seven months ago and does not reflect progress in the SST program since that time.

The Department of Transportation has advised us that significant progress in the last seven months has been realized in certain technical areas as follows:

#### RANGE-PAYLOAD (AERODYNAMICS)

For the production version of the SST, Boeing is considering such aerodynamic improvements as increased strake size and leading edge sweep, increased sweep of outer wing panels, and optimum twist design of the horizontal tail. These configuration changes will make significant aerodynamic improvement in the B2707-300 design.

#### WEIGHT

Some concern has been expressed as to possible engine, wing and vertical tail weight increments and resulting effects on range/payload. More recent data on advanced engine/suppressor combinations indicate that the potential range penalty of 215 nautical miles may be reduced by about 50 percent. Also, wing weight penalties to prevent flutter are being intensively analyzed and for the production aircraft (where a new configuration wing is designed for a considerably higher takeoff weight with the result that the wing is stiffer), it is felt that such added weight will be within present allowances. Likewise, the necessity for a larger vertical tail is not felt to be evident at this time. Flight test with the prototype will be required to validate that the present tail with the automatic flight control system can satisfactorily handle all flight emergencies including double engine failures on one side.

## NOISE

The Boeing Co. is working with the engine company, members of industry and the government on a coordinated aggressive noise technology program. Recent testing has revealed three significant breakthroughs in noise improvement which have dramatically improved the SST noise posture. Actual ground tests on the prototype engine and detailed flight performance analysis have revealed significantly less effective perceived noise than was estimated initially. Wing flap tests in the NASA wind tunnel showed an improvement in lift and a marked reduction in takeoff distance, thereby improving the altitude of the airplane over the community during climb out. Recent tests of advanced suppressors are encouraging in their acoustic and performance characteristics.

The combination of these features, characteristics and suppressor developments will result in achieving a marked reduction in SST engine noise.

Prior to production commitment, the capability of the commercial SST to achieve noise levels consistent with those required for certification of new four-engine, intercontinental subsonic transport aircraft will be demonstrated.

The current DOT review summarized above has also reaffirmed our view that the prototype development and flight program as planned should provide the basis for production of an operational aircraft meeting airline requirements. NASA will continue to conduct technical reviews of the SST program on a periodic basis.

Sincerely yours,

H. DALE GRUBB,  
*Assistant Administrator for Legislative Affairs.*

Original signed by Gerald J. Mossinghoff.



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
WASHINGTON, D.C. 20546

REPLY TO  
ATTN OF

July 29, 1970

MEMORANDUM to: A/Dr. T. O. Paine  
Administrator

From: RD-A/Deputy Associate Administrator (Aeronautics)  
Office of Advanced Research and Technology

Subject: United States Supersonic Transport Program

In response to your request for a technical assessment of the National Supersonic Transport Program, representatives of the OART Centers met on July 27 and 28 to formulate a position paper on the SST. The new position (Attachment 1) is based on, and endorses, our previous position paper of March 24, 1969.

Significant progress has been made during the past year in the areas of inlet design, flight control systems, and fuel tank sealants. A number of items, such as aeroelastic effects, directional stability and control power cannot be adequately assessed until the prototype begins its flight test program. A third group of problems remain in a high risk category for the production airplane irrespective of prototype success. These include performance margins, engine durability, and engine noise. Each of these areas of concern is summarized in Attachment 2. Recommendations for changes in NASA emphasis are included in these summaries.

Observations of the competitive efforts, the Concorde and the TU-144, over the past year, indicate that these programs are proceeding well and are not known to face major technical difficulties. NASA personnel continue to work closely with the Concorde team, exchanging information which would benefit both our programs.

The project organization is not arranged to levy heavy support requirements on NASA, and it is sometimes difficult for NASA personnel to stay close enough to project problems to effectively contribute to their solutions. The OART Centers, however, will continue to make their resources available to the program with priorities consistent with assuring maximum success.

*Neil A. Armstrong*  
Neil A. Armstrong

Attachment 2

FINAL  
July 29, 1970

Attachment 1

NASA Position on the SST Technical Issues

A review of the previous technical assessment of the SST made by NASA in March 1969, together with the results of pertinent research efforts in the intervening period, reaffirms that the definition and resolution of problems associated with the development of this aircraft requires the flight test of a prototype vehicle. The current review also reaffirms that the prototype development and flight program as planned should provide the basis for production of an operational aircraft meeting airline requirements.

With regard to technical problems identified in the review of 1969, progress has been made in several areas including the inlet system, the advanced flight control system and fuel tank sealants. Nevertheless, some problems will not see final resolution until the development and flight test of the prototype aircraft is completed. Such problems include structural weight of the vehicle, efficient solution to the aeroelastic and flutter problems, and the achievement of the necessary levels of aerodynamic and propulsive efficiency, and these must be resolved in an integrated sense without degradation in vehicle performance. There is a problem of developing an efficient long life engine. In addition there is a need to suppress noise, particularly sideline noise, that emanates from the jet exhaust. This latter problem has assumed greater significance during the past year in the light of noise restrictions placed by the Government on the operation of subsonic transport aircraft. The imposition of noise restrictions, depending on their severity, to the operation of supersonic aircraft might require modification of the engine design and its integration into the airframe for the SST production aircraft.

The NASA will continue to make its resources available in support of the SST program to assure the maximum success.

The following personnel participated in the NASA review of the SST program conducted on July 27 and 28, 1970:

Mr. Neil A. Armstrong, Headquarters  
Col. John Coulter, Headquarters  
Mr. Leonard Sternfield, Headquarters  
Mr. Thomas Shillito, Headquarters  
Dr. Leonard Roberts, Ames Research Center  
Mr. J. Lloyd Jones, Ames Research Center  
Mr. William Andrews, Flight Research Center  
Mr. Fitzhugh Fulton, Flight Research Center  
Mr. Lawrence Loffin, Langley Research Center  
Mr. Donald Baals, Langley Research Center  
Mr. Carl Schueller, Lewis Research Center  
Mr. Newell Sanders, Lewis Research Center

The review group's assessment of important technical areas of consideration in the SST program are included in the following summaries.

Range/Payload

Structural and Aeroelastic Considerations

Stability and Control

Jet Noise

Engine Hot Section Durability

Inlet System

Fuel Tank Sealants

Flight Operations

FINAL  
July 29, 1970

Range/Payload Characteristics of the B2707-300

The range and payload of the supersonic transport are vital to the success of the program, for these characteristics govern the operational acceptability, direct operating costs, and economic return on investment. The subsonic competition for the SST is the advanced Boeing 747, Lockheed 1011, and the Douglas DC-10. The payload fraction (ratio of payload to gross weight) for these subsonic transports range from 12 to 15 percent for a typical trans-Atlantic mission. The corresponding payload fraction for the B2707-300 ranges from 6½ percent for the 234-passenger prototype baseline airplane to about 8 percent for a 298-passenger study aircraft. Studies made by Boeing have indicated the economic viability of an 8-percent payload fraction for the SST.

The range/payload characteristics of a transport aircraft are determined by a complex interplay between the basic efficiency factors of the vehicle -- aerodynamic, propulsion, structural and operational. NASA experience with the SST program over the past decade has shown that the technology in these areas must be pushed to the limit to attain the required range/payload characteristics. An assessment of the four basic technology areas relative to the B2707-300 performance is herewith presented.

Aerodynamic: The cruise lift-drag ratio at  $M=2.7$  for the 234-passenger prototype was validated by NASA/DOE at about 7%. The basic configuration chosen by Boeing necessarily represents a compromise between  $M=2.7$  and subsonic cruise efficiency, structural simplicity, and airport performance. For this configuration Boeing has done an excellent job in attaining the current level of cruise efficiency, for they have utilized advanced aerodynamic techniques of area rule, wing warp, fuselage camber, and favorable propulsion pod interference. The utilization of stability augmentation to minimize trim drag at  $M=2.7$  cruise also is an advanced concept. There appears to be little potential for further aerodynamic improvement for the B2707-300 configuration without a major change in the basic wing-fuselage configuration.

Propulsion: The General Electric turbojet engine proposed for the B2707-300 has an over-all propulsive efficiency of approximately 45 percent -- one of the highest of all thermal engines. Cruise efficiency is an overriding consideration in cycle selection, for the aircraft cruise range is directly proportional to the propulsive efficiency. The aircraft "off-design" performance is also an important factor, for only 60 percent of the fuel is burned at  $M=2.7$  cruise conditions. Inlet and exhaust nozzle performance is an integral part of the propulsion system, and any degradation in performance is directly reflected in range/payload.

From a performance standpoint the largest area of uncertainty in the propulsion system is associated with the jet noise suppression devices. Incorporation of multitube suppressors degrades nozzle efficiency and increases propulsion system weight. As noted in the "engine" and "noise" areas, the most effective jet noise suppression system may be an enlarged engine operated at derated take-off conditions.

Weight: The operating empty weight (OEW) reflects the summation of structural, systems, and propulsion weights. The OEW combined with fuel load and payload equals the take-off weight. Any increases in OEW must be reflected in reduced range or payload (for the B2707-300 a 1000 pound increase in OEW = 17 mile range decrement). The basic areas of concern relative to increased OEW are as follows:

(a) Engine weight Development experience with the present prototype engines causes some concern for engine weight. Also noise suppression could add several thousand pounds in additional weight. Boeing estimates a range decrement of 215 N Mi at the present state of noise suppression development.

(b) Wing weight A substantial increase in current wing weight estimates may be required to provide adequate flutter margin at transonic speeds. Wing weight also is critical relative to selection of the form of wing surface panel construction.

(c) Tail weight The present prototype design may have inadequate directional stability at supersonic speeds (outboard engine seized). This may require an enlarged vertical tail with a weight penalty tentatively estimated to be as great as 5000 pounds. Prototype flight tests will determine the necessity for such a modification.

Operational: The basic operational problem affecting range and payload is that of fuel reserves. By present FAR standards the SST carries fuel reserves greater than the payload of the aircraft (e.g., 68,000 pounds compared to a payload of 50,000 to 60,000 pounds). Since this reserve fuel must be carried for the full range, it is equivalent to structural weight or payload. There is not yet adequate SST experience to consider reduction in fuel reserves, but advances in navigation, communication, air traffic control, weather prediction, and operational procedures may provide a basis for future reduction.

#### Performance Projections

Relative to the range/payload performance of the SST, one area of technical concern is the level of performance improvement projected by Boeing in proceeding from the prototype technology to the production aircraft. Boeing projects performance improvements in the areas of aerodynamics, propulsion, structures, and fuel reserves -- along with

a performance decrement due to noise suppression -- such that a range increase of approximately 400 N Mi is anticipated. In one study this performance improvement has been traded for increased payload such that a 298-passenger aircraft projects a range only slightly less than the 234-passenger prototype. It is the 298-passenger version upon which the SST economic projections are largely based. Although Boeing has identified the areas of production technology improvement and is undertaking active programs in the noted areas, the projected production aircraft performance cannot be validated at this time. The level of SST performance projected for the production aircraft is believed attainable, although there may be required substantial change from the prototype design. A major technical effort by Boeing -- as well as the NASA -- will probably be required to attain the production SST performance goals now projected.

### Structural and Aeroelastic Considerations

Because of the relatively long cruise duration of the B 2707-300 at elevated temperatures (350 to 450°F), titanium has been selected for the basic structural material. Operational experience has been established with all-titanium military aircraft (YF-12/SR-71) and with substantial titanium components on operational subsonic commercial aircraft. The basic problem of the titanium structure is the assurance of structural integrity after 50,000 hours of useful life. NASA has effective research programs under way on the mechanical properties of titanium under long-duration thermal cycles, stress corrosion, and fatigue. Results to date substantiate the selection of titanium for application to the supersonic.

A major structural problem of concern relative to the prototype wing design is the attainment of an adequate flutter margin at transonic speeds without a severe weight penalty. Weight increases of 10,000 to 15,000 pounds have been projected for "brute strength" solutions. This structural design problem results from the large lower-surface panel cutouts for the wheel wells. Flutter tests recently conducted at Langley with a Boeing half-span aeroelastic model resulted in a laboratory solution to the flutter problem, but subsequent engineering studies precluded acceptance of this solution. The current analytical and experimental programs under way provide encouragement for an early acceptable solution to the problem of transonic flutter margin.

Flight tests of the prototype will serve to validate the wing flutter design.

There is a current structural design problem associated with the development of wing surface panels relative to wing weight. A recent design change has been made by Boeing to incorporate surface panels of titanium honeycomb core aluminum brazed to titanium face sheets. This recent design change requires assessment of the long-term mechanical properties and fatigue life of such construction in an SST environment. Since the exposed wing surface comprises about 15,000 sq. ft., a change in panel weight of only a fraction of a pound per square foot would be significant. Boeing tests already under way should provide adequate data for prototype construction and for eventual application to the production aircraft.

FINAL  
July 28, 1970

Stability and Control

Relative to current commercial airplane design, the SST mission requirements have dictated the incorporation of unconventional stability, control and augmentation systems concepts. Also recent developmental changes in the airframe and propulsion system have been introduced by Boeing which have had an impact on the over-all stability and control characteristics. The basic control systems and subsequent modifications generated from design change have been periodically assessed by NASA Center representatives and in general are considered to be rational and feasible. However, there are several areas of concern, although not considered to be of a high risk nature, that can only be evaluated and corrected, if necessary, in the prototype test phase.

Initially unforeseen handling or control problems may develop due to the interaction of pilot location (far forward of the center of gravity) and basic airframe aeroelasticity. The influence of this relationship may become evident in regions of turbulence or conditions following an inlet unstart. In addition the long flexible structure of the airplane may effect longitudinal control in the low speed region related to take-off and landing approach. In this regime of the flight envelope, pitch control may present a problem in the rotation for take-off and in the landing flare maneuver. The concern is that of providing adequate control power to precisely

maneuver the large heavy aircraft to a prescribed flight path dictated by noise abatement or general operational procedures. The solution to the potential aeroelastic and limited longitudinal control problems may be relieved with the development of structural mode suppression systems and improved control actuators.

In addition to the above there is concern for the inherent directional stability and damping of the aircraft during periods of critical inlet unstarts and/or engine seizure. Currently it appears that an increase in the vertical tail size may be required to provide the necessary stability when these emergency conditions develop. Recent considerations have been made by Boeing to include a folding ventral fin on the prototype airplane in order that the problem may be fully assessed under real environmental conditions. This approach to the problem solution is considered to be logical and consistent with practices followed during the YF-12/SR-71 development. Results of this evaluation will be available for incorporation in the production airplane design.

In all of the above regions of concern the contractor is well aware of the problems and is working cooperatively with NASA Centers to develop rational and timely solutions prior to freezing the production configurations.

FINAL  
July 28, 1970

Jet Noise

Since the last assessment of the SST, new requirements for engine noise levels have been imposed on certain subsonic airplanes. This complex requirement, which establishes permissible noise levels within the airport and surrounding community, has not yet been applied to the SST. However, the probability of some noise restraints being imposed in the future should not be ignored. Some of the possible implications are discussed below.

The presently planned SST with afterburning turbojets can almost surely meet the new FAA rule of 108 PNdB on take-off at 3.5 miles from brake release and on landing at 1 mile from the approach end of the runway. Modest development of jet noise suppressors and compressor inlet noise suppressors will achieve these goals.

The 1500-foot sideline goal of 108 PNdB cannot be reached with the noise suppressors and operating techniques considered to date. Retractable multi-tube suppressors can hold the sideline noise to 115-116 PNdB (approximately the level of today's large jet transports). An intensive development effort will be required to produce a reliable, workable, durable suppressor within acceptable size, weight, and performance loss limits. Even with intensive development, it is not certain that a suppressor of acceptable performance and durability will be produced.

An alternate chute-type of jet noise suppressor is proposed by General Electric which is much simpler than the multi-tube suppressor.

This simpler suppressor is more likely to have acceptable durability, and acceptable size, weight and performance penalties. However, the expected noise reduction is only 4.5 PNdB and the resulting sideline noise will be 124.5 PNdB.

Continued research may turn up new noise suppression methods that are more effective than the present candidates. However, tremendous research efforts in the last several years have failed to turn up promising new ideas.

Now, oversized dry turbojet engines operating at reduced specific thrust can, without doubt, reduce the sideline noise to 115 or 116 PNdB. These engines will be larger and heavier than the presently planned engine and the aircraft range will suffer; the amount can only be determined from very detailed engine and airplane studies.

FINAL  
July 28, 1970

Engine Hot Section Durability

The hot section is defined as including the primary combustor, turbine, afterburner and exhaust nozzle-noise suppressor.

The operating temperatures of the proposed afterburning turbojet engine are appreciably higher than anything yet experienced in long lifetime commercial operations and thus this area must be considered a risk item. Also, data and experience available from high temperature military engines are not adequate to assure that the desired durability will be attained, particularly in the early history of the program. This uncertainty could be alleviated by better documentation and dissemination of the experience being accumulated on high temperature military engines and such action is recommended. Based on today's experience, it must be anticipated that in the early portions of the program, engine life will be shorter than desired and thus replacement and maintenance costs could be higher than anticipated.

If, after detailed studies, a decision were made to utilize oversize dry turbojet engines, as mentioned in the section on noise assessment, the engine durability problem could be improved considerably. However, this would probably have an adverse effect on airplane performance. The magnitude of such an effect can only be determined by making detailed engine cycle studies in conjunction with aircraft configuration integration studies. The results of these efforts should be considered in the selection of the production engine.

FINAL  
July 28, 1970

### Inlet System

Concern over the SST inlet system was expressed in the review made by NASA in 1969. The sources of concern were the mechanical complexity of the system and the fact that the experimental testing performed in the course of the inlet development was all conducted at small scale. The inlet system probably will be suitable for the prototype, but the concern for mechanical complexity relates to routine service and maintenance in airline operation. Arrangements recently have been made between NASA and Boeing to construct and test a large (1/3-scale) model to obtain more reliable data on which to base prototype performance predictions.

In addition, research studies at Ames and at Boeing have resulted in simplified inlet system designs having improved performance. Included in the joint NASA-Boeing large-scale wind tunnel test program will be tests of a model of the Ames simplified design which is being considered for application to the production airplane and as a back-up design for the prototype. As a result of these planned wind tunnel tests, the design development and preliminary research results, the SST inlet system performance will be on a more sound basis than was foreseen one year ago.

It is recommended that the later stages of the prototype aircraft flight program include tests with one or more engine nacelles modified to incorporate the inlet design planned for the production airplane to obtain experience with the complete inlet-engine-exhaust nozzle combination operating in true flight environment.

FINAL  
July 28, 1970

Fuel Tank Sealants

Historically, in the development of previous supersonic aircraft, problems have been encountered in the sealing of fuel tanks because of the more severe thermal and mechanical cycling. With regard to the effective sealing of fuel tanks for the SST there are under development materials that appear operable for 5,000 hours that can be used on the prototype aircraft. For the longer period required by the production airplane (50,000 hours) no materials have yet been developed which can sustain the thermal cycling and mechanical flexing; however, work is progressing in the development and selection of elastomeric materials (at Ames Research Center and at Marshall Space Flight Center) aimed at meeting the SST requirements. The extent to which these requirements will be met must await the results of test programs to be conducted during the next year. While there is continued concern, it is expected that progress will be made toward the development and qualification of appropriate sealant materials for the SST fuel tanks.

FINAL  
July 28, 1970

### Flight Operations

Within the present framework of planned flight operations there are no known problem areas that would prevent an orderly progression into SST prototype and production programs.

#### (1) Sonic Boom

Sonic boom research is continuing but there is no reason to expect any major breakthrough in the immediate future that would make commercial flights overland acceptable. Operational and flight test experience of the USAF and the NASA in B-58, B-70, YF-12 and SR-71 airplanes indicate that flight testing of the SST can be conducted over remote land areas of the U. S. without undue objections from the overflown areas. Utilizing certain operational procedures during accelerations, decelerations, and supersonic turns can assist in minimizing the sonic boom but won't eliminate it.

#### (2) Wake Turbulence

The high-energy vortex generated by the SST wing during all phases of flight is expected to be hazardous to other airplanes. Experience has shown the hazard to exist behind the B-70, C-5, Boeing 747, and other large airplanes. The vortex energy of the SST is expected to be of the same magnitude as that behind the C-5 or the 747. Therefore, compliance with the same FAA operational procedures which require a certain spacing behind the C-5 or 747 should provide adequate safety behind the SST.

### (3) Pilot Requirements

Take-off and landing speeds of the SST are expected to be less than in B-70, YF-12 and B-58 airplanes, therefore, except for the higher acceleration rates on take-off, the problems experienced in that phase of flight should not be greatly different than present commercial jets. The C-5 and 747 airplanes both have the pilot seated some distance above the ground at touchdown. No special problems have been experienced by pilots during transition to these airplanes. Therefore, the problem of adjusting to the height above the runway will be minor and probably similar to the C-5 and 747. NASA pilots who have flown the B-70, YF-12 and B-58 airplanes feel that some special supersonic training will be required for SST pilots. A large portion of the training can be done in ground simulators. The USAF successfully trained a variety of pilots into the YF-12 and SR-71 airplanes. These pilots ranged all the way from experienced supersonic pilots to pilots with virtually no supersonic experience. The conclusion is that good, highly trained pilots will be required to fly the SST but these pilots will not be required to have extraordinary piloting skills.

### (4) YF-12A Operational Experience

The YF-12A is not an SST but it has been surprisingly operational for a prototype airplane. The two YF-12A airplanes had been laid up for two years, but after extensive maintenance and instrumentation work were both flown to Mach 3.0 on their first flights after lay-up. Until its recent scheduled instrumentation lay-up, the NASA YF-12A had excellent reliability in meeting the planned schedule.

## SAMUELSON STATEMENT

Mr. YATES. All right. I will give it to you as soon as I finish my examination.

Mr. Secretary, let me go to the subject of profits and balance of payments, all of which are discussed in your principal statement. One of your neighbors in Massachusetts is a very eminent economist, Prof. Paul Samuelson of MIT, who I am sure you know. Professor Samuelson had this to say about the SST. He said:

The economic case for the SST is so weak, and the economic arguments against it are so strong, that only one conclusion is warranted:

The U.S. Government should immediately cut back on its SST program, cutting our losses and making whatever compensation payments are legally due and are equitable to those corporations and laborers in the aircraft industry who will be hurt by this decision.

Until one has read the arguments that the Boeing Co. tries to make for the SST, one does not realize how very weak indeed is the case for it. The fact that private enterprise in our huge financial markets will not touch the project without having Government advance the preponderance of all the money involved and having Government take on its shoulders the bulk of all the risk is itself a warning that the project is an uneconomical one—and only if the strongest possible case is made in terms of public interest could one even pay any attention to the proposal.

And I will put this in the record. It is not too long. I just want to quote from the last paragraph:

No one has the wisdom now to be doing detailed planning for 1984, or 1988 or 1990. Any rational calculation shows that no committee of reasonable men can expect with reasonable assurance the 300-500 SST's will be sold that would have to be sold if the SST is not to go down as one of the worst scandals in American history. Congress should act immediately to end what must be regarded as an economic fiasco.

(The statement follows:)

## STATEMENT ON THE ECONOMICS OF THE SST

(By Paul Samuelson)

The economic case for the SST is so weak, and the economic arguments against it are so strong, that only one conclusion is warranted:

The U.S. government should immediately cut back on its SST program, cutting our losses and making whatever compensation payments are legally due and are equitable to those corporations and laborers in the aircraft industry who will be hurt by this decision.

Until one has read the arguments that the Boeing Co. tries to make for the SST, one does not realize how very weak indeed is the case for it. The fact that private enterprise in our huge financial markets will not touch the project without having government advance the preponderance of all the money involved and having government take on its shoulders the bulk of all the risks is itself a warning that the project is an uneconomical one—and only if the strongest possible case is made in terms of public interest could one even pay any attention to the proposal.

Even if the SST had no adverse effects upon the environment, in the form of supersonic booms and contamination of the atmosphere, it would be an economic and a political disaster. The strongest economic argument that the Boeing Co. can put forward for it is that from 1978 to 1990 it may add substantial sums to the export side of our balance of payments. The strongest political argument that they can make for it is that it will make jobs. Any way that the U.S. Government or anyone else spends a billion dollars on goods will make a billion dollars worth of jobs, and it would be a return to the outmoded depression philosophy of makework—in which men are hired to do useless things like digging holes and filling them up again in order to increase jobs and purchasing power—if we were to succumb to the makes-jobs argument.

As for the balance-of-payments argument, what we need are efficient exports that can pay their way—including paying their way in terms of providing their needed capital and the risk-taking inherent to sound projects—not contrived, subsidized additions to our balance of payments. If the Government is foolish enough to want to spend \$1.2 billion subsidizing uneconomic exports, it can get much better value for its money than by buying a lottery ticket toward what may improve our balance of payments by 1978 to 1990. By such a date, our balance of payments may be in any shape, be in surplus where further exports would be the worst thing in the world rather than a benefit. No one has the wisdom now to be doing detailed planning for 1984, or 1978 or 1990. Any rational calculation shows that no committee of reasonable men can expect with reasonable assurance the 300-500 SST's will be sold that would have to be sold if the SST is not to go down as one of the worst scandals in American history. Congress should act immediately to end what must be regarded as an economic fiasco.

QUOTE FROM SAMUELSON'S "ECONOMICS"

Mr. YATES. You want to comment on that, Mr. Secretary?

Secretary VOLPE. If I may, Congressman. First of all, Mr. Samuelson has never asked for any of our studies that would give him information about the economics of the SST.

Secondly, Mr. McCracken is the man responsible in this administration, as Chairman of the Council of Economic Advisers, for staying in close touch with this situation. You have heard parts of his letter. The entire letter is made available for the record. But I would like to also read you something else by Professor Samuelson in which he said:

We can begin with the least controversial measure aimed at enhancing growth. All agree that expanded research—in pure science, applied science, development and engineering, administration and management, city planning—can pay high social dividends in terms of productivity. As was discussed on page 724, it has not been increased capital and labor so much as increased technical productivity that has been responsible for the historically achieved rates of growth. Having more people and more machines of the 17th century variety would not be likely to take us far beyond the standards of living of the Mayflower Pilgrims. Obviously, better machines—not simply new machines—are needed for progress.

I could go on to read.

(The complete article is as follows:)

QUOTE FROM PAUL A. SAMUELSON'S "ECONOMICS," EIGHTH EDITION, 1970, McGRAW-HILL PUBLISHING CO., PAGES 799-800

EXPANDED PRIVATE AND PUBLIC RESEARCH

We can begin with the least controversial measure aimed at enhancing growth. All agree that expanded research—in pure science, applied science, development and engineering, administration and management, city planning—can pay high social dividends in terms of productivity. As was discussed on page 724, it has not been increased capital and labor so much as increased technical productivity that has been responsible for the historically achieved rates of growth. Having more people and more machines of the 17th century variety would not be likely to take us far beyond the standards of living of the Mayflower Pilgrims. Obviously better machines—not simply new machines—are needed for progress.

Business firms do much research and can be urged to do more. However, there is no reason to think that management is so stupid as not to see for itself how much research is likely to be profitable to it; so unless some new public policies on research are added, we are unlikely to achieve greater progress here than is already the case.

This is where the Government comes in. Since 1940 the Government has been directly and indirectly supporting much of the scientific research done in this

country. It could expand the level of its support. But how can nonmilitary research be justified as a legitimate function of Government?

Recall from chapter 8 that there is a prima facie case for public intervention whenever there are such economic "externalities" present as to make it unlikely that each entrepreneur, as he reckons his private benefit and costs in money, will thereby be truly reflecting the benefits and costs to society as a whole. Smoke nuisance was an example of an external diseconomy calling for public action. Similarly, research is an example of an "external economy" calling for public action, as the following soliloquy shows:

When I, as a prudent businessman, balance the dollar cost to me of an extra unit of research with the benefit that it can bring me, I shall realize that most of the results of my research will soon—or in the case of patents, eventually—serve to benefit all other producers in my industry and in society generally. The benefit to society as a whole, then, is likely to be much greater than to me: so I shall not be motivated to do all the research that society needs. Because of this externality, the Government has a reason to subsidize research—by direct grants to universities, firms, and its own laboratories and by favorable tax treatment of research.

We can therefore deduce this corollary.

The single least controversial measure for inducing greater growth is promotion and subsidy of more research and development.

Mr. YATES. Costs that relate to the SST or is this just a general statement?

Secretary VOLPE. Yes.

Mr. YATES. Has he said this in connection with the SST?

Secretary VOLPE. It was in connection with technical productivity overall that he was talking about from the comments that I just read, sir.

Mr. YATES. It did not relate specifically to the SST.

Secretary VOLPE. I don't believe so.

#### LETTER BY MERTON J. PECK

Mr. YATES. May I read to you, Mr. Secretary, from a letter by Merton J. Peck, chairman of the Department of Economics of Yale University, an expert on economics of compensation in the transportation industry, and a former member of the Council of Economic Advisors.

The Boeing Co.'s January press release suggests what is wrong with the SST proposals. The SST advocates have chosen the wrong forum. They should be pressing their case with investors rather than with Congressmen. The press release says the proposal "is not a subsidy, it is an investment in the future."

This is Mr. Magruder's phrase as well.

And the Government's \$1.2 billion will be repaid in full by the time the 300 SST's are sold, and when 500 SST's are sold, the Government will be paid an additional return of \$1 billion on its investment. Thus the SST appears to promise \$2 back for every dollar invested, a deal that should arouse dramatic interest in the investment community.

Why doesn't it? The press release says only this:

This is a lot of money. No private company has the financial reserves for such a commitment. Yet many big companies are involved in the SST program and the automobile industry has really managed to privately finance \$500 million each year for its model changes, whereas the SST \$1.5 billion prototype program runs for several years. Surely what is suggested as a very profitable investment ought to be able to find private finances. There may be another reason that the SST cannot be privately financed. The high returns are subject to very high risk, so much so the investment community is not interested.

We ought to insist that Congressmen be just as tough-minded with our tax dollars as investors are with their own. If such a standard prevailed, there would be no need for lobbying. SST advocates could make their case to the investors. If the case were a convincing one, the money would be forthcoming. If it were not, the SST would not be built. This is the free enterprise rule that is applied to other marvels of modern technology from new computers to new chemical processes. I find no reason why SST's should be made an exception. All the standard arguments, employment, balance of payments, and so forth could equally justify public investment in other industries, indeed often with less harmful environmental effects, and with more positive economic gain.

Would you like to comment on that, Mr. Secretary?

Secretary VOLPE. No. I think you have a few letters there to read, Congressman.

Mr. YATES. I didn't intend to read them all, Mr. Secretary.

Secretary VOLPE. Let me say I thought Mr. Magruder answered that very clearly this morning.

Mr. YATES. I thought you would be particularly interested in the two that I read. I won't read the rest. I will just put them in the record if I may.

(The information follows:)

#### ECONOMICS OF THE SST

(By Merton J. Peck)

The Boeing Co.'s January press release suggests what's wrong with the SST proposals. The SST advocates have chosen the wrong forum: they should be pressing their case with investors rather than with Congressmen.

The press release says the proposal "is not a subsidy. It is an investment in the future," and the government's \$1.2 billion will be "repaid in full by the time the 300th SST is sold and when 500 SST's are sold the Government will be repaid an additional return of \$1 billion on its investment." Thus the SST appears to promise \$2 back for every dollar invested, a deal that should arouse dramatic interest in the investment community. Why doesn't it?

The press release says only "This is a lot of money. No private company has the financial reserves for such a commitment." Yet many big companies are involved in the SST program and the automobile industry has regularly managed to privately finance \$500 million each year for its model changes, whereas the SST \$1.5 billion prototype program runs for several years. Surely what is suggested as a very profitable investment ought also to be able to find private finance.

There may be, however, another reason the SST cannot be privately financed. The high returns are subject to very high risk—so much so that the investment community is not interested. We ought to insist that Congressmen be just as tough minded with our tax dollars as investors are with their own. If such a standard prevailed, there would be no need for lobbying; SST advocates could make their case to the investors. If the case were a convincing one, the money would be forthcoming. If it were not, the SST would not be built. This is the free enterprise rule that is applied to other marvels of modern technology from new computers to new chemical processes. I find no reason why SST should be made an exception. All the standard arguments—employment, balance of payments, and so forth—could equally justify public investments in other industries, indeed, often with less harmful environmental effects and with more positive economic gain.

Mr. Bow. Would the gentleman yield to me?

Mr. YATES. I would be delighted to yield.

Mr. Bow. It seems to me, Mr. Chairman, we could read letters all day long and get them on both sides of this question from eminent people in the country.

Mr. YATES. Right.

Mr. Bow. But we have no opportunity, those of us who favor this prototype program, to cross-examine these witnesses, to find out what their qualifications are.

Mr. YATES. I told you what his qualifications were.

Mr. Bow. This is not enough just to say that this man is a professor at Yale. I have known some Yale professors that many times I didn't pay too much attention to, but it just seems to me that the reading of letters is not solid evidence. What we should do is have these people before us.

Mr. YATES. Let me say to the gentleman that I called Professor Samuelson. Unfortunately he is busy with his classes at MIT and he couldn't come here.

Mr. Bow. The fact remains—

Mr. YATES. I decline to yield further. You will have your own time. The point I want to make is that one doesn't question credentials like Professor Samuelson's.

Mr. Bow. I do.

Mr. YATES. I know you do, but that doesn't mean that your criticism is justified. And I don't have to defend Professor Samuelson. Professor Samuelson has just won the Nobel Prize for economics, which I submit is a pretty good credential. Professor Peck is the head of the Economics Department for Yale University, which is a very good credential. Apparently, they're not the professors you know.

#### INTERNATIONAL AIR TRAVEL

Now I will go on to another point. Mr. Secretary, in your statement you talk about the opportunities that youth will have to ride the SST. Do you remember that statement?

Secretary VOLPE. Yes; I do, sir.

Mr. YATES. Have you seen the poll on the Nation's youth?

Secretary VOLPE. Oh, yes; I have seen it.

Mr. YATES. "The SST has little support among U.S. college students".

Mr. VOLPE. Yes; I have seen it. I am not at all surprised either. They have had a pretty one-sided story to look at. If I were a private citizen out there, Congressman, I think I would probably be against the SST myself, as a result of what I have read in the news media.

Mr. YATES. I think that would be true, Mr. Secretary. I think you are a pretty good man. I think you are bound by the affairs of your office.

Secretary VOLPE. No; I am not bound by that. I am bound by my own conscience in this particular situation. I am just trying to indicate that I don't believe the American public has had the full story on this question, and that is what I congratulated the committee this morning on opening this to public hearings.

Mr. YATES. I certainly tried to give it to them in the past, Mr. Secretary. You know how detailed our examination was.

Mr. Secretary, is the SST intended for domestic travel?

Secretary VOLPE. Not at boom-producing speeds—I have said this over and over again. I said it at the hearing last year. I am quite

sure you will also recall, Congressman, that for the first 5 or 6 years of production of the SST, they could not meet the no-boom policy and would be limited to transoceanic travel alone. If and when at the end of that period, in the second or third generation SST's, assuming the sonic boom has been eliminated, you might fly supersonically overland.

That is a determination that will be made by my successors. You will probably still be here, Congressman Yates.

Mr. YATES. Mr. Secretary, I hope you will be here, too.

Secretary VOLPE. You are very kind.

Mr. YATES. But the answer to my question is, "No," it is not intended for domestic travel, is that correct?

Secretary VOLPE. No, not at the present time.

Mr. YATES. What do you mean by "not at the present time"?

Secretary VOLPE. For the foreseeable future.

Mr. YATES. As long as it projects a sonic boom, it will not fly over land, is that correct?

Secretary VOLPE. That is right.

Mr. YATES. So that we can say that it is intended for international travel over water.

Secretary VOLPE. That is correct, for at least the first 5 or 6 years that it is produced.

Mr. YATES. How many people will be using the SST? I had occasion to check the CAB for international travel statistics for the year 1969. First class revenue passenger miles amounting to 2.5 billion were first class; coach and economy revenue passenger miles amounted for 20.2 billion; where flown, nonscheduled revenue passenger miles amounted for 10.5 billion miles; supplemental revenue passenger miles the figure is 9.6 million, so there are approximately 40 billion revenue passenger miles being flown for nonfirst class passenger, 40 billion as opposed to two billion first class. Who is going to ride the SST? Are there going to be coach fares for the SST, and will they be the same fares that people can have in the 747?

Secretary VOLPE. I envision that by the time the American SST gets on the market, it will probably have two classes of service. I envision that when the Concorde gets on the market, it will probably have only one class of service. I would envision by the time that our plane gets on the market, that it probably will have two types of passengers.

Mr. YATES. Is a surcharge contemplated for the SST fare?

Secretary VOLPE. Mr. Magruder has already testified that for a relatively short period, as was true in the original jets, there probably would be a surcharge, until the obsolescence of the other planes took place.

#### GOVERNMENT SUPPORT FOR PRODUCTION

Mr. YATES. Mr. Secretary, we have here the statement, a letter by Paul McCracken dated February 26, which starts out by saying:

The purpose of this letter is to pass along to you the Council's assessment of economic considerations pertinent to the issue of continuing with the completion and testing of the two prototype SST planes.

Is Mr. McCracken coming before this committee so we can cross-examine him?

Secretary VOLPE: No; he is not.

Mr. YATES. When Mr. McCracken says that this represents the Council's assessment, does that include the view of Dr. Houthaker?

Secretary VOLPE. I concluded it recommends the majority opinion of the Council of Economic Advisors. I am not aware of each individual's position.

Mr. YATES. You know that Dr. Houthaker in the Cabinet committee report expressed his opinion as being that the SST would be a white elephant.

Secretary VOLPE. What Dr. Houthaker might have said a year and a half or 2 years ago, which was also expressed in some letters that we have spoken about today, Congressman, may not be the same as his thinking today. I know my thinking today is quite different in some aspects than when I first arrived in Washington in January of 1969. If we don't learn something every day, I think that there is something wrong with us.

Mr. YATES. Well, then there is hope for you to turn around on this thing.

Secretary VOLPE. I will get progressively tougher, if I may, Congressman.

Mr. YATES. I am told that in a letter dated July 1970. Dr. McCracken—and I ask you this question because you say Dr. McCracken isn't coming before the committee—stated that the Government should not provide funds for the SST after the prototype stage. Do you know whether that is true or not?

Secretary VOLPE. I am not sure.

Mr. YATES. I am told that that is what he said and I don't want to say that he said it. Does Mr. Beggs know if this is true?

Mr. BEGGS. I don't know, Mr. Yates.

#### FULL TEXT OF DR. MCCrackEN'S MEMORANDUM

Mr. YATES. Can you find out from Dr. McCracken whether or not he did?

Mr. BEGGS. Surely.

Secretary VOLPE. Yes, certainly we can.

(The information follows:)

#### MEMORANDUM FOR THE PRESIDENT

THE CHAIRMAN OF THE COUNCIL OF ECONOMIC ADVISERS,  
Washington, D.C., July 31, 1970.

Subject: The SST Program.

Economic considerations point strongly in the direction of continuing the SST program through the production of a prototype. The probability of ultimate economic success for the plane is high enough to warrant carrying the project through to that stage and canceling the SST project now would prematurely close off our options. The adverse implications of thus terminating the project, given a significant probability that the plane will be an economic success, would constitute an excessive risk for the Nation and the economy.

The economic considerations pertaining to this decision have to do with the external payments position and also the domestic economy. As for the balance-of-payments issue, the absence of an SST, if an economically viable Concorde materializes, would reduce the competitive strength of our own aircraft industry. At the present time U.S. manufactured planes have about 84 percent of the free world market. If the Concorde were successful and we have a successful SST, our own share of the world market might drop to something like 79

percent by 1990. Without an American SST, however, we might lose at least another 10 percentage points of the world market by that year if the Concorde project is a success.

Beyond the direct impact of aircraft sales on our external payments position one must also evaluate secondary implications for our external payments. The advent of more rapid travel probably would have some adverse net effect on tourist expenditures abroad. This would occur, however, if the Concorde project is successful even without an American SST. On balance, therefore, a decision to terminate the project now would carry with it a significant risk that our balance-of-payments position would thereby be adversely affected when this generation of aircraft matures into the market.

As a general rule, of course, specific program decisions should not be undertaken or avoided merely because of their effect on our balance of payments. Moreover, it is important to bear in mind that the impact of this program on our international payments position would not in any case show up for a decade. At the same time the implications of this decision for our balance-of-payments position must be recognized even at this early stage, and they point in the direction of a favorable decision on continuing into the prototype stage.

As for the domestic economy, canceling the SST project at this date would apparently lead to a layoff of approximately 5,000 engineers and skilled workers. Most of these are employed in Seattle and the layoff would aggravate an already difficult unemployment situation. It would add, to be specific, roughly 0.5 percent to the 8.8-percent unemployment rate (in May) in Seattle, and there would be adverse secondary repercussions elsewhere. Moreover, it would adversely affect the future strength of the aircraft industry, which has been an important segment of our domestic economy.

It should be stated, incidentally, that continuing the SST should not be supported as a means to assure reasonably full employment. By the middle of this decade (when the project, in any case, would begin to employ large numbers of skilled workers), the attainment of reasonably full employment can be achieved in other ways.

In our planning for this project we should insist that the certification and production stages be financed by private industry. If private industry is not willing to support production after the prototype is built, such disinclination would raise a serious question as to whether the project was economically feasible.

PAUL W. MCCrackEN.

Mr. YATES. As of this morning, Mr. Secretary, I understood you to say that it was not your intention that the Government request funds for underwriting any stage of the SST beyond the prototype state. Is this correct?

Secretary VOLPE. Given a healthy airline industry, given a healthy economy, and the production of the kind of a plane which I am sure we are going to produce, there would be no need for any Government money beyond the prototype phase.

Mr. YATES. Does this mean that you would oppose the Government providing any money for construction of the production phase of the SST?

Secretary VOLPE. I would not try to determine what my judgment would be 8 years from now, Congressman.

Mr. YATES. So that there is a possibility that later on you may find the Government asking for such funds.

Secretary VOLPE. I won't be here 8 years from now, Congressman.

Mr. YATES. You may be, maybe not in this—

Secretary VOLPE. I know I won't be here 8 years from now.

Mr. YATES. I think, Mr. Secretary, that is the Government's loss.

Mr. BOLAND. I think he is right too.

Mr. YATES. I do too, except the Democrats are known to be bipartisan.

May I ask the Secretary whether he agrees with what Mr. Beggs said to Senator Proxmire's committee on the economic analysis and the efficiency of Government, in the hearings on the SST, May 7, 11, and 12, 1970? At that time Mr. Beggs indicated, in response to this question:

Chairman PROXMIRE. Let me ask you point blank, Will you or will you not give me assurance the Government will not go ahead with financing part of phase 4 and 5?

Mr. BEGGS. Mr. Chairman, I am on record as I think Mr. Yates stated in the Appropriations Committee with the statement that while I was of the opinion that private financing would be available if it were not at that time and if we felt we had a successful SST program on our hands, that is a successful transport after the prototype testing, and it required some Government-guaranteed loans, then I would think that we would so recommend.

Is that a correct quote, Mr. Beggs?

Mr. BEGGS. That is correct.

Mr. YATES. Do you agree with that, Mr. Secretary?

Secretary VOLPE. I don't know if I will be here or Mr. Beggs will be here when that decision is made, and so I don't know that it is of very much consequence. I would agree with it, with the provisos that I added, and those provisos are such that you and I have got to figure whether this country is going to, either under Democratic or Republican administration, just continue to stand still or go down hill. I am one American who doesn't believe that.

#### PRODUCTION DECISION

Mr. YATES. I have one more question, Mr. Secretary, in Mr. Magruder's statement, and I will ask him about this too, I think this is a question of policy that is more properly addressed to you though, Mr. Magruder says this:

There will be no commitment to production unless the airplane is economically viable and will have been shown not to be harmful to the environment.

Who makes that determination, first that the airplane is economically viable and second, that it will not be harmful to the environment?

Secretary VOLPE. We have a variety of environmental committees, not just the Secretary's judgment, my Under Secretary's judgment, or Bill Magruder's judgment. We have a number of these committees, some of whom are made up of people in Government, some of whom are made up of people from outside of Government, and some of whom are consultants, who have been advising us and will continue to advise us. These are not questions that one person alone is going to make a judgment on, and say, "Ah, I have got the answer."

Mr. YATES. Is this the President's decision or is it your decision?

Secretary VOLPE. What I am saying now?

Mr. YATES. As I understand what you have told me is that you have a number of committees whose recommendations will be requested. Those committees will report to, I assume, the then Secretary of Transportation. Will the Secretary of Transportation then report to the President, and will it be his decision as to whether to go ahead with the production model?

Secretary VOLPE. It will neither be this Secretary of Transportation or any other Secretary of Transportation that will make that decision.

It will be the Environmental Protection Agency, in accordance with the act that the Congress passed that will make that judgment. You will have him as a witness, I think, later this afternoon.

Mr. YATES. Does that committee make a judgment on whether or not the plane is economically viable?

Secretary VOLPE. Only environmentally.

Mr. YATES. I asked you two questions.

Secretary VOLPE. In the final analysis, the airlines will make the judgment as to whether or not it is economically viable.

Mr. YATES. But, Mr. Secretary, somebody has to decide that the plane is economically viable in order to go into the production phase.

Secretary VOLPE. Yes.

Mr. YATES. As I understand it, the airlines do not make that decision at that point.

Secretary VOLPE. If I were in this same position at the time this decision has to be made, I would certainly feel it a part of my obligation to find out how many firm orders there were for the production of planes. If I found out that all they had was six orders, I certainly would not be saying, "OK, let's go ahead with the production of the plane," because in that case it would require Government financing. There is no question about it.

If there were orders for 200 or 300 of them available, then, of course, commercial and private enterprise would support the production of the plane, so therefore there would be no question.

Mr. YATES. My question is only this: Who has that decision, to decide whether you go ahead into phase 4?

Secretary VOLPE. The marketplace, I would say, Mr. Congressman.

Mr. YATES. Only the marketplace has that decision? You mean that there is no official in Government at that point who has anything to do with the movement of the SST into phase 4?

Secretary VOLPE. Only if it requires additional Government financing would the Government get into it.

Mr. YATES. Are you saying that the SST administration would end with the end of the prototype phase?

Secretary VOLPE. Yes. Of course, it would have to be certified by the Federal Aviation Administration as an airworthy plane and probably cleared by the Environmental Protection Agency, and from then on it is a private enterprise proposition.

Mr. YATES. So that at the end of the prototype phase, Mr. Magruder's job folds up as the representative of Government; is that right? Is that what you are saying?

Secretary VOLPE. Yes.

Mr. MAGRUDER. That is when I would leave also, Mr. Yates.

Mr. YATES. Well, we will hate to see you go too, Mr. Magruder. And the President has no decision at that point either. In order words, at that point you have two prototypes, which are shown to the airlines of America and of the world, to let them decide whether or not to go into phase 4 and phase 5. This is what you are saying?

Secretary VOLPE. I think I have answered it two or three different ways, Congressman.

Mr. YATES. But isn't that what you are saying really?

Secretary VOLPE. I didn't say it exactly the way you have just put it. We would get into it at that time only if we believed that it was

essential for the Government to stay in it. I don't see the Government staying in it at this time. I am trying to look down the road as far as I can, and I believe that if we produce the kind of a plane we have talked about the Government won't have to stay in it at all.

Mr. YATES. At that point does Congress have anything to say about whether or not the SST goes into production?

Secretary VOLPE. Only if Government funds are required. I am sure Congress will have a great deal to say about it.

Mr. YATES. And if Government funds are required, it will be necessary, for the SST, to obtain congressional authority to proceed with phases 4 and 5?

Secretary VOLPE. Yes, to the extent this would involve Government funding of anything beyond developmental work, testing or the acquisition of experimental aircraft.

Mr. YATES. That is all the questions I have.

Mr. McFALL. Thank you, Mr. Yates.

#### PRIVATE FINANCING

Mr. CONTE. Could I ask one short question?

Mr. McFALL. One short question.

Mr. CONTE. I want the record to show that the point was made in regard to Boeing's net worth and General Electric's net worth. Could you give us that again, Mr. Secretary?

Secretary VOLPE. The Boeing net worth was \$790 million and General Electric we didn't have for sure, but it runs into several billions of dollars.

Mr. CONTE. How much have you paid General Electric thus far for the development of its engines? How much will you pay them altogether?

Secretary VOLPE. \$375 million approximately when it is all done, and about \$280 million to date.

Mr. YATES. Mr. Chairman, I asked Mr. Beggs this morning as to why he gave the answer to this committee that it would have cost private industry approximately \$300 million more to build the prototypes than it will the Government. That is correct, isn't it, Mr. Beggs?

Mr. BEGGS. I believe, Mr. Yates, that my answer was in response to the assumption that you would enter the market and borrow the money, in which case it would cost you perhaps one or two points more in interest than that rate which is available to the Government. In addition to that, of course, you would not have—it would be a higher risk kind of a proposition in that you would not have—the Government guaranteeing the development program, and that too would add to the cost. Our estimates were that that would be several hundred million dollars more expensive.

Mr. YATES. Thank you, Mr. Chairman.

Mr. McFALL. Thank you, Mr. Secretary. You have done an excellent job here before the committee today. We will now go to Mr. Magruder's testimony next. I think probably you would want to be excused, Mr. Secretary, would you not?

Secretary VOLPE. If I may, yes, Mr. Chairman and members of the committee. However, may I suggest, because of the fact that we have two or three other witnesses here, Mr. McLellan, the Assistant Secre-

tary for Domestic and International Business of the Department of Commerce is here to present Secretary Stans' statements. Bill Magruder will be here for the full 3 days I am sure, and will be available for the committee at any time you want him. However, if you desire to hear from him now, Mr. Ruckelshaus also of the Environmental Protection Agency is here. If you desire, we would like to put those two on, and then you can start on Bill Magruder and have him on as long as you want. We will be guided by your preference, of course.

Mr. McFALL. Do you desire to leave at this time, prior to the beginning of that testimony.

Secretary VOLPE. I beg your pardon, sir.

Mr. McFALL. Would you yourself desire to leave at this time?

Secretary VOLPE. Yes, if I may.

Mr. McFALL. Suppose we have a 5-minute break, and we will come back and hear Mr. McLellan and Mr. Ruckelshaus, and then go to Mr. Magruder who has a very long and detailed statement. We will have a 5-minute break.

Secretary VOLPE. May I thank the committee, Mr. Chairman, for their very attentive courtesies.

(Short recess.)

#### STATEMENT OF THE DEPARTMENT OF COMMERCE

Mr. McFALL. The committee will come to order. The next witness before the committee is Mr. Robert L. McLellan, the Assistant Secretary for Domestic and International Business of the Department of Commerce, who will present the statement of Secretary Stans.

Mr. McLellan, we welcome you before the committee and we will be glad to have your statement at this time.

Mr. McLELLAN. Thank you, Mr. Chairman. I am pleased to be here. I have a couple of qualifications. I don't have an "L" in my name. That was incorrectly printed in the Department of Commerce's register 3 months ago and I have been known as Robert L. McLellan ever since.

I wouldn't worry about it except when I come back 20 years from now to get my retirement they will say, "No, it is somebody else."

Mr. BOLAND. As long as it is you yourself who knows it, that is OK.

Mr. McLELLAN. The second comment, while I am here taking Secretary Stans' place, this is my statement on behalf of the Department of Commerce. Secretary Stans regrets he couldn't be with you today. His time was requisitioned to be with President Nixon, on his trip to the Midwest. He is sorry he couldn't be here.

#### BALANCE OF TRADE

Mr. Chairman and Members of the Committee: I appreciate this opportunity to appear before you to discuss the foreign competitive threat to the U.S. commercial aircraft industry and its potential impact on our balance of trade.

It has consistently been the policy of this administration, as well as preceding administrations, to encourage the export trade of the United States, which benefits our entire economy and which in 1970 was re-

sponsible for 3.1 million jobs. However, as our trading partners close the technological gap and become more self-sufficient, export expansion becomes increasingly difficult. At the same time, our appetite for foreign goods is increasing.

According to the Commerce Department's review of the U.S. position in foreign trade, as discussed by the Secretary before the Joint Economic Committee on February 17, 1971, we are unable to avoid the conclusion that the outlook for the U.S. trade balance is far from satisfactory. The U.S. merchandise surplus averaged about \$1 billion for the 2 years 1968 and 1969, improved to \$2.7 billion in 1970, and now looks as if it will drop to something around \$2 billion for 1971. This is substantially under the \$5.0 billion average for the 8 years 1960-67. Moreover, and of the greatest significance in the context of these proceedings, it is interesting to note that the value of exports of civilian aircraft, engines, and parts equals the entire merchandise surplus of \$2.7 billion for 1970.

Such is the importance of aeronautical exports that major foreign governments are now providing direct financial support to projects directly benefiting their civil aviation activities. This demonstrates their firm commitment to high export levels for aerospace products and related technologies. Of course, it also indicates a desire to reduce as much as possible their future imports of aircraft. The most prominent example of this commitment is the British and French Governments' cooperation in developing the Concorde. They have combined their technological and financial resources for this project because of the importance of the aircraft manufacturing industry to their overall economic health. Their financial support of this program will exceed \$2 billion, I am told.

Two prototype Concorde aircraft, one French and one British, are already in flight test. The prototypes first flew in March and April, respectively, of 1969. The first supersonic flight was made in October, 1969, and the first Mach 2—twice the speed of sound—flights were made last November. Seven U.S. airlines and nine foreign airlines now hold options on 74 Concorde aircraft. The seven U.S. airlines have options of 38 of them, options amounting to something between \$874 million and \$1.14 billion, based upon a price range of \$23 million to \$30 million each.

Preliminary negotiations are underway to conclude contracts with airlines currently holding options, while prime prospects for new orders include six European as well as several major South American carriers. The SST offers significant advantages to South American airlines: distances are great from that continent, there is increasing pressure to improve its air transportation links, and most major routes can be flown over water.

Concorde's cost is estimated at about \$20 million per airplane, based on 1967 prices. The cost of airframe and engine spare parts increases the total to about \$23 million. Total sales are predicted to be 250 aircraft by 1980, anticipating the introduction of an American SST. If the U.S. program is canceled, and if no major restrictions are placed on supersonic transport operations into the United States, the anticipated Concorde market could be as high as 800 aircraft by 1990.

Although the Soviet Union has not yet been a serious competitor

in the international air transport market, its improving technology and certain desire to enter this field will make it an important contender before 1985. It was recently accepted as a member of the International Civil Aviation Organization, the first step to approval of Soviet aircraft by the free world's certification bodies.

At the same time, the Soviets are moving rapidly to modify airports and airway facilities to conform to international standards. They are actively seeking customers for their supersonic transport, the TU-144, and are vigorously marketing the YAK-40, a 30-seat subsonic trijet. They have requested negotiation for a bilateral airworthiness agreement with the United States and have discussed with U.S. companies the granting of sales rights for the short-range YAK-40.

The TU-144 made its first test flight on December 31, 1968. It first flew supersonically in June 1969, and exceeded Mach 2 in flight tests 1 year later, thereby accomplishing firsts in each stage of supersonic transport development. The aircraft probably will be ready for regular commercial service in 1973. Aeroflot representatives have reported that the first international commercial services will begin the week of October 23, 1971, between Moscow and Calcutta, India. It is estimated that Aeroflot and other bloc national airlines combined will initially require 20 of these aircraft. Reports also indicate that there may be pressure, to buy the TU-144, on other national airlines which are negotiating routes either into the Soviet Union or trans-Siberia.

Foreign competition is not new to U.S. commercial aircraft manufacturers. The British developed the first commercial jet transport, the Comet, in the early 1950's. Ten years later they were overtaken by Boeing and Douglas. Government financed research and development of the B-47 and the B-52 enabled them to do this. Because of the superiority of American jet transports, 76 percent of all such aircraft in operation throughout the free world today are built in the United States. Without firm commitment to research and development programs such as those the Government has so successfully supported in the past, the margin required to insure American preeminence in world aviation markets will become ever more difficult to maintain.

Twenty-six airlines have reserved 122 delivery positions for our SST. Of these airlines, 12 are United States, 14 are foreign. A total of \$22.4 million has been deposited in the U.S. Treasury to hold these positions.

Of DOT's total market estimate of 500 American SST's by 1990, fully half are expected to be exported. The market for the SST is forecast on the basis of a 9-percent-annual increase in free world air traffic between 1970 and 1990, including only overwater routes with no supersonic flight over populated areas—a conservative estimate, as the air travel growth rate averaged 16 percent a year from 1964 through 1969, and 15 percent a year for the last two decades.

Both the Concorde and the Soviet SST's are moving into production phases. If the U.S. program is not continued, there will exist only foreign sources of supersonic jet transport aircraft. And the U.S. economy will have lost a leading export product for the 1978-90 period. It is apparent that delays in the U.S. program add substantially to eventual sales of competitive aircraft because of their earlier availability.

I have confined myself primarily to discussion of the Concorde and the TU-144, because their appearance in the marketplace is most imminent. In fact, however, the Concorde, the TU-144, the Franco-German A-300B Airbus, the French-Italian-Spanish-Belgian "Mercure," the German-Dutch VFW-614, and the Dutch-German-Irish F-28 together, for the first time, provide a family of European aircraft which will compete with American supplies for airline fleet requirements in all markets.

It is a fact in commercial aircraft marketing that the supplier of one level of aircraft to an airline is favored by that airline for each succeeding round of equipment replacement or new equipment orders. In the past, European supplies have not been able to achieve an overall competitive advantage, despite initial market penetrations, because U.S. suppliers have been able to offer a full line of economical, efficient, and attractively priced aircraft in a sufficient range of compatible models to meet an airline's total requirements. They have been able to do this even when they have entered the market later than the foreign competition. For the foregoing reasons, we cannot rely on continuance of the advantages we have enjoyed heretofore.

More than 50 percent of the U.S. commercial aircraft industry's product is exported. Therefore, a high level of activity in the industry is largely dependent on foreign orders for commercial jet aircraft. Present advanced technology, wide-bodied jet aircraft programs, those involving the Boeing 747, the McDonnell-Douglas DC-10, and the Lockheed L-1011, will peak between 1971 and 1975. Given the limited number of new commercial aircraft programs available for sales efforts, the SST program represents the most important future activity for the aircraft industry and our chance to maintain technological superiority. In the latter half of the 1970's, new market sales for the aircraft industry will depend heavily on the SST program.

We have said that U.S. export sales of aircraft, engines, and parts amounted to \$2.7 billion in 1970. Commercial airline aircraft alone accounted for \$1.3 billion of that total. Without these sales, our trade surplus would have been in jeopardy. The Department of Commerce estimates that the total value of the aircraft exports in 1975 will increase by 40 percent over 1970, reflecting initial deliveries of the new, wide-bodied jet transports to foreign airlines. Between 1975 and 1978, however, total exports will decline by 16 percent as the normal lull in airline procurement cycles for large jet transports takes place.

The latest Department of Transportation estimates for the period 1978-90 indicate that the failure to build the American SST could mean as much as a \$22 billion swing in commercial aircraft transactions, a figure reflecting the sum of \$10 billion in lost export sales and a potential outflow of \$12 billion which U.S. carriers would spend to remain competitive in the international air transportation market. These are very large figures, but they are also reasonable, especially when one takes note of the announced determination of the Europeans and the Soviets to supersede our leadership in the civil aviation field worldwide. The Department of Commerce has reviewed these figures and concurs that they are fair estimates of the potential trade impact.

These, in our view, are the long-term ramifications of the development of a commercial supersonic transport on our international trade.

Now the question to be resolved is whether two prototype aircraft should in fact be built and tested. The basic purpose of the SST prototype development program is to determine conclusively the answers to remaining questions concerning final production and marketing of an SST which is safe and compatible with sound environmental practices. Development of these prototypes will also enable us to refine the estimates we have presented to you today, refinements which will be made available to the committee as they become available. For balance of payments purposes, the United States simply cannot afford to lose the initiative in commercial aviation by default.

Thank you, Mr. Chairman.

#### CONCORDE'S ECONOMIC THREAT

Mr. McFALL. Mr. Secretary, thank you for your statement. I know all the members of the committee will have questions for you, but I would like to run through a few that will perhaps have been answered already in your statement. However, you may wish to elaborate on the information which you have already presented.

Obviously from your statement you consider the Concorde an economic threat, but does it really appear to be a substantial economic threat to our Nation's commercial air supremacy?

Mr. McLELLAN. Yes, indeed, Mr. Chairman. I might just point out by way of background that we have been running, as I mentioned, a substantial trade surplus in the commercial aircraft engine and parts category. I would like to point out that that surplus, in 1970, amounted to \$2.5 billion. Out of the \$2.7 billion exported, there was a \$200 million import for a net favorable balance of \$2.5 billion. Now without the SST capability to compete, and given the circumstances of imports of Concorde, or even other types of supersonic aircraft, you are going to have, you could have as much as this \$22 billion swing on the balance of payments in the 1978-90 period.

Mr. McFALL. Do you feel that this figure, which is significant, is properly calculated? I think that is a figure which Mr. Volpe gave, and I am sure it is a figure that Mr. Magruder has in his testimony. That is the same figure that the Department of Commerce comes up with in its calculations of the effect of the SST.

Mr. McLELLAN. We would endorse the Department of Transportation's figures with respect to air travel growth and with respect to the numbers of aircraft that would be involved in the supersonic classification; yes, sir.

#### FOREIGN TRAVEL

Mr. McFALL. To what extent do you feel the increased foreign travel generated by the SST will offset the favorable balance-of-trade impact of sales of the aircraft?

Mr. McLELLAN. I can't see that the increased transportation would represent a disadvantage to the United States. The more travel there is, the greater is the opportunity for increased business activity, increased tourist activity. We are hoping we can close the tourism gap, somewhat, that the United States now has.

I might comment there. You know, we have been running a \$2.5 billion deficit in the tourist account. We have a considerable effort

underway to bring more people into the United States, and improve that balance. Some advanced aircraft systems, in contributing to the transport of more people, will be constructive in terms of international trade and tourism.

Now to the extent that U.S. airlines have to buy foreign made aircraft to transport those people, of course, that represents a serious disadvantage to our balance of payments.

#### SST EFFECT ON WEATHER RADIATION

Mr. McFALL. One more question, Mr. Secretary. Last month the Secretary announced the appointment of a committee headed by Dr. Frederick Henriques to study the potential effect of supersonic transport planes on weather, climate, and radiation levels. What has the panel learned, and when will the results of the study be made public?

Mr. McLELLAN. Yes, sir; I might just qualify my answer by saying I am not responsible for the science and technology activities of the Department of Commerce, but I can report on this particular point because I have followed it with interest.

That committee was announced with the commission, or the charter, to report back to the Secretary, I believe, by the end of September of this year. They are looking into two things. They are considering the possibilities of adverse weather impact, as a result of SST operations, and the question of adverse radiation impact.

They have two specifics in their commission. The first is to determine whether there is now sufficient information available to determine whether or not there would be adverse weather impact and whether or not there would be adverse radiation impact. Secondly, if there is not sufficient information to make those determinations, they are to recommend what will need to be done in order to provide the answer to those two questions.

#### BALANCE OF TRADE

Mr. McFALL. Thank you. Any questions on my left of the Secretary?

Mr. BOLAND. You indicated that the latest figure, there was a \$2.5 billion favorable balance-of-payment position that the United States enjoyed.

Mr. McLELLAN. Yes, sir.

Mr. BOLAND. On page 8 of your statement, you indicate aircraft alone accounted for \$1.3 billion, I presume of that total, so we would have had a favorable balance-of-payments position of about \$1.2.

Mr. McLELLAN. I would like to qualify that, Mr. Boland, if I may. We exported a total of \$2.7 billion of civil aircraft, engines and parts. We imported, in the civil aircraft engines and parts area \$200 million, for a net favorable trade of \$2.5 billion. Of the \$2.7 billion that we exported, commercial airlines abroad, accounted for \$1.3 billion of that total. Therefore that \$1.3 billion does not include the sales of private aircraft abroad, executive aircraft, and related parts and systems.

Mr. BOLAND. In the last paragraph on page 8, "The latest Department of Transportation estimates for the periods 1978 to 1990," will you enlarge upon that statement? That statement indicates that the

failure to build the American SST could mean as much as a \$22 billion swing in commercial aircraft transactions.

Mr. McLELLAN. Yes, sir.

Mr. BOLAND. That is a large figure. Let me see you develop that.

Mr. McLELLAN. The figure comes about thus: Assuming that the United States does have an SST program, the Department of Transportation estimates, and we would agree with these based upon our current knowledge, that there would be a \$10 billion net in the export category. That would result from the foreign sales of 270 American SSTs, offset by the import of 60 Concorde.

If there is no SST program in the United States, we estimate that there would be a total import of 380 Concorde of the first and second generation production model, for a \$12 billion net import value, so the swing from the \$10 billion, if we have a program on the export side, to the \$12 billion if we don't have one on the import side, represents a \$22 billion bridge on the balance-of-payments account.

Mr. BOLAND. You indicate that the cost of a Concorde would run around \$20-million with spare parts, the cost of the air frame, increases the total amount to about \$23 million. The Concorde's cost is estimated at about \$20 million based on 1967 prices. What about 1970 prices? What is the cost of the Concorde now?

Mr. McLELLAN. It is going to be considerable and, based upon the information I have seen, something around \$30 million depending on the configuration and special requirements of the purchasing airline.

Mr. BOLAND. Who in the Department of Commerce reviewed the figures of the Department of Transportation, and how much time did the Department of Commerce spend on the matter relating to the balance of payments? This has been an issue which has been bandied about considerably in the SST problem. Who has reviewed this in the Department?

Mr. McLELLAN. I have on my left the Director of our Aerospace Industry Operations group, Bureau of Domestic Commerce, Mr. Dick Cohen. He can comment on that for you if he may.

Mr. BOLAND. Yes, Mr. Cohen.

Mr. COHEN. The figures were checked over under the supervision of our Assistant Secretary for Economic Affairs and his Deputy Assistant Secretary, and included with them were industry analysts and economists from our Bureau of Domestic Commerce. We used the data which were available from forecasts made by the International Civil Aviation Organization, by the manufacturers, and by each of the agencies which we felt were authoritative in the field of projections of both air transportation and aircraft marketing. We adjusted them according to our judgments of competitive structure, and of what we could determine of the future economic situation, and came up with figures quite similar to what are provided in these tables.

Mr. BOLAND. That is all. Thank you.

Mr. McFALL. Mr. Conte.

#### GALBRAITH STATEMENT

Mr. CONTE. Mr. McLellan, 15 leading economists have expressed their opposition to the SST, and most of this group have stated that the United States should not support the project merely on a balance-of-trade grounds. J. Kenneth Galbraith stated:

All judgments on the balance-of-payments effects of building the SST are purely speculative. By choosing the figures and selecting the assumptions, one can reach whatever results he wants—there can be a big adverse effect from an adverse tourist balance or a favorable effect from the planes sold. The truth is that these calculations are strictly fraudulent and should detain no one.

Would you like to comment on this statement?

Mr. McLELLAN. Yes. Dr. Galbraith is certainly entitled to his opinion, but that is all it can be.

Mr. CONTE. You disagree with that?

Mr. McLELLAN. Pardon?

Mr. CONTE. You disagree with his opinion?

Mr. McLELLAN. I do disagree with his opinion. Based upon the calculations of anticipated airline traffic operations, based upon what we consider to be at least reasonable projections of the productivity of the SST airplane, and therefore based upon the cost and income relationships, this appears to be an economically successful aircraft development, obviously depending upon the satisfactory conclusion of testing of the prototypes with regard to both cost and environmental factors.

#### PRIVATE BANKING SUPPORT

Mr. CONTE. As an economist, has the SST project generated any financial support from any private banking circles, and if so, can we have their names?

Mr. McLELLAN. I can avoid your question by commenting I am an engineer instead of an economist, but I don't want to do that.

Mr. CONTE. That is all right. You can get it for the record.

Mr. McLELLAN. I will have to ask for some help on that from Mr. Magruder. To the best of my knowledge, the private money in it thus far has been deposits by airlines for—

Mr. CONTE. I am talking about financial institutions, banks, insurance companies.

Mr. MAGRUDER. They have said they support the program as it is presently laid out.

Mr. CONTE. Or are willing to put up some cash for production.

Mr. MAGRUDER. The people that I have counseled with, and who have given me permission to make the statement I made earlier in response to one of the committee's questions about whether or not there would be private financing available, so the government could step aside at the end of phase 3 are the top people in the lending institutions on the aviation side, Chase Manhattan Bank, the First City National Bank of New York, and the Bank of America. Those are the three main financial institutions that I have used as sort of an ad hoc group to guide me in saying things that would be in concert with the financial community.

Mr. CONTE. You can enlarge that for the record if you want to.

Mr. MAGRUDER. I speak to it in my testimony.

Mr. CONTE. Mr. McLellan, W. J. Baumol, a Princeton economics professor, has stated that the logic of the free enterprise system is that a new product is worth producing if its potential demand is sufficient to cover its cost and provide an attractive return to capital invested. Capital will pour in to take advantage of private opportunities and Government funding becomes unnecessary.

My question is, Why hasn't this been the case with the SST?

Mr. McLELLAN. The answer is because of the length of time involved in the development process, and the time value of the money involved until there is an economic return based upon jet aircraft production, and the justification for it is that it is in the national interest to see this development take place in terms of the balance of payments, among other justifications.

Mr. CONTE. You point out on page 2 that major foreign governments are now providing direct financial support to civilian aviation projects, with the obvious implication that it may be in the best interests of the United States to do the same thing. You were here when I asked Secretary Volpe my question. Why isn't it just as vital to maintain our transformer, heavy transformer industry, as it is to maintain our aircraft industry, airframe industry?

Mr. McLELLAN. Just on that first point, the funding as you fully appreciate, both of the Concorde between the British and the French as well as the TU-144 with the Russian Government, is a total Government funding of the entire project.

#### SUPPORT FOR OTHER INDUSTRIES

Mr. CONTE. Mr. Volpe made that point and I pulled him up short and said so it is in the transformer industry. They own their own industry, British companies and French companies, some Italian companies.

Mr. McLELLAN. Well, Mr. Conte, I think as you know, Secretary Stans, I, and others are very much concerned about the condition of a number of American industries that have been seriously injured by imports from abroad. There are a number of programs that hopefully will be constructive in easing that circumstance at least, but I think we have to be clear and recognize the distinction between this new technological development, a development that is recognized as probably attainable, in contrast to funding development programs in the transformer industry, where the advanced technology is pretty well understood already.

The need of the electrical transformer and switchgear industry today is not for substantial amounts of money over a long period of time to achieve new, high levels of technological goals that are very much in sight, as in the case of the aircraft development that we are talking about here.

Mr. CONTE. You see my point. If something is not done to help this particular industry, and I zero in on the transformer industry although there are others, if you cannot sell transformers to your own Government which has been the case in the past 5 years, then these large corporations in the United States cannot do the research and development.

Mr. McLELLAN. This is right.

Mr. CONTE. We have developed a transformer that could carry direct electricity 50 to 60 miles. That was a great innovation in this particular field. You say you are an engineer. We did it all on our own and it cost a lot of corporate money and they did not come to the Federal Government.

I am pleased to hear at least that you are concerned about our plight and are willing to give us a helping hand.

Mr. McLELLAN. We are concerned.

## CONCORDE OPTIONS

Mr. CONTE. As of this date has any U.S. airline made a definite firm commitment to purchase the Concorde?

Mr. MAGRUDER. No, it is my understanding that all of the commitments are options to buy, but with penalty clauses if they forego the option which call for the forfeiture of their money. I understand the moneys they lose will be of the order of \$100,000 to 200,000 per airplane at this time. They are optioned to come up to buy in the next 30 or 60 days. Within the next 30 or 60 days, from the information available to me, the Air France and BOAC people are probably going to announce that they have made some commitment to buy.

Mr. CONTE. That is BOAC and Air France, both Government owned.

Mr. MAGRUDER. That is right.

Mr. CONTE. Both governments are making the airplane. Personally, even though I said there is a gray area here in the U.S. SST, I think you can make a strong argument for it and there are some arguments against, but in regard to the Concorde the governments own the airlines or maybe wouldn't buy the Concorde. It is a shell, it only has 110 or 112 seats. It is not a very comfortable plane. There are not that many facilities on it. It will have to be a first-class plane with no tourist seats at all. It has problems. Your SST is a far superior plane.

Mr. MAGRUDER. I am going to talk about the Concorde later and refute some of those negative points.

## SURCHARGE

Mr. CONTE. I should not discuss this with you because you are the expert, but looking at it I would not pay the extra premium to fly the Concorde. I would take the Jumbo 747 where I would have first-class relaxation and elbow room. If anybody belches in the Concorde you will have a problem.

Mr. MAGRUDER. Did you pay a premium to fly in the first jets in 1960, which only carried 110 or 120 people and had a 15-percent surcharge?

Mr. CONTE. It was a 17- or 18-hour trip by prop whereas I could get there in 7½ hours.

Mr. MAGRUDER. It was 9 hours by prop and you went across in four and a half hours and you got terribly uncomfortable.

Mr. CONTE. You mean going across to Europe?

Mr. MAGRUDER. No; going across the United States.

Mr. CONTE. I am talking about going to Europe, it took me about 17 hours.

Mr. MAGRUDER. It cut it in half. They cut the 17 hours to 8 hours. The point I am making is that you did exactly in 1960 what you are saying you won't do in 1973 with the Concorde. You have already done it. In fact, you have done it two or three times. Every time we jumped productivity in an airplane and went up in speed and size, you always do what you just said you wouldn't do. You get in the airplane that saves seat time. That is what comfort is.

## TU-144 OPTIONS

Mr. CONTE. To be truthful with you, if I am paying the freight I usually go tourist and try to find three empty seats, pull the arm rest, grab a blanket and go to sleep.

There is one last question. In regard to the purchases, do any foreign airlines hold options on the Soviet TU-144?

Mr. McLELLAN. I do not know that any foreign airlines hold options.

Mr. CONTE. Why don't you put that in the record. Thank you, Mr. Chairman.

## FEDERAL BUDGET DEFICIT

Mr. McFALL. Mr. Yates.

Mr. YATES. Mr. McLellan, what is your background?

Mr. McLELLAN. I am an engineer. I was with a corporation called FMC Corporation for 20 years in international management before I came into the Department in June, 1969.

Mr. YATES. You were an engineer?

Mr. McLELLAN. I was an international business executive.

Mr. YATES. Do you have any qualifications as an economist?

Mr. McLELLAN. Twenty years of experience in international business would be my qualifications.

Mr. YATES. Can you tell us what the deficit is likely to be this year?

Mr. McLELLAN. The trade deficit?

Mr. YATES. No, the deficit in the federal budget. I consider that a point because I want to follow up with questions.

Mr. McFALL. Not even the Secretary of the Treasury or Paul McCracken or any of the people that testified before the full committee the other day really know what the deficit will be.

Mr. YATES. Are we going to have a deficit this year?

Mr. McLELLAN. On a full employment basis (laughter), I understand from our economist friends, there would not be.

I am not sure I understand the significance of your question. I would defer on these questions to both the Council of Economic Advisers as well as the Assistant Secretary of Commerce for Economic Affairs.

Mr. YATES. You are the witness on the balance of payments and about how great the SST is going to be.

My next question was going to be this: I assume we are still trying to fight inflation.

Mr. McLELLAN. We are indeed.

Mr. YATES. Is it to our national advantage in fighting inflation to have a greater or less deficit?

Mr. McLELLAN. Our objective is to minimize any deficit.

Mr. YATES. Presumably if you did not spend the some \$290 million for the SST you would have a smaller deficit, would you not?

Mr. McLELLAN. You might have a smaller immediate deficit.

Mr. YATES. That is right. We are fighting inflation at the present time.

Mr. McLELLAN. Yes.

## UPPER ATMOSPHERE POLLUTION

Mr. YATES. You talked about the Weather Committee that had just been appointed. You did not tell the committee how that committee proposes to do its work.

Mr. McLELLAN. I am sorry, Mr. Yates, I cannot respond on that particular point. Mr. Magruder may be able to do so. This is not in my area of responsibility.

Mr. YATES. I thought it was the Department of Commerce Committee.

Mr. McLELLAN. It is, but under the Assistant Secretary of Science and Technology. I am commenting here on the balance of payments aspects and not the scientific determinations to be made by that committee.

Mr. YATES. Then you do not know whether people in your Department are of the opinion or not that the question of pollution of the upper atmosphere could be tested without the prototype. You do not know whether that is a fact or not, do you?

Mr. McLELLAN. I think I can say this: The people in our Department feel that it is necessary to make those determinations on a scientific basis, and this committee will be constructive in doing so.

Mr. YATES. I can tell you some of the people in your Department, at least one has said, that prototype need not be constructed in order to find out about pollution of the upper atmosphere which was the subject of the Williamstown Committee Report. But they say it could be done just as easily by using flights of the B-57s, plus balloons. They could tell through those devices, without the prototype whether the possibility of pollution existed in the upper atmosphere. Do you know whether that is true or not?

Mr. McLELLAN. I do not, sir. I do not know who was making the comment. To the extent that comment came from the Department of Commerce it demonstrates we also have a democratic organization and there can be differences in viewpoint.

## GOVERNMENT SUBSIDIES

Mr. YATES. All right.

Do you favor giving subsidies to private industry?

Mr. McLELLAN. I favor American involvement in the cost of American industry on a development of this type, on the basis that it is in the national interest. It seems to me to be in the national interest.

Mr. YATES. Do you agree with this statement? The real and very powerful case against the SST rests on other grounds. The logic of the free enterprise system is that a new product is worth producing if the potential demand is sufficient to cover the cost and provide an attractive return to the capital invested in it.

Mr. McLELLAN. We have many examples, of course, where Government involvement in development cost has been vital to the national interest and private enterprise system. The Atomic Energy Commission would be one example where Government funds have been invested in the national interest.

Mr. YATES. Do you know of any other time when Government funds have been invested in the private commercial aircraft industry?

Mr. McLELLAN. You just cannot separate the Government investment in the B-47 and B-52 program and its relationship to the commercial aircraft industry. It was not direct, I admit. On an indirect basis it was there and technically as direct as any involvement now.

Mr. YATES. Isn't there a difference between the Government's purchase of a military aircraft and the subsidization of a commercial aircraft?

Mr. McLELLAN. I am sorry, Mr. Yates. I missed the question.

Mr. YATES. Isn't there a difference between the purchase by the Government of a military aircraft which it will own and the subsidization of a commercial aircraft which will be owned by a private industry?

Mr. McLELLAN. In fact, those are different arrangements. But that does not mean that the Government support of this kind of new development is not valid.

Mr. YATES. Then you are saying that you favor the Government subsidization of the aircraft industry in this instance?

Mr. McLELLAN. Indeed, under the conditions that the investment of Government funds will be made. It is incorporating the provisions for repayment if we have a successful program.

Mr. YATES. Suppose the Concorde were not a threat. Let us take that for an assumption. Suppose for some reason, like the Comet the Concorde were to blow up and were not a threat. In one of its test flights this is a possibility. I know in the paper it lost a piece from the engine and had to fly back to the airport on three engines. The Concorde flew to its base on three engines; but suppose it were to blow up, which might set it back some time. Would you consider that there was the same urgency to Government subsidization of the SST that there is now?

Mr. McLELLAN. Yes, sir; I would, and I would on the basis that this country is a great country because, among other things, of its technological progress. We have the opportunities available to us for technological progress in the air transport industry and, in the case I am presenting here, with it, a favorable balance of payments. The opportunities of sales of the SST abroad in the absence of a Concorde would be very great, and you would have an even more beneficial impact on the balance of trade.

Mr. YATES. Suppose Germany was manufacturing some product in which Food Machinery Co. was interested and Food Machinery Co. came to the Government for a subsidy, saying that with this subsidy it could build up balance of payments and outsell the German machine, would you favor that?

Mr. McLELLAN. First of all I would have to declare myself uninterested to avoid a conflict of interest. Second, on the principle you are talking about, generally we would not, unless it could be demonstrated that it was this type of thing where you have long leadtime in the technological development, and the accomplishment of that development would be in the national interest.

Mr. YATES. All right. How much of a threat does the Concorde pose in the event that its per mile costs are anywhere from 30 to 100 per cent more than the per mile costs of 747?

Mr. McLELLAN. I will defer to Mr. Magruder.

Mr. YATES. I will ask Mr. Magruder that question during his testimony. You do not have an answer to that question?

Mr. McLELLAN. No, sir, I do not. I defer.

Mr. YATES. I have one or two more questions. You say in your statement the Soviets are moving rapidly to modify airports and airways facilities to conform to international standards. They are actively seeking customers for their supersonic transport, the TU-144. How do you know that?

Mr. McLELLAN. I know what I have been advised by our own people in the Department of Commerce and the information we had from the Department of Transportation. I have seen representative ads from Aeroexport, the Soviet export operation, describing their family of aircraft.

Mr. YATES. Do you know of anybody outside of the bloc countries who have bought Soviet aircraft?

Mr. McLELLAN. Outside the bloc?

Mr. YATES. Yes.

Mr. McLELLAN. I have seen Ilyushin 18's operating in North Africa that I think were owned by North African airlines but I would want to examine that.

#### SOVIET THREAT TO U.S. AIRCRAFT INDUSTRY

Mr. YATES. Probably a gift under their foreign-aid system.

Mr. McLELLAN. I have no knowledge.

Mr. YATES. And probably the companies took it because they could not get a better plane. Up to the present time the Russian aircraft industry has not been a threat to the American or any other aircraft industry, has it?

Mr. McLELLAN. Essentially it has not.

Mr. YATES. That is correct.

Now you say they are starting to move and they will become a threat to the American aircraft industry.

Mr. McLELLAN. They have that potential.

Mr. YATES. Do you know of any sales they made?

Mr. McLELLAN. I do not know of any sales.

Mr. YATES. Do you know of any commitments of sales of the TU-144?

Mr. McLELLAN. Options but not sales.

Mr. YATES. That is all, Mr. Chairman.

Mr. MINSHALL. No questions.

Mr. McFALL. Mr. Edwards.

#### BALANCE OF TRADE

Mr. EDWARDS. Can't we boil your statement down to one simple fact and that is that the SST would have an enormous impact on the balance of trade.

Mr. McLELLAN. That is exactly right, Congressman Edwards.

Mr. EDWARDS. Thank you, Mr. Chairman.

Mr. McFALL. Mr. Steed.

Mr. STEED. Mr. McLellan, you made reference to the situation that will happen in terms of the Concorde in the event we do not go ahead with the SST. What comment can you make on the impact the TU-144 could have if we do not go ahead with the SST?

Mr. McLELLAN. I do not have any projections on the TU-144 potential sales, if we do not go ahead, beyond this estimate of some 20 aircraft. Mr. Magruder may be able to give you a better figure.

We do know this: If the TU-144 comes up to reasonable airline performance requirements, they are in a position under the conditions by which they market their products abroad to put heavy price competition against both the Concorde and U.S. SST, if they decide to do it. That could only result in greater sales of the TU-144, again given reasonable operating characteristics.

Mr. STEED. In addition to the trade balance factors that get involved in the actual sale of aircraft, what additional spin-off does a nation have if it becomes dominant in the field such as this?

Mr. McLELLAN. That was the point I was trying to make here in part of the testimony. It gives them an opportunity to develop a family of aircraft, which gives a competitive advantage over the country or the company that does not have a whole range of aircraft.

No. 1, they get greater opportunities for sales of other kinds of aircraft. Secondly, there is all that follow-on business that goes with the sale of your airplanes, in the form of spare parts, maintenance equipment, ground handling systems. We observe very often where we are involved in the heaviest aircraft sales we are also most involved in air traffic system sales and engineering. There is a continuing progression of business involvement that does relate. You cannot put an exact measure on that but you know it is present.

Mr. STEED. Is there any doubt in your mind that if we abandon the SST that Russia will not have any benefits from it? Do you think it will benefit Russia if we quit at this stage?

Mr. McLELLAN. It would benefit the Russians as well as the British and French Concorde program if we dropped off. It sure would. It would give them a great competitive advantage over the United States in the sale of aircraft around the world.

Mr. STEED. That is all, Mr. Chairman.

#### AIR TRAVEL GROWTH

Mr. BOLAND. You indicate in your statement that the air travel growth rate between 1964 and 1969 was at the rate of about 16 percent a year. In the last two decades it was about 15 percent annually. What was it in 1970?

Mr. McLELLAN. In 1970?

Mr. BOLAND. Yes. If you do not have it you may supply it.

Mr. McLELLAN. We will give you that figure.

Mr. BOLAND. Mr. Beggs, do you have it?

Mr. BEGGS. I have that one. Mr. Boland. The growth of international air transportation in 1970 was on the historical average of 15 percent.

Mr. BOLAND. In 1970?

Mr. BEGGS. Yes. While the domestic growth slowed very drastically the international growth stayed about the same.

Mr. MAGRUDER. Between 15 and 20 percent. It was quite healthy.

Mr. BOLAND. For the international growth?

Mr. MAGRUDER. Yes.

Mr. BOLAND. What did it drop down domestically?

Mr. MAGRUDER. Around 11½ percent.

Mr. BOLAND. That is all. Thank you very much.

Mr. McFALL. Thank you very much, Mr. McLellan. We are glad to have your testimony.

Mr. McLELLAN. Thank you.

Mr. McFALL. Our next witness will be Mr. William Ruckelshaus of the Environmental Protection Agency.

We welcome you before the committee, Mr. Ruckelshaus, and we will be glad to have your statement.

#### STATEMENT OF ADMINISTRATOR, ENVIRONMENTAL PROTECTION AGENCY

Mr. RUCKELSHAUS. Thank you, Mr. Chairman. I have with me today the Assistant Administrator for Research and Monitoring of the Environmental Protection Agency, Dr. Stanley Greenfield, who has just about 10 days ago been sworn in as the Assistant Administrator for Research and Monitoring. Dr. Greenfield was a participant in the MIT study at Williamstown last summer and a member of the Atmospheric Panel, which dealt with the atmospheric impact of the SST. As one charged, Mr. Chairman, by the President and the Congress with the protection of the environment, I appreciate the opportunity to appear before your committee and address myself to the environmental questions which have arisen concerning the appropriation to continue the development of the supersonic transport.

One of my duties as environmental protector is to examine critically every proposed Federal project to determine its impact on the environment, and to oppose that project if it is not consistent with my Presidential and congressional charge.

To be more specific, if the Congress were being asked today to appropriate moneys to construct, or assist in the construction of a commercial fleet of, say, 300 or even 500 SST's before many of the critical environmental questions were answered, I would oppose this request for an appropriation.

This, of course, is not what the administration is requesting of the Congress. The request is for the money to continue in the development of two experimental airplanes to determine their commercial feasibility.

Before these two experimental planes should ever be translated into a commercial fleet, all of the environmental questions regarding noise, sonic boom, radiation effects from the possible reduction of ozone, cosmic radiation effects on passengers and crew, climatic effects from ozone reduction, increased water vapor or increased dust particles in the stratosphere, the effect of increased oxides of nitrogen in the stratosphere and any others that may arise, must be answered.

This administration is committed to getting those answers before commercial production proceeds.

This commitment is not new. Then why, one might ask, the environmental furor?

The argument is that once the two experimental planes are built, the momentum of the program will be such that there will be no stopping it. Too much money will have been invested and too many jobs will be at stake to halt the commercial development of the SST. It must be admitted that there is historical validity to this argument.

In the past the momentum of large-scale programs has had a way of insuring the perpetuation of those programs regardless of their merit.

If we subscribe to the inevitability of history being repetitive then the momentum argument is unassailable. I do not so subscribe.

Technological projects can be stopped if their continuation is found to be environmentally unsound. The recent Presidential decision regarding the cross-Florida barge canal is a case in point. Indeed, they must be stopped if man is to control his own destiny. We have reached a point in the history of man and his habitat where man's activities must constantly be measured against their environmental impact.

It is our intention to insure that such measurements are made in connection with this project.

It is also argued that the environmental measurement can be made without developing the two experimental airplanes. While this statement is not without controversy, it appears that most of the environmental questions can be answered without the two prototypes. The question of whether to continue with the development of the two experimental airplanes is not an environmental one (no one contends the two planes will have any significant impact on the environment), but rather is one of economics. It is the position of the administration that if all the environmental concerns are satisfied and our country is to remain competitive with the British-French Concorde and the Russian TU-144, we must not now cease completion of the testing of the two experimental airplanes.

I am not an economist and cannot answer all of the economic questions many of you gentlemen have. Other witnesses here today have tried to convince you of the economic wisdom of proceeding with the program. I am charged with protecting the environment.

I do not see technological experimentation as inconsistent with that charge. Nor do I believe that when there are economic reasons for proceeding we as a society must cease technological experimentation because the ultimate use of that experimentation might be environmentally damaging. If the environmental impact proves to be adverse, then the technology must not be used. Such a conclusion does not detract from the economic arguments to proceed with the experiment nor does the present environmental concern by itself warrant it.

I believe we can control our technology so as to maximize its benefits and at the same time preserve and protect our environment.

The mindless onrush of technology must be stopped. The rational application of our scientific and technological ability, giving full attention to the environmental impact of that application, must proceed.

It's the difference between saying "Stop the world, I want to get off," and "Look before you leap."

The latter approach must make more sense to a society that wants to survive.

#### SST EFFECTS ON THE ATMOSPHERE

Mr. McFALL. Thank you. I am sure the committee will have a number of questions for you and I would like to begin.

Last year Mr. Russell Train, Chairman of the Council on Environmental Quality, told the Joint Economic Committee that the water vapor emitted by the SST's flying at 60,000 to 70,000 feet would react so as to destroy some fraction of the ozone in this part of the atmosphere. The effect of destroying this could be that the shielding capacity of

the atmosphere to penetrating and potentially highly dangerous ultraviolet radiation is decreased. Do you agree with that statement? And would you comment on this?

Mr. RUCKELSHAUS. Mr. Chairman, as a preface to my comment on your question, the Environmental Protection Agency has now been in existence something less than 3 months. We are determined to review the entire research program that is sponsored by the Department of Transportation and the administration through other departments of Government, to insure that all of the questions including the one you just asked are answered prior to the commercial development of the SST. The direct answer to your question is that there will be studies made of the effect of water vapor on the ozone and the resultant impact of that reduction, if any occurs, on radiation on people on the earth. It is my understanding of the present status of that study that no definitive answer can be given as to the impact of water vapor on the ozone and the amount of that impact or of the resultant impact of increased radiation on the earth.

Mr. McFALL. Do you have any information that would lead to an opinion in this matter or let us put it another way: Is there sufficient information to substantiate the opinion of those scientists who say it would have a destructive effect?

Mr. RUCKELSHAUS. No; I do not think you can say that there is sufficient evidence at this stage, Mr. Chairman, to give a definitive answer that there is a relationship between the increased water in the lower stratosphere and the reduction of ozone so as to insure that there will be an increased impact of radiation on the earth. I do not think there is sufficient evidence to make that statement scientifically at this time.

#### SKIN CANCER

Mr. McFALL. It has been reported that a National Academy of Sciences Panel on Atmosphericics warned that large-scale deployment of SST's might increase the incidence of skin cancer if exhaust from the planes thins the protective layer of ozone that shields the earth from the full force of the sun's rays. Do you have any information which substantiates or contradicts that statement?

Mr. RUCKELSHAUS. In the statement, Mr. Chairman, it says both "might" and "if." I would say it might increase if there was a reduction in the ozone. It means that we do not have the information either as to whether there is a reduction in the ozone caused by the increased water vapor, or what the result of that percentage decrease in the ozone would result in.

Mr. McFALL. So there is no information which would substantiate it, and none that would contradict it.

Mr. RUCKELSHAUS. There is a telegram that was sent. I did not receive this telegram, Mr. Chairman. It was sent to Mr. Magruder, and maybe he can read you the telegram that he received apparently this morning in answer to your question.

Mr. MAGRUDER. This wire is from Dr. Tom Malone, Chairman of the National Academy of Science Review Subgroup on Weather and Climate Modification. It was sent in response to a recent much publicized allegation which I have also read that some such report of the Academy of Sciences existed.

I want to advise you that the National Academy of Sciences has not issued such a statement. I am Chairman of the National Academy of Sciences Review Subgroup on Weather and Climate Modification which is presently updating its 1966 report. The review subgroup is analyzing a number of tentative conclusions and will publish its report after these conclusions have been subjected to the normal National Academy of Sciences procedure of thorough scientific review to assure their validity.

#### IMPACT OF WATER VAPOR ON CLOUD FORMATIONS

Mr. McFALL. Others have stated that the impact of water vapor on cloud formations might change the weather or affect the surface temperature. Would you comment on this?

Mr. RUCKELSHAUS. That is another of the concerns in the Environmental Protection Agency that we intend to see is answered prior to any commercial development of the SST. That is part of the research program.

Mr. McFALL. Is there any information at the present time that would lead you to a tentative opinion one way or the other?

Mr. RUCKELSHAUS. Dr. Greenfield, who is a meteorologist might be able to give you a more definitive answer, Mr. Chairman.

Dr. GREENFIELD. This is one of the areas where there is still a considerable amount of uncertainty, and it is one of the areas that gave us pause. You know approximately how much water vapor will be put into the atmosphere by the operation of the engines. You know that it is not going to increase the water vapor in terms of saturation level of the atmosphere all over the globe to the point where you suddenly reach 100 percent saturation. There is some concern that in some of the colder northern regions you might indeed produce sufficient closeness to saturation that additional clouds might occur. Unfortunately, at this time we do not have a great deal of information as to what the actual amount of water vapor is in that region of the stratosphere all over the globe and how it varies in time. This is another area where we have to get more data before we can get definitive conclusions.

Mr. McFALL. What measurements and tests have been conducted in the past of supersonic flights at high altitudes to determine the effect on the environment? There have been some 550,000 hours of flight of supersonic military aircraft. Has there been any test of the effect of these airplanes?

Mr. GREENFIELD. To the best of my knowledge, Mr. Chairman, no tests at all have been made on the effect of these flights on the atmosphere.

#### NEED FOR THE PROTOTYPE PROGRAM TO OBTAIN ANSWER TO ENVIRONMENTAL QUESTIONS

Mr. McFALL. It has been stated that there is nothing about the effects on the environment of SST's that will be learned from the two prototypes that cannot be learned at far less cost using other equipment. Do you agree? How essential is the construction of two prototypes to learning the effects on the environment of the SST? I think you discussed this in your statement but would you enlarge upon it?

Mr. RUCKELSHAUS. Yes.

Mr. Chairman, I think it is generally agreed that we can get the answers to the environmental questions without going ahead with the production of the two prototypes. As I said in my statement this is not completely without controversy, there are some who say we can get more information regarding the environmental impact by the production of the two prototypes but I do not believe the administration's case for the development of the two prototypes rests on the environmental information that will be gained from that development. Most of the questions regarding the environment can be gotten through modeling or through one means or another without going ahead with two prototypes.

Mr. McFALL. You do not have any information that would indicate that the SST would be harmful to the environment, is that correct?

Mr. RUCKELSHAUS. Would you repeat that, please?

Mr. McFALL. While you do not have information that would indicate that the SST's action on the atmosphere would not damage the atmosphere, the converse is also true. You do not have the information that would indicate that the SST would be destructive?

Mr. RUCKELSHAUS. That is right. We cannot say one way or the other at this time.

Mr. McFALL. Do you know of anyone else that can say?

Mr. RUCKELSHAUS. That has that information?

Mr. McFALL. Yes.

Mr. RUCKELSHAUS. We certainly would be glad to receive it if they do have such information, Mr. Chairman.

Mr. McFALL. Part of the controversy stirred up by the SST is by the statements made with great certainty by the opponents of the SST that these environmental effects will come about. But you say that there is no such room for certainty at the present time; is that correct?

Mr. RUCKELSHAUS. Mr. Chairman, I am not in a position to state the argument for one side or the other. All my opinion is that we do not have that information at this time. These are concerns, and we intend to look into them.

#### NOISE STANDARDS

Mr. McFALL. Reportedly there is legislation pending in New York and 16 other States which would ban the Concorde because of the apparent inability to get down to the perceived noise level of 108 decibels. What noise level do you feel should be prescribed for planes landing at U.S. airports?

Mr. RUCKELSHAUS. We have been given the responsibility under the Clean Air Act of 1970 to conduct over the next year a study of the noise standards presently being set by the Department of Transportation, and the problem of noise in general in the environment.

We are in the process of setting up as mandated under that statute an Office of Noise Abatement in the Environmental Protection Agency. The Administration has submitted a bill to Congress to give the Environmental Protection Agency the authority in cooperation with the Department of Transportation to set noise standards for airports. We are given in effect in that legislation the veto power over any noise standards set. It is my opinion that the best information we can get at this stage as to the health effects of noise in airports are embodied in the present proposed FAA rulemaking. This does not mean that further research—and research, I think, is needed in this area, would

not prove otherwise. We believe as of the present state of our knowledge that those standards as set in the prepared rulemaking, as far as airport noise is concerned, are acceptable levels.

#### SONIC BOOM OVER WATER

Mr. McFALL. Concern has been expressed about sonic boom effects with respect to overwater flights. What have we found out with respect to our supersonic military flights? Will this be a serious environmental problem with respect to the SST?

Mr. RUCKELSHAUS. A study was made and provided to the Department of Transportation about a year ago in which it showed that the effects of sonic boom over water were almost completely dissipated within 15 to 20 feet of the surface. We are again in the process of reviewing that study to determine whether further study is needed on the effects of sonic boom over water.

Mr. McFALL. Do you know any effect on underwater sea life?

Mr. RUCKELSHAUS. I do not know of any effect at this time, Mr. Chairman.

Mr. McFALL. Do you think your measurements will show any effect on underwater sea life?

Mr. RUCKELSHAUS. I would hate to speculate what our study of the study that is already made or our review of the study already made or what our research might show. At this point we cannot state that there is any effect that we have discerned on sea life from sonic boom.

#### ACCEPTABLE ENVIRONMENTAL POLLUTION

Mr. McFALL. Are there questions on my left?

Mr. MAHON. Is your position with respect to the SST, that you will go deeply into the question of pollution of the upper atmosphere and make an objective determination as to whether or not the degree of pollution will be acceptable?

Mr. RUCKELSHAUS. Mr. Chairman, I do not know if I exactly put it that way—

Mr. MAHON. You put it your way.

Mr. RUCKELSHAUS (continuing). that the degree of pollution is acceptable. Our study will go as deeply as possible into all of the questions and concerns that have arisen regarding the environment, and we intend to look very closely at all of the answers that are given to these concerns and questions, as our charge is to protect the environment.

Mr. MAHON. By using the two prototypes, can't you come up with a better determination of what the environmental effect may be?

Mr. RUCKELSHAUS. There will be, to the extent that redundancy of research is helpful, that help. To the extent that we can get a more definitive answer that we can without the prototypes, that will also be helpful. As I stated in my statement, I think we can get most of these answers without the prototypes.

Mr. MAHON. Your decision in the matter will not be influenced by the economics involved or by the interest which might come from commercial sources that we proceed with the construction of a fleet of SST's?

Mr. RUCKELSHAUS. My decision, Mr. Chairman, will be based on my charge by this Congress that I protect the environment.

Mr. MAHON. Do you think there would be any reason why the SST program could not be stopped in the event that it is determined for environmental reasons that the threat to people on this planet would be too great?

Mr. RUCKELSHAUS. I believe in the future we are going to have to be able to cut off technological experimentation and the ultimate use of that experimentation if it is found to be environmentally unacceptable. I think we have to adopt that capacity as a society or we are really in trouble.

#### IMPACT OF CURRENT AIRCRAFT ON THE ENVIRONMENT

Mr. MAHON. What are you doing to determine the degree of threat to the environment that comes about by the thousands of aircraft which are now in operation?

Mr. RUCKELSHAUS. We are making the same kinds of studies regarding those airplanes as the research that is being done is geared toward the impact of those aircraft as it is of the proposed supersonic aircraft.

Mr. MAHON. What is the difference in the threat to the environment that will result from SST flights and the threat to the environment which comes from the 707 and other aircraft?

Mr. RUCKELSHAUS. The difference is the altitude, and the fact that we are flying in the lower stratosphere as opposed to the troposphere in which the conventional jets fly. In the stratosphere we have two problems, and that is the fact that the particulate matter and water vapor and oxides and other emissions from the plane are likely to remain there on an average of 18 months, whereas in the troposphere they much more quickly fall to the earth.

Mr. MAHON. In your opinion the hundreds of aircraft which are going in and out of our cities at this time do constitute a considerable threat to environment?

Mr. RUCKELSHAUS. Dr. Greenfield might be able to expand that, Mr. Chairman.

Dr. GREENFIELD. Maybe I can give you one example of the type of thing you might deal with concerning the lower altitude jet aircraft. The lower altitude jet aircraft have been flying in ever-increasing numbers since 1956. There are some data developed by the Department of Commerce, the Weather Service people, which indicates almost paralleling the increase in jet traffic has been an increase in the clouds around 20,000 or 30,000 feet in the atmosphere. These clouds do inhibit the passage of radiation through the atmosphere, so they do have some effect on the temperature of the lower atmosphere. That is an observable effect.

Right now we still do not know, for many complex reasons, what the ultimate effect of this type of temperature change will be on the climate. But it is an example of how the lower altitude jets are producing a noticeable effect on at least one parameter of the atmosphere. This is a case where you have a great deal more water vapor in the lower atmosphere than you have in the stratosphere where the SST's will fly. In the case of the SST's you have a combination of possibly two conflicting things. In one case, as Mr. Ruckelshaus pointed out, at the altitude of the SST, the particles remain there for a much longer period

of time. This means that you do not have just the simple output of each airplane, but these add to a certain extent so you get a greater amount than you have from just 1 day's operation. This means you have at least a potential of these particulates or the water vapor producing an effect which might be out of proportion to just a few aircraft that you fly up there.

Also in the case of the stratosphere there is a condition that we do not know very much about, the dynamics, the motions in that region. There is a suggestion, for example, that the difference in temperature between 50° north and the pole may be an important difference. If you fly aircraft in that region in the stratosphere, and indeed the particles do cause an increase in temperature, there might be an effect. But you cannot say that with certainty. We just do not know enough about it to say. There are subtle differences and they have to be investigated.

Mr. MAHON. Do you foresee that, if the number of aircraft increases and we continue to use the same type fuel for aircraft, the time might come when the Government would have to reduce the number of aircraft utilized in this country for transportation purposes?

Dr. GREENFIELD. If it turns out that the utilization of these aircraft is producing a bad effect, then I would say yes, that would have to be the case.

Mr. MAHON. Do you think they are producing a significantly bad effect at this time?

Dr. GREENFIELD. No, certainly not at this time, but it is something that we want to keep watch on very carefully. The people like the Department of Commerce weather people are keeping a very close watch.

Mr. MAHON. But you have not detected anything that is too significant as of the present time?

Dr. GREENFIELD. No, sir.

Mr. MAHON. Thank you.

Mr. McFALL. Mr. Conte?

Mr. CONTE. Mr. Greenfield, you were with the Williamstown group up until recently?

Dr. GREENFIELD. No, just the summer study.

#### NO ENVIRONMENTAL CONCERN WITH RESPECT TO PROTOTYPE PROGRAM

Mr. CONTE. That is in my backyard. They are doing a fine job at Williamstown. It is the administration's view that the construction and the testing of these two prototype planes will present no environmental problems. How can we be sure of this? Will there be a lot of test flights?

Mr. RUCKELSHAUS. All of the environmental concerns that have been raised regarding noise and presumably the test flights would be made in an area where noise would not be any problem as far as being close to a community as many of the airports now are. The effects on the upper atmosphere or the radiation impact of crew or passengers are concerns regarding the massive use of SST's where the effect is cumulative rather than the effect of any two SST's. For that reason we do not really believe, nor to my knowledge is anyone really claiming that these two experimental airplanes will have any significant impact on the environment.

Mr. CONTE. Of course, you do not know what the effect of the sonic boom will be on the water and you will have tests over water?

Mr. RUCKELSHAUS. Yes.

There have been some studies made on that already, and we are looking at the studies to determine whether more tests are needed.

Mr. CONTE. Dr. Conway of the University of Washington, I imagine you are familiar with him, has suggested a question of the SST effect of ozone concentration in the stratosphere might be cleared up, and this is in conjunction with the chairman's question, by a series of high-altitude flights by planes equipped with measuring equipment to gage ozone reactions caused by water vapor. Are you contemplating such tests in the near future and if so, when?

Mr. RUCKELSHAUS. I cannot give you the date.

Mr. CONTE. You are contemplating such tests?

Mr. RUCKELSHAUS. Yes.

Mr. CONTE. It is amazing that this has not been done. This plane has been kicking around for a few years.

Mr. RUCKELSHAUS. I think some of these concerns are rather new.

Mr. CONTE. I have been hearing Mr. Yates talk about ozone since I have been on this committee.

Mr. YATES. That is right.

#### EFFECTS OF NITROGEN OXIDES

Mr. CONTE. Will you get those for the record? A Boeing engineer on the SST project has declared there is almost a total lack of information about the potential effects of nitrogen oxides that will be produced by operation of the SST fleet in the stratosphere.

Are you conducting research in this field?

Mr. RUCKELSHAUS. Studies will be made.

Mr. CONTE. No studies have been made thus far?

Mr. RUCKELSHAUS. Not to my knowledge.

Mr. CONTE. When do you anticipate making them?

I will tell you, if I was in charge of the environment, I would have some quick answers here.

Mr. RUCKELSHAUS. The quick answer to your question is before this test program is over these studies are going to be made.

Mr. CONTE. When do you anticipate to make them? This thing has been moving along, you are in the two-thirds phase of the prototype right now. I think it is high time you start making some experiments.

Mr. RUCKELSHAUS. I could not agree with you more and I think these experiments are going to be made.

Mr. CONTE. You are not going to give any time estimate?

Mr. RUCKELSHAUS. I cannot give you that time estimate now. I can give it to you for the record if the time estimate is important.

#### SONIC BOOM STUDIES

Mr. CONTE. In 1964, the FAA conducted a study on the effects of sonic boom on the population and property in Oklahoma City, Okla. Have there been more recent studies of a similar nature? If so, what do they conclude?

Mr. RUCKELSHAUS. I do not know of any more recent studies. I do know there is no intention of flying the SST over land.

Mr. CONTE. I understand that. I am just asking whether there have been any further studies or any more experiments.

Mr. RUCKELSHAUS. Not to my knowledge. Have there been?

Mr. MAGRUDER. Yes. There were tests subsequent to the Oklahoma City tests that were done at White Sands on the structural impact and also tests on structures and the aspects of human response.

#### ENVIRONMENTAL STUDIES

Before I took this job I spent 8 months touring the airlines and the scientific communities and probing into every possible question as to whether I really wanted to come back here and join Secretary Volpe and Secretary Beggs and this great team. Contrary to what you have just said and in complete support of what Mr. Ruckelshaus just said, I must say there was not one single environmental question of the type you have asked today that was raised by any scientific source from September 1969, until I arrived here in March.

In April I had my first meeting with an environmental group in which the kind of issues you brought up here today were raised. In May, 30 days later, this administration organized a complete environmental committee, and a \$27 million research program. This administration has nothing to be ashamed about acting with complete alacrity. The environmental committee did their work in less than 60 days from when those concerns were first issued. At that time the Council on Environmental Quality had passed on some of the best scientists that now work for Mr. Ruckelshaus and at that time worked at places like HEW, Interior, and Commerce. I do not think the record should show anybody should be admonished for not acting quickly.

Mr. CONTE. I am not admonishing you. I run my office conscientiously with great speed and dispatch. People have an interest in the environment and more citizens in this country will bring suit because they own a piece of this environment. It is theirs. They have a right to clean water. They have a right to clean air. They have a right to be free of all the sonic booms and noises and all these sorts of things and the effect of these noises. You are going to find more citizens bringing suit against the Federal Government, bringing suit against corporations.

I just happen to be amazed that these studies haven't been made. I have heard in this committee more than 6 months ago, more than a year, more than 2 years, some of these same questions. You go back and read the record. They are in there.

Now, I have great admiration for your background and, as I said earlier, I just don't want to tangle with you when it comes to your field but when it comes to the environment I will tangle with you or any other person on that side, and I am not admonishing them. I am just telling them "Get moving." I just felt that they should have had some studies made on high altitude flying either through balloons or through airplanes, or what not, to find out what the effect of ozone radiation would be.

#### OIL RESERVE IMPORTS

My next question. I want to ask a question. For 12 years I have been fighting oil import quotas. They have had a tremendous effect on the price of oil to consumers in New England and the eastern seaboard.

This Government has seen fit to put quotas on oil so that oil has dribbled into this country from Venezuela, the Middle East, and other places. Some British analysts have concluded that the enormous fuel consumption of supersonic transport could create a major oil crisis in 15 years. More specifically, they estimate that by 1980—that isn't too far off—322 million tons of crude oil would be provided for the fuel for the SST program. This represents one-third of the total anticipated U.S. consumption by that time. Have you any information which confirms or denies these estimates? Does this present a grave threat to our oil reserves?

Mr. RUCKELSHAUS. I don't have any estimates that confirm or deny those, Mr. Conte. In addressing myself to these environmental concerns that have arisen and have come up as questions to the development of the two experimental airplanes, I have tried to determine what the amount of our research is and to what extent that I think new research is required, and we are going to be looking very closely at all of those problems.

#### FUEL REQUIREMENTS FOR A FLEET OF 500 SST'S

Mr. CONTE. Is there anyone who can tell me whether these planes will use all this oil?

Mr. BEGGS. We have the figures.

Mr. MAGRUDER. We read that same paragraph. It was expressed in a London newspaper about 4 or 5 months ago. We went for our answer to the Department of the Interior, the Bureau of Mines, and to the major fuel petroleum organizations in this country. The answer came back, as I recall the numbers—and we will submit the actual verified numbers for the record—that less than 5 percent of the total oil production would be consumed by the SST fleet. We have said before this committee many times less than 1 percent of all pollution from consumers of petroleum reserves, comes from the aircraft, SST's and subsonic jets, too.

Mr. CONTE. I am not getting into the environment angle now. I am concerned about the consumption of oil. Could you give me any ballpark figure what 500 SST's on normal flight to Europe, Australia, and all the routes would consume? I realize you don't have that now.

Mr. MAGRUDER. I will submit that for the record.

(The information follows:)

The estimated fuel requirements for a fleet of 500 SST airplanes for the year 1990 is 0.5 billion barrels which is less than 0.06 percent of the estimated oil reserves.

Mr. MAGRUDER. But I was going to say the conclusion of this letter was that we have adequate fuel reserves to the year 2000. Before you worry about the SST fuel consumption—let's assume we don't have an SST fleet—please keep in mind that we are going to carry the traveling public in the 1980's and 1990's, and you would have to have 1,500 DC-10/30's or a thousand 747's all needing fuel.

Mr. CONTE. Which use crude oil.

Mr. MAGRUDER. Same oil.

Mr. CONTE. I would just like to get a figure. Regardless of what you say about reserves, we are hurt. We have been hurt for 12 years

in New England. Do you realize that we use 70 percent of all the heating oil in the United States in New England, the eastern seaboard? We have been paying right through the nose because of this whacky policy of having this quota system. If there is that much oil let's release some and send it up there. We had a real scare this year. Not only are we paying a high price but there is a tremendous shortage of oil up there.

#### REPORT ON IMPACT OF SST'S ON OIL RESERVES

Mr. MAGRUDER. I will get you this report.  
(The report follows:)

#### FICTION & FACT

##### THE FICTION

"If British and American plane makers sell their planned total of supersonic airliners, the world could face a critical oil shortage within 15 years. This is the unmistakable conclusion to be drawn from an analysis of the planes' projected fuel consumption measured against the amount of oil that the petroleum industry expects to provide by 1985."

Denver Post-London Observer, news syndicate, Sept. 1, 1970.

(By Edward R. Heydinger, Manager Economics, Marathon Oil Co.)

##### THE FACT

In the article cited, the authors stated that because "producing one ton of kerosine means refining seven tons of crude oil, a 1980 SST fuel requirement of 46 million tons of kerosine will "take up a colossal 322 million tons (of crude oil) annually." By 1985, ". . . nearly 600 supersonics, (will cause) a far more serious drain on world oil."

This erroneous conclusion originates from their assumption that oil is refined to yield only kerosine, or that 46 million tons (roughly one million b/d) will "take up" 322 million tons (6.4 million b/d) of crude oil. The authors fail to consider that this same 6.4 million b/d would also provide 3.2 million b/d of gasoline, one million b/d of light fuel oil, and about 1.2 million b/d of heavy fuel and other products. If this were not the case, one could also conclude that the residual fuel in the U.S. alone would "take up" nearly 30 million b/d of crude oil—over half of current total world oil production! Or that U.S. demand for lubricants would "take up" 11 million b/d of crude oil, over 25% of current total world oil production!

The article assumes that, by 1980, some 300 British-French Concorde and 80 U.S. Boeings will consume about one million b/d of fuel. By 1985, nearly 600 SST's, (285 of which are U.S. Boeings) would consume approximately 1.9 million b/d, using the authors' statistics.

By 1980, total world demand for oil is expected to approximate some 83 million b/d. It appears that SST fuel consumption would amount to about 1% of anticipated world oil demand, and obviously well within range of the petroleum industry's supply capacity. Even by 1985, when total world oil consumption is expected to approach 100 million b/d, the SST fleet would represent no more than 2% of this expected total. It should be noted that, currently, jet fuel amounts to 6% of total U.S. oil consumption; thus the authors' projected SST requirement at 2% of total world oil consumption seems no cause for alarm.

Whether by the SST or some other form of jet transport, the consumption of jet fuel is likely to continue to increase at a healthy pace as passenger and cargo transportation needs expand. The addition of an SST fleet would have only marginal effects on total jet fuel consumption by 1985, since it would displace other types of aircraft, and result in little if any incremental effect on the rate of depletion of the world's oil supplies.

The U.S. Department of Transportation estimates that as late as 1990, an SST fleet of 620 aircraft would only consume 1.5 million b/d of a free world jet fuel consumption of 4.1 million b/d. Here again, no threat to oil supply can be construed as the result of SST development. The Department of Transporta-

tion further observed that, even in the event of a large SST fleet, there would be adequate fuel for the total world jet fleet well into the next century.

There are many factors to consider concerning the development of an SST fleet, but precipitation of a world oil shortage is certainly not one of them.

U.S. GOVERNMENT MEMORANDUM

DEPARTMENT OF TRANSPORTATION—OFFICE OF THE SECRETARY

Date: September 24, 1970.

Subject: SST's and World Oil Supply.

From: Acting Chief, Engineering Division.

To: Director, SST Development, SS-1.

In accordance with your request of September 15, 1970, the Engineering Division has investigated the matter of the impact of SST operations on the world's oil supply.

A preliminary response was provided by SS-100 memorandum of September 16, 1970 to SS-2, which forwarded (a) TBC article "Critique of the London Observer Article on SST and World Oil Crisis," and (b) Engineering Division comments on (a).

The results of our investigation are attached for your information. The basic conclusion is that the SST's will not be a threat to the world's oil supply, and there will be adequate jet fuel available to power the total world jet aircraft fleet to the year 2000 and beyond.

The following figures from Enclosure C of the attachment are considered to be particularly noteworthy:

Figure 1—This shows that oil reserves are being discovered at a significantly faster rate than oil is being consumed.

Figure 2—This shows the relative uses of the various energy sources—petroleum products, natural gas, and coal—and indicates that jet fuel, including the SST, represents a very small part of the total requirement.

Figure 3—This shows that 5% of the projected crude oil production—a very conservative figure—is more than adequate to supply all the civilian jet fuel demands.

Figure 4—This shows the projected trends for the various petroleum fuels, and indicates that gasoline for automobiles—not jet fuel for aircraft—will continue to be the major driving force in crude oil consumption.

Attention is also invited to Enclosures D and E of the attachment, which provide U.S. Department of the Interior endorsement of the basic conclusion of this investigation.

In accordance with your suggestion, a comparison has been made between a 1985 fleet of (1) SST's and subsonic jets, and (2) all subsonic jets. As indicated in SS-100 memorandum of September 16, 1970, the B747 can provide about a 32% saving in fuel per passenger mile compared with the B2707-300. However, as indicated in Figure 3 of Enclosure C of the attachment, the U.S. SST fleet fuel consumption in 1985 represents about 15% of the total civilian jet fuel. Therefore, a 32% saving in this 15% segment, obtained by replacing all SST's with subsonic jet would represent only about a 5% saving in overall civilian jet fuel consumption.

R. W. PINNES, SS-100.

Attachment.

SST FUEL REQUIREMENTS AND COMPARISON WITH  
PROJECTED WORLD SUPPLY/DEMAND

SUMMARY

An investigation was undertaken in an effort to determine the approximate impact of the SST on the world's predicted petroleum supply and demand. The results of this investigation show that the SST will not be a threat to the world's petroleum supply, and that there will be adequate jet fuel available to power the total world jet aircraft fleet well into the next century.

APPROACH

An extensive survey was made through contacts with representative firms in the oil industry, the airlines, the AIA, the ATA, DOD, Department of the In-

terior, Boeing and General Electric. A list of contacts is appended as Enclosure A. Information and data received from these sources was reviewed and, that judged relative, was used as the basis for the discussion and material presented herein. A list of references, from which such material was obtained, is included as Enclosure B. Four figures, showing some significant trend data are presented in Enclosure C.

#### RESULTS—GENERAL

Practically all the information that was found to be applicable and helpful was obtained from The Boeing Company and the Department of the Interior. Results of contacts with the oil industry, airlines, ATA, AIA, and other sources were disappointing. The oil industry appeared reluctant to furnish any material in the form of data or quotable comments. The other contacts also had little to offer. It appeared that the oil industry's reluctance was due primarily to proprietary considerations and concern over political/policy matters. In general, a major obstacle seemed to be the lack of worldwide figures and forecasts.

#### RESULTS—SPECIFIC

##### A. *World Outlook—Resources*

Since the SST will be predominately an international vehicle, the emphasis of this investigation was directed to the worldwide supply of crude oils and fuels. It is the opinion of one source in the Geological Survey Division of the Department of the Interior that there is sufficient worldwide resources (underground) of liquid petroleum to meet the world's projected demands for the next 100 years. While this is a personal opinion, it does come from a knowledgeable individual. However, according to official publications (Reference (1)), the total estimated liquid crude oil in the earth approaches 10 trillion barrels. Historically, past records show that all previous estimates have been most conservative, as illustrated in Figure 1. Generally, authoritative sources predict adequate supplies to meet future jet aircraft demands (References (4), (5), (6), (7)).

Data presented in Reference (2) show an even greater and additional source for crude oil. This source is oil rich shale which is estimated to contain a total of 2,100 quadrillion (2,100,000 trillion) barrels of crude oil. While it is not contended that these amounts are readily producible by today's standard techniques and economics, this vast potential supply remains to be tapped when the more accessible supplies are diminished.

The oil industry prefers to quote "proven reserves." These they define as crude oil, in areas already explored by drilling and other techniques, which can be reasonably judged as economically productive on the basis of available geological and engineering data. In essence, what this means is that such forecasts are limited to what has been gleaned from actual explorations and they do not consider the total picture insofar as gross estimated reserves or the future producibility of such. Popular referral to these figures tends to mislead the general public to the belief that the oil supply outlook is approaching a critical stage.

##### B. *Production/demand*

It is not possible to present the many complex operations involving mining, refining, distributing, and marketing crude oil derivatives in a limited discussion of this nature. Some of the aspects which are significant to the supply of fuel for the transportation industry and, in particular, for the operation of jet aircraft will be highlighted further.

Demands for oil are undergoing changes. A lesser proportion of total production is now being absorbed by industrial, heating, and electric utility requirements. This shift has mainly been the result of greater use of natural gas, and further shifts in electrical power generation should result from increasing use of nuclear power. The shift away from oil as the energy source in these areas, plus the inherent favorable characteristics of oil as the energy source for transport vehicles (high energy level, transportability, and handling) makes it increasingly apparent that future growth in the petroleum industry will be tied to the transportation demand (References (6), (8)).

While the projected increases in demand for jet fuel are significant, the amounts in relation to the world's estimated supply are relatively small. Figure 2 shows the relative amounts of the total of all jet fuels compared with total petroleum, natural gas and coal requirements projected through the year 2000.

In another projection, where it is assumed that the production of jet kerosene will be only 5% of the estimated crude oil produced, all the world's entire civilian fleet requirements, including SSTs, can be accommodated with comfortable margin (Figure 3). This information correlates reasonably well with calculations made by SS-310. In a typical period (1990), the total Free World commercial fleet jet fuel requirement was calculated at about 1.5 billion barrels, one-quarter of which is for SST.

Production of kerosene-type jet fuel has been limited to approximately 13-15% of the crude oil processed when conventional refining methods are used. Generally, the amount of kerosene produced has been a function of the demand for automotive gasolines. "Hydrocracking" is a relatively new refining technique. It yields kerosene in much greater proportions from the crude than the approximate 14% obtainable from the normal "straight-run" conventional processing. Hydrocracking has been in limited use for a number of years and further use, as required, will free production of kerosene from its subordinate role to gasoline. Hydrocracking should make it possible to produce as much kerosene as is required to meet demands independent of automotive and other distillate requirements (References (4), (5), (6)).

Opinion is mixed as to the future costs for jet fuels. Increased use of hydrocracking to produce greater yields is viewed by some as a factor toward increased production costs and higher prices (References (4), (5), (6)). On the other hand, there is also belief that, because most of the fuel used in SSTs will be foreign produced, the cost will be considerably below domestic prices. Additionally, the ratio of jet fuels to automotive is projected as maintaining close to the "straight-run" refining mix, thus favoring lower production costs. Figure 4 illustrates the variations in projected demands for crude oil distillates through the year 2000. Furthermore, the increased bulk demand for jet fuel will stimulate discount rates. These factors may tend to maintain price at relatively stabilized levels (Reference (7)).

#### *C. Department of Interior Endorsement*

In response to a request from this Office, the U.S. Department of the Interior provided the following enclosures in support of the basic conclusion of this investigation:

Enclosure D—Assistant Secretary of the Interior Hollis M. Dole letter of September 16, 1970 to Mr. Magruder.

Enclosure E—A statement by Mr. James A. West, Division of Fossil Fuels—Bureau of Mines, from a talk on "National Material Policy" in July 1970.

#### CONCLUSIONS

1. The SST is not a threat to the world oil supply. The estimated requirement for the entire SST fleet in 1990 is only 0.5 billion barrels which is a very tiny fraction of the remaining resources.

2. Production capabilities can be adapted to obtain a higher proportionate yield of jet fuel if future requirements so demand.

3. Regardless of the refinement method, jet fuel does not entail production of more crude oil than is needed in the world economy. The situation may be compared to the meat packing industry where it has been alleged that everything is used but the squeal.

4. Future cost of jet fuel is speculative but there are reasons to believe that conditions will exist to maintain the historical trend of relatively stable price.

E. P. BURKE, SS-120.

## LIST OF CONTACTS

1. American Petroleum Institute.
2. Department of the Interior.
3. FAA Library.
4. FAA—Office of International Affairs.
5. FAA—Office of Plans and Programs.
6. DOT—Bureau of Public Roads.
7. Defense Fuel Supply Center.
8. U.S. Navy.
9. Air Transport Association.
10. Aerospace Industries Association.
11. ESSO Research Division.
12. Phillips Petroleum Company.
13. TEXACO, Inc.
14. Gulf Research Division.
15. Chevron Oil Company.
16. Mobil Oil Company.
17. Humble Oil and Refining Company.
18. Pan American World Airways.
19. Trans World Airlines.
20. General Electric Gas Turbine Division.
21. The Boeing Company.

## REFERENCES

1. Department of the Interior—Geological Circular 522 (1965) "Resources—Oil, Gas, Natural Gas Liquids—U.S. and World".
2. Department of the Interior—Geological Circular 523 (1965) "Organic Rich Shale—U.S. and World Land Areas".
3. Oil and Gas Journal; December 29, 1969.
4. Federal Aviation Administration—"Jet Fuel Requirements and How They Will Be Met"—Staff Study (1968).
5. Seventh World Petroleum Congress—Mexico City (1968)—"Supersonic Air Transport Engine Developments and Fuel Requirements—U.S.A."; A. H. Batchelder, President, Chevron Research Company.
6. Boeing Company Document S-3172, "Economic Study of Domestic Jet Fuel," November 6, 1968.
7. Boeing Company Document D6A11511-1, "Supersonic Transport Operating Economics Including Escalation Effects"—Model 2707-300; March 11, 1970.
8. Boeing Company Document D6A11867-1, "Air Quality as Affected by Air Transportation Including the Supersonic Transport," Revision C; July 28, 1970.

## LIST OF FIGURES

1. "World Crude Oil Resources and Consumption," Figure 4.1-1, Reference (7).
2. "World Consumption of Coal, Natural Gas and Petroleum Products (1950 to 2000)," Figure 3.2-2, Reference (8).
3. "World Supply and Demand for Civilian Jet Fuel," Figure 4.1-6, Reference (7).
4. "Projected World Average Distribution of Petroleum Fuels," Figure 4, Reference (8).

FIGURE 1

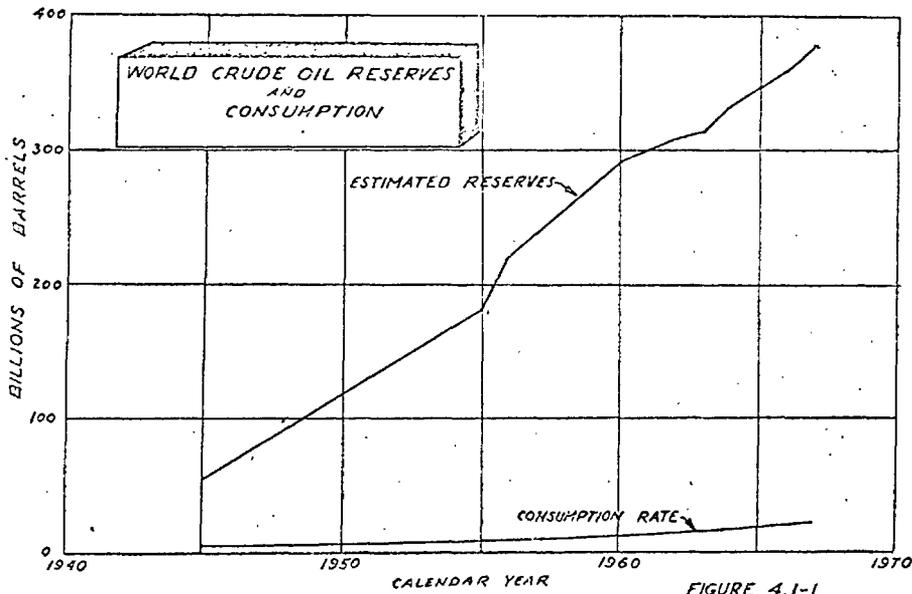


FIGURE 4.1-1

FIGURE 2

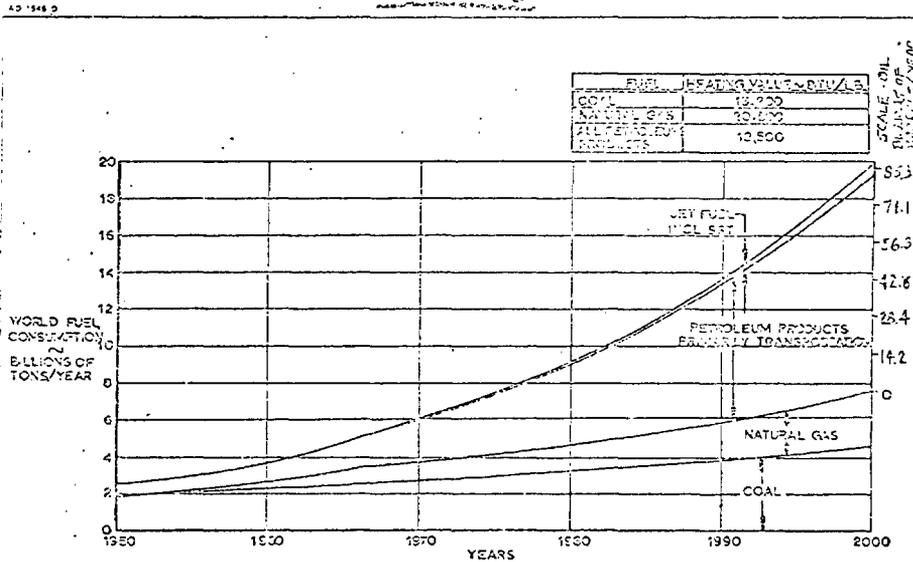


FIGURE 3.2-2 WORLD CONSUMPTION OF COAL, NATURAL GAS, AND PETROLEUM PRODUCTS (1950 TO 2000)

FIGURE 3

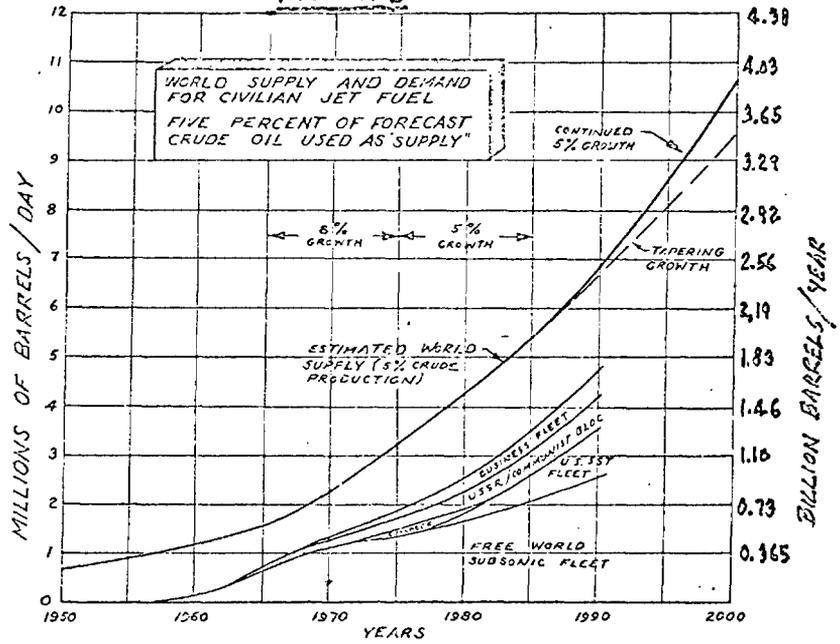
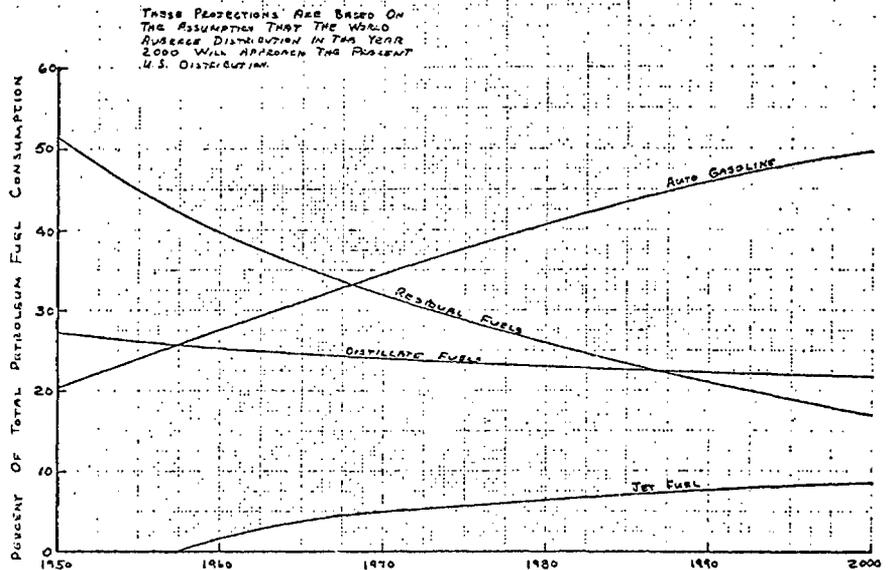


FIGURE 4.1-6

FIGURE 4



ENCLOSURE D

U.S. DEPARTMENT OF THE INTERIOR,  
OFFICE OF THE SECRETARY,  
*Washington, D.C., September 16, 1970.*

Mr. WILLIAM M. MAGRUDER,  
*Director of Supersonic Transport Development, Department of Transportation,  
Washington, D.C.*

DEAR MR. MAGRUDER: This will acknowledge your request for information on the future availability of petroleum fuels for the projected supersonic transport fleet.

Based on expert opinions of personnel in the Office of Oil and Gas and in the Bureau of Mines, the oil industry should be able to develop the necessary facilities and technology to provide all the fuel needed by the supersonic transport fleet projected for operation in the late 1970's and in the 1980's. The world supply of crude oil should be entirely adequate for the fuel requirements.

Sincerely yours,

HOLLIS M. DOLE,  
*Assistant Secretary of the Interior.*

## ENCLOSURE E

FAA Form 2800-2 (1-65)		0052-642-5000	(1360)
REMINDER MEMO		DATE	
		9/22/70	
→ AVOID ERRORS — PUT IT IN WRITING ←		WORK ORDER	
		ROUTING SYMBOL	
TO: Mr. Vierling		SS-2	
SUBJECT: Department of Interior Statement - Oil Resources			

The following statement was submitted in response to our request:

"In combination, there are adequate energy resources in the U.S. and throughout the world to meet all foreseeable levels of energy demand to the year 2000 and beyond."

This statement was contained in a talk, National Material Policy, given by Mr. James A. West, Division of Fossil Fuels .. Bureau of Mines, during the Engineering Research Foundation Conference at New England College, Hamaker, New Hampshire, July 13-17, 1970.

SIGNATURE		ROUTING SYMBOL
E. Burke 		SS-120

## TECHNOLOGICAL EXPERIMENTATION

Mr. CONTE. Thank you, Mr. Chairman.

Mr. BOLAND. Mr. Ruckelshaus, how old is EPA.

Mr. RUCKELSHAUS. Since December 2, Mr. Boland.

Mr. BOLAND. You have been in the process of pulling together a lot of the other activities of the various agencies of this Government that have been spread over a plethora of agencies, HEW, DOT, Interior, you name it, and I guess it had something to do with the environment, and finally this administration has the environmental program in one area where one man is responsible now to the President, to the administration, responsible to the Congress, for the enforcement of the laws with respect to the environment, and let me say that I congratulate you and commend you for what you have done up to this point in your job.

I have seen you on some of the television programs and I must say that I think you bring to this job a great deal of dedication and spirit and ability and know-how and knowledge. And you showed it when you were with the Department of Justice, so I have faith in the fact that you will call the shots as you see them.

Now, just let me ask this question. Do you believe that the SST is an example of the mindless onrush of technology that we are now facing today?

Mr. RUCKELSHAUS. No. Mr. Boland, what I really believe is that this can be an example of the way we have to treat technological experimentation environmentally and that is before experimentation results in an ultimate use which might be detrimental to the environment we get all of the answers to the concerns that have arisen because of the experimentation itself. That is precisely what my statement says and precisely the approach that I think has to be taken in technological experimentation in the future.

Mr. BOLAND. I take it from your statement, Mr. Administrator, that all of the problems with respect to environment can be solved without the production of two prototypes, not the problems, but at least you can get the answers to the problems that the SST conjures up. Is this true?

Mr. RUCKELSHAUS. I think that is true, Mr. Boland.

Mr. BOLAND. Well, why don't we go ahead with those experiments and those tests and shut down the SST until we find out precisely does it really violate the environment, and if it does let's stop it?

Mr. RUCKELSHAUS. I think the answer to that is the validity of the economic argument. The question isn't an environmental one. The question is are we in a competition with the French and Russians so that if we wait until we get these answers and until the program itself is dismantled and ceased, in the meantime are we going to be truly competitive with them if the environmental concerns turn out to be unfounded, and I think that is the question that has to be answered by this committee and by the Congress.

Mr. BOLAND. I wonder if we can have for the record, Mr. Chairman, the background on Dr. Stanley Greenfield. I understand he is the Assistant Director for Research; is that right?

Mr. RUCKELSHAUS. That is right, Mr. Boland.

## BIOGRAPHY OF STANLEY GREENFIELD

Mr. BOLAND. I would like to have inserted at this point in the record the background of Mr. Greenfield.

Mr. McFALL. Without objection, it is so ordered.  
(The information follows:)

## STANLEY M. GREENFIELD

Stanley M. Greenfield is Head of the Department of Environmental Sciences, and Manager of the Rand program in Environmental Studies. He received his B.A. (1950) in meteorology and physics from New York University and his Ph.D. (1967) in meteorology from UCLA.

Dr. Greenfield has worked primarily in the fields of geophysics and the upper atmosphere and has done considerable research on infrared radiation, atmospheric physics, and meteorological satellites, as well as on the physical phenomenon of radioactive fallout.

Dr. Greenfield has served on the NASA-DOD Sciences Committee, and has been a consultant to the ARPA Committee on Meteorological Satellites, and to the Committee on Upper Atmospheric Rocket Research of the Space Science Board, National Academy of Sciences. From 1959 to 1961 he was on a leave of absence from Rand to serve as Scientific Advisor to the Air Force Director of Research and Development. Currently, he is a member of the Geophysics Panel of the Air Force Scientific Advisory Board and a member of the Advisory Group for the Air Force Space and Missile Systems Organization (SAMSO). In addition, he is a member of the Science and Technology Council of the California State Assembly, and serves on a panel of the International Environmental Institution Committee of the National Academy of Sciences.

Dr. Greenfield is a member of the American Geophysical Union, the American Meteorological Society, the Honorary Research Society Sigma Xi, and the New York Academy of Sciences. In 1961 he was given the Special Award of the American Meteorological Society for the pioneering research leading to a meteorological satellite. He is the author of some 35 technical papers and reports and has contributed chapters to two technical books.

Dr. Greenfield is Assistant Administrator for Research and Monitoring of the Environmental Protection Agency.

## WILLIAMS COLLEGE SEMINAR (SCEP)

Mr. BOLAND. I do note that he was attendant at the seminar of Williams College which was sponsored by MIT in the summer of 1970 on the study of critical environmental problems, and one of the problems that the EPA addressed itself to was the SST and a great deal of the information and news stories that came out of that seminar were certainly not favorable to the SST.

It occurred to me that perhaps you would like to give your opinion on what that particular study—I am talking about the study with respect to the SST—decided what ought to be done in that area.

Mr. GREENFIELD. Yes, Mr. Boland. The study that was done at that time particularly directed toward the SST was to examine several statements that had been made previously as to some of the possible damaging effects and also try to bring to the fore other effects which had not been brought up before but which also might cause concern. The ozone one mentioned previously, for example, was addressed at that time. It would show that both at Williamstown and more appropriately back at one of the laboratories of one of the participants that at that altitude the effect on ozone of the water vapor was probably not a concern. Had that water vapor been injected at a much higher altitude then indeed it would have been a concern. It did not, however, rule out the fact that there would be an ozone effect and there might indeed be cause for uncertainty by the oxides of nitrogen, but

it left essentially a note of uncertainty that had to be alleviated before you were certain that there would be no effects.

#### PARTICULATES IN ATMOSPHERE

The question of the particulates that were put into the stratosphere was one that concerned several of us, primarily because there had been previous instances in nature where material had been put into the environment at that altitude, notably the large volcanos that had occurred, and that at the time these materials were placed at these altitudes there was a noticeable change in temperature and the temperature went up and as the material gradually moved out of that area the temperature dropped down.

The point that we were raising there was not that the 500 SST's might look like a volcano in the sense of producing a massive influx of material but would conceivably, if they did put out a lot of particulates, produce a change in temperature which would exist for a very long period of time, and it was a question of the dynamics of the stratosphere and what the effect of this change in temperature would be on the stratosphere, and then through the stratosphere back down on man and the climate of the lower part of the atmosphere.

During this entire putting together of the report we were very, very careful to point out continuously the uncertainties that existed in everything we were saying. There was a minimum amount of data available. There were certain things we knew about the volcanos. We don't even know, for example, today what is the exact mechanism that you could model that says particles at a certain altitude intersecting a radiation stream transfers a certain amount of energy to that level. We don't have the information on these things.

So as a result of this, the group at Williamstown was very careful to point out several things: one, that we needed more data; two, that we needed a great deal more research on modeling, on investigating the dynamics of the atmosphere; and, three, that nothing we had seen at this point really said that you should not go ahead with the prototypes, that the prototypes, as Mr. Ruckelshaus has pointed out several times now, were not an environmental question but were an economic question and a question of how technology and the advance of technology is treated in our society.

Mr. BOLAND. And you indicate, too, that you get the answers to the environmental questions without the construction of the two prototypes.

Mr. GREENFIELD. Yes, sir; essentially.

Mr. BOLAND. Who is going to do this, Mr. Ruckelshaus, in your agency? Who is going to conduct these tests? You are going to do them, I presume, as soon as you can.

Mr. RUCKELSHAUS. Dr. Greenfield in our agency is in charge of the Environmental Protection Agency's part in this research and investigative program. There are several committees that I believe have been testified to here before that have been set up by various departments of government to look into these questions, and as part of our responsibility we intend to look very closely at these committees to insure that the requisite research is done, and to insure that the answers that are given to the questions that have been asked and the concerns that have

been raised are valid, and I am convinced that we will get these answers as quickly as possible.

Mr. BOLAND. Thank you very much, Mr. Ruckelshaus. I wish you well in what I am sure is not the softest job in Washington.

Mr. McFALL. Is there a question on this side?

ANSWERS TO ECOLOGY QUESTIONS BY 1973

Mr. MINSHALL. Yes, Mr. Chairman. First, Mr. Ruckelshaus and Dr. Greenfield, you understand the primary purpose of these hearings is to decide whether this committee should act on the appropriation for these two prototypes. That is the whole purpose of this hearing. I mentioned three things about the SST when the Secretary was here. One was technology. We agree that we are within the state of the art, but it is the other two things, the ecology and the economic viability of this program that are of more interest to me.

On the bottom of page 1 of your statement you say: "Before these two experimental planes should ever be translated into a commercial fleet, all of the environmental questions regarding noise, sonic boom, radiation effects from the possible reduction of ozone, cosmic radiation effects on passengers and crew, climatic effects from ozone reduction, increased water vapor or increased dust particles in the stratosphere, the effect of increased oxides of nitrogen in the stratosphere and any others that may arise, must be answered."

And you went on further to say:

"This Administration is committed to getting those answers before commercial production proceeds."

But then you went on, on page 3 of your statement:

"... it appears"—as has been brought out here today quite clearly—"that most of the environmental questions can be answered without the two prototypes."

My point in making these statements and taking them out of your statement is that you have expressed many concerns. You used that word repeatedly, as has Dr. Greenfield, about the state of your knowledge, about what the ecology is and what is going to happen in the upper atmosphere, and you also said "Let's take a look before you leap."

But we have in the Defense Department a new policy of fly before you buy, and before we had that policy they were always dangling a little carrot in front of us and saying, "Look, if you just give us \$100 million next year we sure will get these bugs ironed out." But my point is, aren't you gambling here with nearly \$500 million, a half billion dollars, of the taxpayers' money to go ahead with this prototype program? It is two-thirds down the road, I grant you, but we have to go another \$500 million. You are in effect shooting crap with the taxpayers' money, and as they say in Las Vegas, suppose you crap out and it is all down the drain. Then what?

Mr. RUCKELSHAUS. Well, I attempted to make it as clear as I could in my statement that the question is an economic one.

Mr. MINSHALL. You are the expert on the ecology of it and I am asking you suppose we find out that it is not feasible to go ahead with this program. My point is we are gambling. You can find these answers without going on this prototype program. Why don't we at least slow it down?

Mr. RUCKELSHAUS. Because the economic argument, as I understand it, is if you do slow it down you become uncompetitive with the French and British planes and Russian planes. That is a question that I haven't addressed because I am not—

Mr. MINSHALL. I understand that, however, my question is, how long is it going to be before we know just what the answers are to these questions?

Mr. RUCKELSHAUS. The present target date for getting all of these answers is 1973.

Mr. MINSHALL. All right. Suppose we go ahead with this program and in 1973 you find out that you are going to have to scrub it, whereas you could find out these answers by other means, as you have clearly pointed out in your statement.

Mr. RUCKELSHAUS. Well, I don't want to be repetitive, but my answer is the same; that is the question that the Congress has to answer, and I think the administration has clearly stated that it believes that to remain economically competitive we must go ahead with the development of the two experimental planes.

Mr. MINSHALL. It is feasible, then, that this program would have to be scrubbed.

Mr. RUCKELSHAUS. I am not saying at all that I have many grave doubts. I am saying there are some concerns that have to be answered. I am not suggesting one way or another that those concerns would be answered in the negative as far as the environment is concerned. I am not convinced that they will be answered in the negative. If I thought that there was a good 90 percent chance that we get a negative answer, then I would say I do have grave doubts, but I don't think we have any evidence at this time to indicate that there are going to be the kinds of environmental degradation that would necessitate the calling off of the project.

Mr. MINSHALL. How do you feel about it, Dr. Greenfield?

Mr. GREENFIELD. I feel essentially the same way. There is no reason right now, there is no evidence right now, that says that the effects, if they are noticeable, ultimately result in deleterious effects on the climate as far as man is concerned; you have both uncertainties, the uncertainties of what the effects themselves are, the effect of the SST directly on the stratosphere, and then you have the uncertainty as to how this effect feeds back into its effect on man. We don't really know and, begging the Las Vegas parlance, I guess we are hitching our bets to it in a sense, that you have to go ahead and find out before you go ahead with a commercial fleet. But at the same time we are asking, it is not in our purview to ask the question, at least in the Environmental Agency, as to whether this means from an economic standpoint you go ahead and build the prototype. We can only answer it at this time from the environmental standpoint.

Mr. MINSHALL. And you just don't know.

Mr. GREENFIELD. We don't know.

Mr. MINSHALL. And you will know by 1973?

Mr. GREENFIELD. We hope to. This is where the effort is being bent right now and it isn't just in our agency. It is throughout the Government and the academic community as well.

Mr. MINSHALL. One of our main concerns about this program is the environmental question.

Thank you. That is all I have, Mr. Chairman.

Mr. YATES. Mr. Ruckelshaus and Mr. Greenfield, why will it take until 1973 to get the answers?

Mr. GREENFIELD. I can answer, if I may. I can answer it the following way. You have a large program of sampling that has to go on. It is not a question of just going out and making one or two measurements and then you have the answer there. You have actually a basic research program in the dynamics of the atmosphere. You have to change the models. You know, we have built over the years rather complex numerical models of the atmosphere that are used for both research purposes and for forecasting the weather. It is not easy to change them and direct them specifically in the area of the stratosphere. These have to be done. Characteristically, it takes a year or two even to reprogram these models to allow you to do some of these things, so it is a combination of both experimentation and research.

#### ENVIRONMENTAL R. & D. FUNDING

Mr. YATES. Do you have the money to do it?

Mr. GREENFIELD. These have been costed out. On the question of whether the money is available, I have to turn to Mr. Magruder.

Mr. YATES. Is the money available for experimentation, Mr. Magruder, or is this something that you will have to ask us for?

Mr. MAGRUDER. The money has been made available for the program on a yearly basis. In 1972, we will have each of the following agencies involved: National Oceanographic and Atmospheric Agency, EPA, NASA, DOD, Department of Transportation, universities, and private institutions.

Mr. YATES. Are these all under the direction of Mr. Ruckelshaus' agency?

Mr. RUCKELSHAUS. No; they are not.

Mr. MAGRUDER. These moneys are in our respective budgets today.

Mr. YATES. The point comes to me immediately, is there a centralization of Mr. Ruckelshaus' efforts? If all these various activities are engaged in this who is supervising it?

Mr. MAGRUDER. It is being supervised from the Office of the Supersonic Transport Development. Mr. Ruckelshaus' organization didn't exist when this was set up. This was set up in coordination with Mr. Train and his organization back in May and June of last year when problems were identified. Subsequent to that time we have gone to the agencies in the Government having programs and interest in this area. We have tried to have them adjust their programs to accommodate the SST and the environment, to broaden them, to make it least expense to the Congress and to the taxpayer. Actually, within the DOT the weather modification program is supervised by Assistant Secretary Robert Cannon. In noise research, some is done under contract to Boeing, some under GE, some within the FAA, some under contract with private institutions.

Mr. YATES. May I interrupt just a moment? Shouldn't this be done under the direction of Mr. Ruckelshaus now that he is in existence? You are, aren't you?

Mr. RUCKELSHAUS. Yes; that's right, as far as I know.

Mr. YATES. Shouldn't this be done under his direction for the coordination of all this effort?

Mr. MAGRUDER. I would be happy to discuss that with him. I looked over all of the U.S. Government in April and May of 1970, to find a place to bounce this ball. There simply wasn't any place to coordinate such an activity.

Mr. YATES. I am not criticizing you for it, but I would criticize your predecessors for not having previously foreseen the necessity for this. I think you may have done it, but I know that your predecessors relied upon a report that was put out in 1966, by the National Academy of Sciences, and that report was the basis, I believe, of the assumption by the Supersonic Transport Agency that this was not a problem at all.

At any rate, when I raised this point in committee hearings I was told that it had already been passed upon by the National Academy of Sciences. Now, comes the Williamstown group and raises some doubts as to the validity of the reports issued by the National Academy of Sciences. Now we have the situation of where we have to get definite answers on whether fleets of the SST's are going to pollute the environment.

I am not faulting you for what you did. I think it is a good idea to do what you have done, but I think now that Mr. Ruckelshaus has that responsibility, as I understand his responsibility, he ought to be doing it. The question in my mind is how your funds are going to get over into his agency.

Mr. GREENFIELD. May I inject something?

Mr. YATES. Yes.

Mr. GREENFIELD. There is a fairly good agreement now in the scientific community as to the type of work that has to go on to answer these questions. It is not really necessary that we run this program to have it come out that way. What we intend to do, as Mr. Ruckelshaus said, is look over their shoulders and make darned sure research is being done and review what comes out of it.

Mr. YATES. Would you agree that this is still Mr. Ruckelshaus' responsibility?

Mr. MAGRUDER. I can't answer that.

#### RESPONSIBILITY OF THE EPA

Mr. YATES. Would Mr. Ruckelshaus answer that? What is your responsibility in this?

Mr. RUCKELSHAUS. I think my responsibility, as clearly stated in the name of the Agency, is to protect the environment and if these questions aren't adequately answered, again as I believe I have stated as clearly as I could in my opening statement, we do not intend to support the project, nor does the administration for that matter.

Mr. YATES. Do you have the responsibility of determining whether the studies that Mr. Magruder has outlined and undertaken for the Supersonic Transport Agency will provide adequate information for you to reach that conclusion?

Mr. RUCKELSHAUS. I do not have the authority to order studies to be made under an appropriation to another agency. I do have the responsibility to express my concern to any agency that is conducting studies involving the environment if I think the studies themselves are not aimed at getting the right kind of answers or are not giving the right direction so that we come up with the answers that are needed.

Mr. YATES. Well, I think that puts Mr. Magruder in a very untenable position because you have the ultimate responsibility of passing on what he is trying to do and yet not telling him whether he is doing it correctly or not. I would think that there ought to be some more coordinative program worked out.

Mr. RUCKELSHAUS. There is, Mr. Yates.

Mr. YATES. Tell us about it, then.

Mr. RUCKELSHAUS. There is a coordinated program and we are in the process, as I mentioned, of reviewing all of these studies and going to make recommendations. We already have made some recommendations involving the climatic studies to determine what kinds of further studies are needed, and we have received nothing but cooperation from the Department of Transportation on our request.

Mr. YATES. I for one, as a member of this committee, want to support the studies that will give us the information in this area of concern. I commend Mr. Magruder for what he is doing in this field but I want to make sure that when Mr. Magruder finishes what he has done and this committee supports him with the finances that are necessary for the purpose, that you will not at that time say to Mr. Magruder, "Mr. Magruder, you didn't do this right. We should have done this before."

What you are telling this committee is that there exists now a coordination and cooperation between you so that Mr. Magruder's efforts are approved by your Agency; is that correct?

Mr. RUCKELSHAUS. Yes, that is right.

Mr. YATES. All right. Mr. Ruckelshaus, I think your statement was a very fair and frank delineation of what your responsibilities are and what the problems are.

Mr. RUCKELSHAUS. Mr. Yates, I might interject I think that is precisely the position of the administration, what my statement is.

Mr. YATES. Good. That is fine.

Let me ask you a question. What happens when the Concorde starts to fly? If my memory serves me correctly—you correct me, Mr. Magruder, if I am wrong—the Concorde presumably will have its first production model flying about 1973 or 1974; is that correct?

Mr. MAGRUDER. The earliest is November 1973, and more likely in the first quarter of 1974, and our research program has been timed so that this data will be available to Mr. Ruckelshaus and his organization prior to that airplane going into service. Our latest information indicates that the Russian airplane goes into service in Russia in the fall of this year, so we will not have information to cover those airplanes.

#### NOISE POLLUTION JURISDICTION

Mr. YATES. Mr. Ruckelshaus, do you have jurisdiction as well over noise pollution?

Mr. RUCKELSHAUS. No, I do not, Mr. Yates.

Mr. YATES. Who has?

Mr. RUCKELSHAUS. We have requested the joint jurisdiction over noise pollution with the FAA in the noise abatement bill that was submitted by the administration to Congress, so that we would have the veto power over a noise standard that was set by the FAA.

Mr. YATES. Does the legislation which created you specifically exclude you from having jurisdiction over noise pollution?

Mr. RUCKELSHAUS. Does it exclude me from having jurisdiction?

Mr. YATES. Yes. You said you were trying to get a joint supervisory effect over noise with FAA. I am asking you why you don't have it now.

Mr. RUCKELSHAUS. Because we have no authorization in any existing statute.

Mr. YATES. You have jurisdiction over pollution of the environment, if I understand it correctly.

Mr. RUCKELSHAUS. That is by virtue of the reorganization plan that created the Agency, and what we have is the authority of the agencies we inherit.

Mr. YATES. And none of those agencies gave you the authority to supervise noise pollution.

Mr. RUCKELSHAUS. We have one authority in the Clean Air Act of 1970 which was signed the last day of last year by the President, to make a noise abatement study, and recommend legislation to the Congress, on the basis of that study, which will last 1 year under the statute. We have recommended legislation to the Congress before the study is over.

Mr. YATES. It has been said that the Concorde will have noisier engines than the SST, and for that matter noisier than most of the subsonics.

Mr. MAGRUDER. Can I correct that, please?

Mr. YATES. You may indeed.

Mr. MAGRUDER. The information we have indicates that the Concorde is quieter than the 707, DC-8s but noisier than the new subsonic jet rules.

Mr. YATES. Then you and I agree that its sideline noise would exceed 108 PNDP at the present time.

Mr. MAGRUDER. I don't know the exact number, Mr. Yates, but it is something like 110 or 111, very close.

Mr. YATES. Then it does exceed it. You would not then have jurisdiction to bar the Concorde from this country, if its noise exceeded FAA regulations.

Mr. RUCKELSHAUS. I have no such authority now.

#### INTERNATIONAL STUDY OF ATMOSPHERE POLLUTION

Mr. YATES. Do you think it would be a good idea for representatives of this country, France and England and Russia, to sit down before undertaking the production versions of their plane, and decide on a joint effort, to find out about whether or not supersonic flights by fleets would pollute the atmosphere?

Mr. RUCKELSHAUS. I think Chairman Train testified before this committee or before a Senate committee last May to the effect that this was an international problem, and that there should be an effort made to make a study of this. However, barring that, this country is committed, and this Administration is committed, to making these studies on our own.

Mr. YATES. The problem is that we are told, those of us who oppose the SST, that we are unrealistic, that the SST is going to fly, and if the United States doesn't fly an SST, it will be flown by the Russians, it will be flown by the French or by the British. The point I want to

make is that if your studies find that supersonic flights would pollute the atmosphere, would you have the authority to bar such planes from entering this country?

Mr. RUCKELSHAUS. I think, Mr. Yates, that if that were the result of our studies, if such authority were lacking in my agency, it would be a very simple matter to get it from Congress, to get the authority to bar any polluting mechanism from this country.

#### INTERNATIONAL AGREEMENTS IN SUPERSONIC OPERATIONS

Mr. YATES. I thought it would be a good idea to try to come to some sort of an agreement of that type, and on August 5th of 1970 I wrote a letter to President Nixon in which I said that I was writing to him on a subject of very great importance. I quoted the findings of the Williamstown scientists that had just been issued, and I said that :

Based upon such conclusions, the scientists recommended "that uncertainties about SST contamination and effects be resolved before large-scale operation of SST's begins."

I quoted Mr. Train, what he had said in his testimony before various committees and I concluded by saying :

Mr. President, I believe it makes no sense to go ahead with the SST or with the Concorde or the TU 144 until we know more about what their long-range environmental impact is likely to be.

I suggested to him that the effort be made to get in touch with representatives of the countries, in order to attack this on an international level, inasmuch as I agree with Mr. Train that it is a worldwide problem, that France, Britain and Russia have the responsibility as well to make sure they don't pollute the atmosphere as we have.

I received a reply from Mr. Beggs, in which he said :

The President has asked me to reply to your letter of 5 August urging that the United States intercede with the Governments of France, Britain, and the Soviet Union in the matter of supersonic transport production.

I respectfully suggest that while I understand and appreciate the intent of your proposal, I am also keenly aware of the competitive advantage the European nations in particular realize they have in the development of prototype supersonic transports, now in flight test in all three countries. I strongly suspect that any overtures on our part calling for any delay in their programs would be interpreted first as an effort to reduce the time advantage they now hold over the U.S. program. This suspicion is reinforced by the fact that other nations have not exhibited the same concern over environmental aspects of supersonic aircraft operations that characterizes the U.S. program.

I will put this exchange of correspondence in the record.  
(The information follows:)

August 5, 1970.

THE PRESIDENT,  
*The White House,*  
*Washington, D.C.*

DEAR MR. PRESIDENT: I am writing to you on a matter of very great importance. I am sure you know that a group of distinguished scientists concluded a month-long meeting over the last weekend at Williamstown, Massachusetts, on critical environmental problems. Their conclusions with respect to contamination of the stratosphere by products of SST's were as follows :

1. CO<sub>2</sub> creates no problem.
2. Global water vapor may increase 10% ; increases in regions of dense traffic may go up 60%.
3. Particles from SO<sub>2</sub>, hydrocarbons and soot may double pre-Agung global averages and peak at ten times those levels where there is dense traffic.

4. Effects on climate could be: increased clouds from water vapor; increased temperatures in the stratosphere with possible increase in surface temperatures.

5. A feeling of genuine concern has emerged from the above set of conclusions. The projected SST's can have a clearly measurable effect in a large region of the world and quite possibly on a global scale. We must emphasize that we cannot be certain about the magnitude of the various consequences.

Based upon such conclusions, the scientists recommended "that uncertainties about SST contamination and effects be resolved before large-scale operation of SST's begins."

Now that the MIT group of scientists have raised their warning flag, I urge you to initiate conferences immediately to obtain from France, Britain, and Russia their assurance that they will not proceed with production of the Concorde or the Tupolev 144 pending the undertaking and completion of a study by an authoritative commission of the effect on world environment of projected supersonic flight. I feel quite sure that you would be willing to give our nation's pledge that SST's will not enter production until such a study is completed.

In hearings before House and Senate Appropriations Committees, the Department of Transportation witnesses have tended to dismiss this possibility that the world's atmosphere and temperature might be changed by such flights by alluding to studies done in 1966 by the Office of the National Academy of Sciences and the Office of Meteorological Research. I have spoken in the last few days to officials of both such offices who participated in the 1966 studies and in the month-long meeting at MIT. The scientists now believe the 1966 studies did not address themselves to the entire problem and are, therefore, inadequate. They said there must be much more comprehensive research undertaken. Innote that yesterday Mr. William M. Magruder, the head of the SST program, conceded for the first time the possibility that supersonic flight could have potentially harmful atmospheric effects.

The same conclusion was reached by Mr. Russell Train who is Chairman of the President's Council on Environmental Quality. In testimony before congressional committees, he stated that additional water in this part of the atmosphere could have "two effects of practical significance":

"First, it would effect the balance of heat in the entire atmosphere leading to a warmer average surface temperature . . . secondly, water vapor would react so as to destroy some fraction of the ozone that is resident in this part of the atmosphere. The practical consequences of such a destruction could be that the shielding capacity of the atmosphere to penetrating and potentially highly dangerous radiation is decreased.

"Clearly, the effects of supersonics on the atmosphere are of importance to the whole world. Any attempt to predict those effects is necessarily highly speculative at this time. The effects should be thoroughly understood before any country proceeds with a massive introduction of supersonic transports."

Mr. President, I believe it makes no sense to go ahead with the SST or with the Concorde or the TU 144 until we know more about what their long-range environmental impact is likely to be. I suggest respectfully we cannot ignore warnings like those offered by the MIT scientists and by Mr. Train and hope to preserve the environment.

Respectfully yours,

SIDNEY R. YATES,  
*Member of Congress.*

THE SECRETARY OF TRANSPORTATION,  
*Washington, D.C., August 27, 1970.*

Hon. SIDNEY R. YATES,  
*House of Representatives,*  
*Washington, D.C.*

DEAR MR. YATES: The President has asked me to reply to your letter of 5 August urging that the United States intercede with the Governments of France, Britain, and the Soviet Union in the matter of supersonic transport production.

I respectfully suggest that while I understand and appreciate the intent of your proposal, I am also keenly aware of the competitive advantage the European nations in particular realize they have in the development of prototype supersonic transports, now in flight test in all three countries. I strongly suspect that any overtures on our part calling for any delay in their programs would be interpreted first as an effort to reduce the time advantage they now hold

over the U.S. program. This suspicion is reinforced by the fact that other nations have not exhibited the same concern over environmental aspects of supersonic aircraft operations that characterizes the U.S. program.

With respect to the Study of Critical Environmental Problems sponsored by the Massachusetts Institute of Technology, I believe you will find that the recommendations pertaining to the SST which emerged from that study affirm the actions taken earlier by my department in (1) formulating a comprehensive research program, and (2) establishing committees of eminent authorities in the meteorological, radiation, and noise fields to evaluate the SST as it relates to those areas of concern.

As you noted in your letter, the SCEP focused on two uncertainties: the effects of SO<sub>2</sub> particles, and the possibility of increased cloudiness on a global scale. Two other concerns—relating to the possible destruction of ozone and the build-up of carbon dioxide resulting in a "greenhouse" effect—were essentially dismissed by the study group as inconsequential. The group concluded that the carbon dioxide produced by the supersonic transport would create no special environmental problem and that a climatic effect was not likely. Their additional calculations also removed concern that water vapor might affect climate by accelerating the destruction of ozone. They concluded that the effects of ozone would be small and well within the natural variability.

I beg some disagreement with you, Mr. Yates, on your contention that the Director of the SST Development Program has only recently conceded the possibility of potentially adverse environmental effects. Over the years, we have looked to the Environmental Science Services Administration and to the National Academy of Sciences for counsel on the prospective environmental consequences of SST operations, and as you acknowledge in your letter those organizations have, since 1965, advised us on those matters. It has been their considered opinion that SST operations offered little likelihood of any adverse effects. The possibility, however, has remained an open issue with us. Whenever credible speculation or new evidence has surfaced, we have responded in what I consider to be prompt and appropriate fashion.

For example, initial steps to develop a research program to probe more deeply into upper atmosphere effects of flight operations began here last April and were discussed shortly thereafter with Mr. Russell Train, Chairman of the Council on Environmental Quality. The proposed research program and two advisory committees were subsequently announced by William M. Magruder, SST Director, last month, prior to the MIT-sponsored study in Williamstown. We took the position at that time that the uncertainties with respect to weather modification effects would be resolved before any commitment to a production program was made. This is what the MIT group, as I understand it, has recommended.

Further investigations on combustion product emissions and increased cloudiness, also recommended by the study group, are included in our research program. It has already been determined, I might mention, that substantial reduction of the sulphur content of fuels is fully practical, and we are assured by the petroleum industry that such significant reductions can be achieved.

I realize, Mr. Yates, that your concern in this matter goes beyond the U.S. SST program, since the British, French, and Soviet supersonic transport developments lead our own by several years, and military aircraft which fly at SST altitudes are already operating around the world in considerable numbers. The Environmental and Community Noise Advisory Committees that have been established will follow their in-depth evaluation of the proposed research program (a copy of which I am enclosing) with journeys to the United Kingdom, France, and the Soviet Union for the purpose of exchanging views and recommendations on possible environmental effects, noise, and other matters of common concern. Preliminary talks with the British and French have been conducted by Mr. Magruder on the Concorde noise program, and preliminary agreements between Britain and France on this subject have been in effect since June. In my opinion, negotiations with other nations engaged in supersonic transport developments, concerning the possible environmental effects of those aircraft, can be most tactfully and effectively handled by persons within the scientific community.

In our own considerations of environmental matters, Mr. Train has been most helpful in identifying possible problem areas, and stating quite clearly that the prediction of possible effects is highly speculative. We have coordinated all of our environmental proposals and programs with him, and he has wholeheartedly approved the research program submitted for his review. He has further said

that in and of themselves the two SST aircraft in the prototype program pose no threat to the environment, so long as their flight tests are properly regulated.

May I suggest that like scientists and engineers we get on with the job. We are eight years away from the introduction of U.S.-built supersonic transports into scheduled service. While the TU-144 and the Concorde will precede the B2707-300 into the skies, any massive introduction of SST's is still some time distant. Our research program is geared to produce definitive answers within three and a half years, well short of the time any large-scale operations of SST's could occur. The prototype flight testing, in fact, can be extremely helpful in capping our research, yielding data of value to the aeronautical community worldwide.

My convictions with regard to preservation of the environment are, I believe, well known and a matter of public record. I assure you that, if circumstances warrant such action, I will be among the first to caution against further SST developments in the United States. At the moment, I see no justification for such action, and no cause for interfering with the prototype program. To the contrary, I believe that prototype development ("fly before we buy"), carried forward in conjunction with intensive environmental and noise research, represents the most effective way possible to get at the truth of the SST's utility to our economy and its precise influence on our environment.

Sincerely,

JAMES M. BEGGS,  
*Acting Secretary.*

Encl: Environmental Research Program, August 1970

Mr. YATES. I still think it would be a good thing to try to sit down with the representatives of the transports of the other countries, the companies making these planes, and work out some sort of a relationship to attack this problem as well as on an individual basis, on an international basis.

I would hope that you would give some consideration to this. I see that Mr. Magruder wants to answer this.

Mr. RUCKELSHAUS. I might just remark that Mr. Magruder may be able to enlighten us on the competitive aspects of this. I am not familiar enough with the attitude of the Russians, the British, and the French as to the competitive aspect economically that they see themselves in vis-a-vis this country, and if they did feel that any overture on our part to come to grips with the environmental problems might be considered as an effort to undercut their competitive advantage—

Mr. YATES. What is the harm in making the overture?

Mr. RUCKELSHAUS. You know again I see no harm in it, but it may well be that there is this competitive problem.

#### ENVIRONMENTAL RESEARCH DATA EXCHANGE

Mr. MAGRUDER. The point I wanted to make to ease your mind, we have already had two discussions with the French and the British and have completely shared our environmental research programs results to date. We have agreements between the French engine manufacturing company and General Electric to share noise information. We have agreements between the Boeing Co. and the airframe manufacturers of Britain and France to share information, so both on a government level and in the industry level, these talks have been going on for a year.

As a matter of fact, you are going to hear from Dr. Fred Singer, who is the chairman of our SST Environmental Advisory Committee; and one of his first tasks is going to be to take selected members of his advisory committee to France, and to continue this kind of dialog that has already been going on.

Now as far as Russia is concerned—

Mr. YATES. Why don't you include Russia?

Mr. MAGRUDER. It seemed to us after consultation with the State Department that the wisest way to include Russians in this discussion would be to get a fruitful, vital, and energetic dialog going with the British, French, and ourselves, and to see if we couldn't draw the Russians in. I think our attitude is just as Mr. Beggs has said. I think he intended in his letter, and I know he has in all of his conversations with me, that the instant we have something that we can get our hands on, in this research area, we ought to share it. It is not proprietary. Perhaps it is in the noise area, but certainly not in the environmental area; and it is to everybody's advantage.

Mr. YATES. I would agree with that. At the suggestion of Congressman Adams of Washington, I met with Mr. Withington last week; and we discussed many of the problems of the SST. He said at that time that there were going to be meetings with the British and the French, and that they were thinking very seriously of having the Russians sit in on some of the conversations as well. I would hope there would be discussions by all of them of the experimentation that is going on so that there can be this kind of a concerted effort.

Mr. BEGGS. We have had conversations with the Soviets, Mr. Yates. We have had quite a few talks, as Bill said, with the English and the French. Our current exchange agreements cover all of the environmental information that will come out of their programs, and we have always expected that we would exchange information on these programs.

Mr. YATES. Again, Mr. Ruckelshaus, congratulations to you and Mr. Greenfield for a very frank, fair, and constructive presentation.

Mr. MCFALL. Mr. Edwards.

#### FOREIGN SST ENVIRONMENTAL STUDIES

Mr. EDWARDS. Thank you, Mr. Chairman.

I assume that the French and English are as concerned about the atmosphere problems as we are. Do you have that same feeling about the Russians? Is this a matter of vital concern to them?

Mr. RUCKELSHAUS. I suspect, Mr. Edwards, if the results were to turn out from the experimentation as some have predicted, and they would show that there was a serious problem resulting from a number of planes flying at that altitude, that it would concern the Russians as well as anyone else.

Mr. EDWARDS. Do you know whether they are making tests or doing the things that you are preparing to do, from their own standpoint?

Mr. RUCKELSHAUS. I do not know the answer to that.

Mr. MAGRUDER. I do not know.

Mr. EDWARDS. Does any one at the table know?

Mr. BEGGS. We do not know specifically, Mr. Edwards; but in whatever talks we have had with them, and we have had several, there has been no disclosure of any test program along environmental lines.

Mr. EDWARDS. Are the French and British making these kinds of tests?

Mr. MAGRUDER. The environmental research program has been established within the Department of Transportation in coordination

with the other departments, and it far exceeds anything, in both depth and detail, that the other nations have taken on. They have done the same sorts of studies that we did previously, and I believe their conclusions are that while there are concerns, there are no facts to indicate that damage to the environment is going to happen from a small number or a large number of airplanes. They are very interested in the research that we are going to do. We are going to trade research program results so we don't repeat, and will save costs in all three or four countries. I think this will develop on a three- or possibly a four-way front in 2 or 3 years.

The Concorde studies weren't planned as in the case of the U.S. program. The timing of the Russian program is out of our hands, and the Russian SST appears to be going into some sort of fleet service this year, in Russia. That we can't control. We can just move as quickly as Mr. Conte has indicated he would like us to move, and we shall do that.

Mr. BEGGS. Just one other comment. The English and French have concentrated, of course, on the noise problem. We have done quite a lot there too. They are now gathering information on the sonic boom. This was alluded to before. They are doing quite a bit of instrumentation, and are gathering information as they fly the aircraft at supersonic speed, but I think as Mr. Magruder said, the upper atmospheric work is unique to this country. They have not been concerned because, as he stated, apparently they feel that the existing scientific evidence indicates that there will not be a problem.

Mr. GREENFIELD. I might interject one point on that last thing, the atmosphere. There is a reason why we are pushing as hard as we are, and that goes to the fact that the modeling and consultation work associated with the aero-dynamics of the atmosphere is inextricably tied to the experimental part. You can't get the full answer by doing just one or the other part of it. You really have to do both. I think there is no doubt right at the moment that the work in this country is far ahead in the modeling part of the atmosphere over what has gone on in Russia or in the United Kingdom.

Mr. EDWARDS. What I am really wondering is this, is the concern of the people in this country greater than it is in these other countries?

Mr. RUCKELSHAUS. I think that if you look at the concern about the environment as a global concern, it is true that the concern has arisen in a more explosive way in this country than it has in probably any other country of the world, with the possible exception of Sweden and one or two other European nations, but it has become a national concern in this country, much more so than other nations of the world, but this does not mean that the same kind of concerns are not arising all over the world at the same time.

I have talked to many representatives of countries from around the world, both developed and less developed countries, and the same kinds of problems that have arisen in this country are arising there, and they are giving rise to the same kind of a popular awareness of the problem of the environment, and the demand to do something about it.

Mr. EDWARDS. Certainly this country and this administration don't have to take a back seat to anybody insofar as its concern with the environment is involved. Is that a fair statement?

Mr. RUCKELSHAUS. I think that is a fair statement.  
 Mr. EDWARDS. Thank you.  
 Mr. MAHON. Would you let me ask a question?  
 Mr. McFALL. Yes.

#### GENERAL CONCERN ABOUT THE ENVIRONMENT

Mr. MAHON. Do you mean that the other countries of the world are concerned about the environment generally, and are growing more concerned, or do you mean they are growing more concerned about the possible threat to the environment of the SST?

Mr. RUCKELSHAUS. No, I think the concern is more general than it is specifically aimed at the SST.

#### CONCERN ABOUT THE THREAT OF THE SST TO THE ENVIRONMENT

Mr. MAHON. Do you get the feeling that other countries of the world would probably consider the threat of the SST to the environment as being a bit trivial?

Mr. RUCKELSHAUS. I hesitate to characterize anybody's concern as trivial until I know the answers regarding their concern. I think that it is true, almost by its character of a country, you can determine their approach to an environmental problem. I could give you some very graphic examples but some nations that are more interested in industrial development than others do seem to have less concern with environmental problems than others.

Mr. MAHON. I am only speaking about the SST.

Mr. RUCKELSHAUS. There are those who say the concern about the SST is trivial, and there are those who say that those who say it is trivial are trivial, so I don't know. I think there is probably less concern in many other countries than there is in this one, but many other countries haven't had the issue focused like we have here.

Mr. McFALL. Mr. Steed.

#### STOPPING SUPERSONIC FLIGHT

Mr. STEED. Mr. Administrator, I must say that on a subject in which you experts are convincing us that there are so many questions no one can yet answer, that it surprises me and sometimes amazes me how many self-appointed experts and maybe qualified experts, see fit to make flat and categorical statements about what supersonic flight in the atmosphere will do to the environment. On the other hand, those who I think are really qualified to speak, as you gentlemen are, carry little weight with many people in the public sector.

What I want to ask you is this: If after the research that you plan, and you come to the point where, in the exercise of your responsibilities, you have to make a determination that supersonic flight was bad for the environment, and therefore would have to issue an adverse order, and knowing that the British, French, and Russian use of the atmosphere for supersonic flight was a fact, and increasing, would you feel that you could go into the world public opinion area, with as much force and effect, if you found these answers without the two prototype models to help you, as you could if you found these answers with prototype models?

Mr. RUCKELSHAUS. I don't think there is any question but what my motivation might be questioned, if I were giving this answer when we had no capacity to compete internationally by the use of SST's.

Mr. STEED. Since they have gone as far as they have, if we find that the supersonic flight is in fact dangerous to the human race, then we would have to be the world leader in trying to stop such use of the atmosphere.

Mr. RUCKELSHAUS. I think that is right.

Mr. STEED. And we would need all the tools that we could command to bring world opinion on our side in that case, wouldn't we?

Mr. RUCKELSHAUS. I think that is right, Mr. Steed. I might add that I believe that some of these questions are susceptible to more scientific certainty that may have appeared today or in previous arguments, and I believe than if the results of the research were to verify those who say the concerns are real, and that these problems indeed do exist, and that we shouldn't go ahead with the production, I believe these scientific judgments on the part of our Government would be generally accepted by scientists around the world.

I think, from my discussions with Dr. Greenfield and many other scientists in the area, that these kinds of questions are subject to rather close and verifiable certainty.

Mr. STEED. And you will want to find those answers as accurately and as positively as human ingenuity will permit you to do.

Mr. RUCKELSHAUS. That is right.

Mr. STEED. That is all, Mr. Chairman.

#### DR. WILLIAM KELLOGG'S STATEMENT ON SCEP

Mr. McFALL. I would like to ask you one further question, Mr. Ruckelshaus, so that there won't be any misunderstanding concerning the effect of your testimony. Tomorrow we will begin with Mr. Magruder. We will be behind schedule. We hope we won't inconvenience the witnesses who were scheduled to start tomorrow morning, but we will start with Mr. Magruder.

Part of Mr. Magruder's testimony will deal with the environment. I want to quote some of his testimony to you, before you leave today, and seek your opinion on it. He will say on page 33:

"First, there are the findings of the MIT-sponsored study of critical environmental problems (SCEP), a month-long seminar held on the campus of Williams College during the summer of 1970. A portion of the study was given over to the possible impact of the SST on world climate.

"Not surprisingly, the SCEP advocated more research. But equally important, I believe, the chairman of this scientific working group made it clear that there is no reason to halt or delay work on the U.S. SST prototype program. This fact, unfortunately, did not always emerge in the press reports and commentary on the SCEP findings. The misleading accounts of the SCEP's position led the chairman of the Working Group, Dr. William Kellogg,<sup>1</sup> to issue a subsequent statement, saying in part:

"I am very much disturbed over recent gross exaggerations and scientific misstatements regarding the SST's potentially harmful ef-

<sup>1</sup> Associate Director of the National Center for Atmospheric Research, Boulder, Colo.

fects upon the atmosphere and man's environment. Last August a group of scientists at the MIT summer study stated that there are indeed environmental uncertainties, caused in no little part by gaps in available information, which require additional research in order that they may be resolved. I pointed out at that time and want to strongly reaffirm that there is no environmental reason to delay construction of the two prototype SST's."

Now, do you agree with that last statement?

Mr. RUCKELSHAUS. Mr. Chairman, I do agree. There are no reasons at this point environmentally to show that the SST is going to be environmentally damaging.

Mr. McFALL. I want to continue to quote from Dr. Kellogg's letter:

"It is my profound hope that the U.S. Congress will not be misled by these exaggerations or by scientific misstatements. Dr. Ed David's<sup>2</sup> statement, which Dr. Walter Roberts<sup>3</sup> and I strongly endorse, says it well: "Let's not suppress technological advances but through research, development and experimentation make sure that those advances are obtained without undesirable side effects." I support a vigorous environmental research program in parallel with prototype SST construction. Don't downgrade the ability of American scientists and engineers to apply their genius to the successful resolution of uncertainty."

Do you agree with that last paragraph?

Mr. RUCKELSHAUS. Yes.

Mr. McFALL. Thank you, Mr. Ruckelshaus. We will start tomorrow morning at 10 o'clock.

TUESDAY, MARCH 2, 1971.

**WITNESSES**

**W. M. MAGRUDER, DIRECTOR, SUPERSONIC TRANSPORT DEVELOPMENT, DOT**

**HON. JAMES BEGGS, UNDER SECRETARY OF TRANSPORTATION**

**JOHN P. OLSSON, DEPUTY UNDER SECRETARY OF TRANSPORTATION**

**WALTER R. BOEHNER, DIRECTOR, OFFICE OF BUDGET, DOT**

**B. J. VIERLING, DEPUTY DIRECTOR, OFFICE OF SUPERSONIC TRANSPORT DEVELOPMENT, DOT**

**R. E. PARSONS, ACTING DEPUTY DIRECTOR, OFFICE OF SUPERSONIC TRANSPORT DEVELOPMENT, DOT**

**HON. HENRY S. REUSS, U.S. REPRESENTATIVE FROM WISCONSIN**

**HON. STEWART L. UDALL, COALITION AGAINST THE SST**

**DR. JAMES McDONALD, INSTITUTE OF ATMOSPHERIC PHYSICS, UNIVERSITY OF ARIZONA**

Mr. McFALL. Our first witness today is the Director of the Supersonic Transport Development, Mr. W. M. Magruder.

Mr. MINSHALL. Mr. Chairman, will you yield before he starts?

Mr. McFALL. Yes.

Mr. MINSHALL. Mr. Magruder, it is my understanding there is available a reference film on the Russian supersonic transport program.

Mr. MAGRUDER. That is correct.

<sup>2</sup> Dr. Edward E. David, Jr., the President's Science Adviser, in a statement issued Dec. 5, 1970.

<sup>3</sup> Director, National Center for Atmospheric Research.

Mr. MINSHALL. Do you plan to show that?

Mr. MAGRUDER. No; we had not planned on it. It is available but we had not planned on it.

Mr. MINSHALL. How long does it run?

Mr. MAGRUDER. Twenty Minutes.

Mr. MINSHALL. Mr. Chairman, I would like to suggest if time permits later on in the hearings it might be helpful to see that film.

Mr. McFALL. We will certainly consider that, Mr. Minshall. We will see how the timing goes.

Mr. MINSHALL. Unfortunately, I am going to have to leave, but I would like to be back to see it.

Mr. McFALL. We are going to have some slides and other pictorial matter here as part of Mr. Magruder's presentation. If you feel that the film would add to the hearing, we could certainly work it in, if time permits.

Mr. MAGRUDER. We will make that available.

Mr. McFALL. I would think we would allow Mr. Magruder to go through his statement, since it is a long statement with a lot of detail. Much of the matter in the statement was discussed in some way or another yesterday, and there will be questions about it. It is a statement that covers the entire case, and I think with greater detail than some of the testimony yesterday.

#### STATEMENT BY DIRECTOR, SST DEVELOPMENT

Mr. MAGRUDER. Thank you, Mr. Chairman.

As you know, this is my first appearance before a House Committee of any kind, and I welcome the opportunity, and especially I am happy that this is an open hearing. I think the difficulty with the SST has been one of communication, for the Congress, with the public and with the news media, to make sure all the facts are understood.

I have noted, in the short time I have been on the program, 1 year now, that most of the questions that have arisen are the same that I asked myself when I considered taking this job. I am going to aim my presentation today at showing the progress that the program has made since 1970 and to answering the key questions or concerns that have been raised. I will submit testimony of experts who have considered these questions over the past few years, and hope that this will clear up any confusion.

First of all, with your permission, I would like to submit my formal statement into the record. I will not read that, but will instead summarize it using a number of charts.

Mr. McFALL. Without objection, we will put that in the record for information purposes, and then we will proceed with your oral testimony.

(The statement follows:)

STATEMENT BY WILLIAM M. MACRUDER  
DIRECTOR, SUPERSONIC TRANSPORT DEVELOPMENT

Mr. Chairman, gentlemen of the committee, it is a pleasure to appear before you today and to have the opportunity to present the case for the United States program to develop and flight test two experimental prototype SSTs.

Since this is my first appearance as a witness before this Committee, I would like to describe the extensive SST personal review that I had made before accepting Secretary Volpe's invitation to head up the SST Program for the Government last year.

This review included discussions with industry, NASA, Air Force, airlines, financial and Concorde key personnel to ascertain their feelings, interest, and general evaluation of the overall SST programs. I don't think I need to tell you that I was convinced as to the strong merits of the SST and the need for this country to undertake this advanced program of far-reaching implications for the future well being of our citizens. I would not have assumed this task if I had any doubts on this score.

There seems to be public confusion about the U.S. Government role in this program on the following accounts:

- o The program is to develop and flight test two experimental aircraft in order to keep our options open in the international competition.
- o There will be no commitment to production unless the airplane is economically viable and will have been shown to be not harmful to the environment.

- o No government commitments have been made for production appropriations for U.S. SSTs.
- o All government participation will be repaid by means of a sales royalty plan.

Today, I feel even more strongly that my decision on the merits of the U.S. SST program was correct. We are in our tenth year of research and development of a 13-year program. I have attempted to check and analyze every piece of "so called" evidence produced on possible detrimental environmental effects and have found none that are supported by recognized scientific authorities as being of sufficient concern to curtail the program - likewise in other crucial areas such as economic benefits. I will speak to all of these points in some detail. First, I would like to describe the status of the program and highlight the extensive progress that has been made since last summer.

PROGRESS

I am pleased to report that in spite of tight funding restrictions, the Boeing and General Electric Companies are essentially on schedule.

Funding

As of March 30, 1971, a total of \$1,009 billion has been invested in the program since 1961. The government's share of this has been \$864 million of which \$708 million has been appropriated and \$156 million authorized under the FY 1971 Joint Resolution. Industry's share has been \$144 million of which \$85 million was provided by the manufacturers and \$59 million contributed by the airlines. In addition, the manufacturers have also invested \$54 million in new facilities and \$25 million in nonallowable commercial expenses for a total of \$864 million by the government or 79 percent and \$223 million by industry or 21 percent.

Schedule and Management

During this fiscal year, the program has advanced well into the final hard design, fabrication, and procurement phase. We are basically on schedule, within budget, and the configuration has remained essentially stable throughout. If anything it appears to be better than predicted.

Engineering manpower peaked in the fall of 1970 with the factory peak scheduled for 1971. Seventy percent of the total manpower required to complete the prototype program will have been expended by the end of FY '71. Presently 14,000 people are working on the prototype program at the Boeing Company, General Electric, major subcontractors and at the suppliers. Through the multiplier factor it safely can be stated that at least 50,000 jobs will result from the SST prototype program.

Monthly DOT/Boeing and DOT/GE management reviews are continuing as well as joint Boeing/GE meetings to ensure that current information is available at all times. Program visibility is good and all program controls appear to be operating effectively.

Reacting to the admonishment by Congress to assure optimum management controls, the Director decided to employ two line Deputies. This was deemed advisable in view of the increasing program tempo and the flexibility that it would provide in the day-to-day management of internal and external SST office activities.

One deputy, R. E. Parsons, will assist in handling those activities directly related to project management, dealing with the contractors and evaluating project performance and rendering timely direction. The other Deputy, B. J. Vierling, will assist in conducting the necessary staff work and formulating policy recommendations necessary to convert the program to private sector when the present prototype phase is completed.

The office staffing is still considerably under authorization and currently recruiting is underway to strengthen the following areas: financial management and economic forecasting, on-site field representation, environmental specialist, and data handling and processing specialist. While we have doubled the size of our field representation, we have not been able to staff the on-site field organization with the types or numbers of personnel I feel are required for optimum management, due to the present uncertain nature of the program.

#### Airplane Progress

The full-scale metal mockup duplicating the prototype design was completed and unveiled in June 1970 on schedule and below budget. Since that time, it has been continuously in use progressively verifying the structural design of the prototype aircraft and the optimum location of ducts, tubing, wiring and equipment and checking functional installation of systems within the structure.

A steady flow of drawings has continued from the design tables to the factories and shops across the nation. Over half of the detail design has been released for manufacturing with the 75% point scheduled by the end of FY 1971. Detail parts fabrication is underway both at The Boeing Company and the seven major subcontractors.

The major subcontractors were all placed under contract last year. The team consists of major companies across the country - Aeronca, Fairchild Hiller, North American Rockwell, Northrop, Rohr, Cleveland Pneumatic and Heath Tecna. Each firm has invested its own capital in special facilities and equipment to accommodate use of the latest manufacturing technologies and has agreed to share the costs of the prototype phase. The first major airplane section will start assembly in March 1971 at Northrop.

Contracts have been awarded for the majority of the airplane systems and substantial orders have been placed for titanium raw materials. There are approximately 550 Boeing first tier suppliers involved, located in 40 states. Raw materials began arriving at Boeing in June 1970 in support of the detail parts fabrication. Finished parts are accumulating in storage as required for the wing major assembly start scheduled for June 1971.

Supersonic, transonic, and low-speed wind tunnel testing is essentially complete. Approximately 39,000 hours of wind tunnel testing have been conducted.

#### Boeing Facilities

Substantially all of Boeing's new facilities (representing a 30 million dollar Boeing investment) are in place or on order including the most modern titanium processing plant in the aerospace industry covering some 87,000 square feet of space.

Engine Progress

General Electric has made steady advances in the development of the prototype engines for the U.S. SST. The engines continue to demonstrate their ability to meet thrust and fuel consumption values equal to or better than those required. The engine program remains on schedule and within budget.

Significant program accomplishments have been numerous; however, the following are particularly noteworthy:

One engine successfully operated for more than 80 hours at simulated 1,800 mph cruise conditions and established a new world's thrust record of 69,900 lbs. for aircraft gas turbine engines.

One engine successfully operated for 150 hours at rated turbine inlet temperature or above.

In December 1970 the first of the actual flight test configured engines became available and testing was initiated. During the first half of FY '71, some 400 hours of testing were accomplished bringing the total to over 1,500 hours for the Phase III program.

With the design of the flight test engine completed, material procurement and manufacturing are proceeding as scheduled. General Electric's first tier suppliers number approximately 2,000 and are situated in 38 states. General Electric has placed 118 million dollars worth of orders out of an estimated Phase III total of 170 million dollars.

Noise Suppression Progress

The Boeing Company is working closely with the engine company, members of industry, and the Government on a coordinated aggressive noise technology

program. Recent testing has revealed three significant breakthroughs in noise improvement which have dramatically improved the SST noise posture.

1. Actual ground tests on the prototype engine and detailed flight performance analysis have revealed significantly less effective perceived noise than was estimated initially.
2. Wing flap tests in the NASA wind tunnel showed an improvement in lift and drag and a marked beneficial effect on takeoff thereby improving the altitude of the airplane over the community during climbout.
3. Recent testing of advanced suppressors are encouraging in their acoustic and performance characteristics.

The combination of these features, characteristics and suppressor developments will result in achieving a marked reduction in SST noise.

Prior to production commitment, the capability of the commercial SST to achieve noise levels consistent with those required for certification of new four-engined intercontinental subsonic transport aircraft will be demonstrated.

#### Airline Reviews

The Airline/SST Committee completed a review of the Prototype and Production design status in November 1970 and continue to be actively engaged in all phases of the program. In March this year a major review of the engine and noise suppressor studies and experimental work for the eventual production aircraft will be held.

#### Environmental Effects Progress

Scientific authorities who have counseled the government over the past

five years have voiced the considered opinion that in the light of existing data there is no evidence of likelihood that SST operations will cause significant adverse effects on our atmosphere or our environment. Nevertheless, the desired degree of certainty about these matters has not been attained. Therefore, the Environmental Advisory Committee was formed in July 1970 and is composed of some of the most knowledgeable atmospheric, radiation and noise specialists in the United States. This committee will advise me on these matters and recommend and plan research in any areas where uncertainties may exist.

Likewise, a Community Noise Advisory Committee has been established and will counsel us in this very important area.

Comprehensive research programs in the key areas of climatic effects, cosmic radiation and noise reduction have been defined and are being undertaken. Already, as I have mentioned, dramatic improvements in the community noise reduction area have been achieved.

FUNDING OPTIONS

Last April I reported to the Committee that the original funding request for FY-71 was reduced from \$315 million to \$290 million and the DOT estimated cost for Phase III was \$1,283 million.

Judicious replanning of schedules, deferral of work to subsequent phases, and general belt tightening allowed us to gain the assurances of the two prime contractors that with timely and adequate future funding there was still a high probability of holding the original schedule and total cost estimate (November 1972 and \$1,207) even with the reduced funding in FY-70 and FY-71. We are currently trying to control to this plan by utilizing all in-house Boeing and General Electric management pressure and maintaining the major subcontractors as originally planned.

If we receive the funding as originally requested, i.e., \$290 million for FY-71 and \$235 million for FY-72, I believe we will be able to recover the schedule time lost under the continuing resolution and still meet the March 1973 first flight date within our Phase III estimate of \$1,283 million. This will permit sufficient funds early in FY-72 to support the rapid buildup and schedule acceleration necessary to effect the transition from the continuing resolution to the \$290 million level. The risk of schedule slippage is obviously higher now than if we had been able to proceed on a timely basis but we believe it is no higher than that assumed by the contractors when they previously gave us assurance that they could maintain the November 1972 flight date within the \$1,207 million cost figure.

The costly option would be to remain at the level of the continuing resolution, i.e., \$210 million for FY-71. This would result in a schedule impact of at least five months (March 1973 to August 1973) and would require renegotiation of both prime and major subcontracts with an associated unfavorable loss to the Government of the existing cost overrun points. It should be noted that, while the cumulative FY-71/FY-72 funding would be less due to our inability to recover schedule time in FY-72, the total Phase III cost impact would be appreciably higher. Preliminary estimates range from \$95 to \$115 million depending on our ability to negotiate the prime contracts and, in turn, the prime contractors' ability to negotiate with the major subcontractors. The element of fiscal doubt introduced by such a drastic program change does not enhance the Government's chances of controlling costs or schedule.

THE INTERNATIONAL THREAT

The great potential for a major breakthrough in the speed of commercial transportation has been recognized by aeronautical engineers and scientists for well over the past decade. Now SST programs by three nations are well into the final stage of proof by flight test. DOT information indicates that both the British/French Concorde and the Russian TU-144 have performed satisfactorily at all speeds, including the design supersonic cruise, and are well on the way to demonstrating that the SST age has definitely arrived and cannot be ignored.

As of the end of 1970, the Concorde prototype airplanes (001 and 002) have completed a total of 376 hours of development flying. Of these total hours, 86 have been at supersonic speeds and approximately 12 have been at supersonic cruise speed. The total number of flights is 188 with 98 of these involving supersonic flight. The highest Mach number achieved to date is 2.07 (1,360 mph) and the highest altitude is 58,000 feet. The TU-144 is estimated to have flown over 400 hours with the highest Mach number being about 2.2 (1,450 mph).

Comparative characteristics and status of the competing SSTs are shown in the charts.

E-4  
E-5

Next I would like to discuss the Concorde and its economic potential in some detail.

Concorde

E-1

The British/French supersonic transport is a pure delta wing airplane. This differs from the U.S. SST, which features a conventional horizontal tail, allowing the use of high-lift devices on the wing for better

low-speed performances. As a result, the U.S. plane has shorter takeoff distances and higher rates of climb over the community, thereby resulting in lower community noise and better subsonic performance. The Concorde is smaller and shorter, about the length of a Boeing 707, and carries about half the payload of the SST. It is also slower, being constructed of aluminum, which loses strength at the higher speeds which produce higher skin temperatures. By employing a more advanced technology and using titanium, the Boeing 2707 is being designed to cruise at just under 1,800 mph. It should have advanced model structural growth capability to speeds over 2,000 mph. Approval has been given for construction of six production Concorde models, in addition to the two flying prototypes and two pre-production models currently under construction. Model specifications and performance guarantee negotiations appear to be complete at BOAC and Air France. Sales agreements could occur as early as March 1971. Reportedly, an advanced model Concorde is also being considered which would be larger and therefore more competitive with the American SST and the State Department has indicated Germany may join in the financing of this advanced model.

Skepticism regarding the economic viability of the Concorde has been heard. When compared with the jumbo jets on the basis of seat mile costs alone, we could draw this conclusion. However, a quick review of the Concorde performance to date versus what the engineers had laid out in their test plans, gives us good reason to believe that the Concorde program will perform as designed. When one reviews the first 707 original range and payload, there is no basis at this time to question the adequacy of the Concorde's range/payload, since all indications are that the first Concorde will carry its

design payload across the Atlantic and will have better range than the first 707 in service which had a range of about 3,300 statute miles with full payload.

The results of the Concorde test program will go a long way toward answering the question, "how profitable will the first supersonic transports be?" The Concorde has performed better than predicted in many areas. Both prototypes are flying at their supersonic cruise speed and have not encountered insurmountable difficulties. The specific fuel consumption and vital aircraft operating characteristics have been generally established for the speed regime through Mach 2.0 (about 1,350 mph) and have confirmed engineering estimates.

In any event, one must recognize that the Concorde introduces a new class of transportation. It will be the queen of the international commercial aircraft fleet as the first of a new generation transport and because of its much shorter trip times. History has shown that speed has value, and that the name of the game in transportation is to reduce travel time. This value could offer airline revenue in several ways. The most obvious are higher load factors and the willingness of passengers to pay a rather modest premium fare for speed.

The Concorde may have a surcharge, not because it is needed, but to protect the slower subsonic jets flying the same routes from early obsolescence. Even with a small 15% surcharge above economy fare which is much less than the present difference between the economy and first class fares, the Concorde can return 12.8% after taxes at a nominal 55% load factor. However, at a 70% load factor (equivalent to only 84 passengers) the Concorde could earn over 20% after taxes. It is reasonable to expect this to be achieved during the first several years of operation, because the Concorde will have a monopoly of

supersonic operations, and the potential demand for the higher speed will far exceed the number of Concorde available.

The Concorde manufacturers have been emphasizing the desirability of the Concorde as a single-class airplane, with a probable fare level 15% below jet first class, catering to travelers who are sensitive to the value of time savings. With the advent of the U.S. SST, however, in a likely mixed-class configuration, the Concorde would probably be changed accordingly. Furthermore, rather than be used in a head-on competition with the more economical U.S. SST, the Concorde would be more likely shifted to long-range routes with low traffic density, where frequency and load factor considerations would favor a smaller airplane with lower airplane mile costs. On this basis, the initial Concorde would probably continue in service until improved models became available.

Depending on the test program and on the performance of the production Concordes, the British and French Governments could decide to partially subsidize production costs. Since sales price and airline return on investment are directly coupled, a decrease of 20% in the selling price of the Concorde through subsidization could make the aircraft one-third more profitable to the world's airlines, even at a relatively moderate load factor of 55%.

Chart E-8A illustrates the relationship of load factors and the sales price on airlines rate of return.

E-8A

The Concorde breakeven load factor for the New York - Paris route at a 15% surcharge is only 7½% higher than the 747 at the current fares and only 2½% higher than the 707. Because of the potential for high load

factors, the Concorde should have a good opportunity to earn as much as the advanced subsonic jets, particularly on the high-density routes where it will first be introduced. The U.S. SST's breakeven load factor is about 9 percentage points less than the Concorde and at surcharge fares would be less than both the 747 and 707.

E-9

Another way of looking at the effect of load factors on profit is to measure the effect on gross operating profit for the aircraft that will be competing in the supersonic era. Chart E-10 shows that the Concorde at a 15% surcharge will earn a higher annual profit than the long-range DC-10-30 at load factors above 55%, as well as more than the current long-range jets. It is interesting to note that the Concorde without any surcharge will earn as much profit at 75% load factor as the stretched DC-8. The U.S. SST, as might be expected because of its much greater productivity, will earn substantially more annual operating profit than any other aircraft, and at 55% load factor will earn about 50% more than the 747 on long-haul routes in transatlantic and transpacific operations.

E-10

E-10A

#### Russian TU-144

E-2

Unfortunately, we do not have anything like the depth of information on the TU-144 that we have on the Concorde. However, representatives of Pan American and Boeing have inspected the aircraft at Moscow.

The aircraft is a delta wing supersonic transport quite similar in planform to the Concorde. Its range equals that of the Concorde. It is reportedly designed to fly somewhat faster, the higher speed capability being

dependent upon the application of titanium in certain critical temperature areas. The payload is slightly less than the Concorde at 120 all-tourist passengers. The TU-144 is the first commercial supersonic transport to have flown and the first to be flown at supersonic speeds. It could be in airline service as early as 1972 or 1973.

In their June 26 issue, the publication Interavia stated:

"According to a Pravda report, preparatory work for series production of the TU-144 SST is almost completed. Aeroflot has announced its intention to operate the TU-144 on the route between Moscow and Khabarovsk, a journey time of 3 hrs. Aeroflot also envisages the creation of a route for the SST linking Moscow-Delhi-Singapore-Tokyo."

FAMILY OF AIRCRAFT

I have just expressed to you my conviction that foreign governments do have promising SST developments that are much further along than ours. These aircraft represent a distinct threat to our present position of superiority in the air transport and aviation industry, and further to our ability as a nation to continue to maintain a favorable balance of trade. This threat does not concern the U.S. SST alone but reaches out to cover the whole family of aircraft that the United States is now able to offer the nations of the world for any and all missions or transport needs. Before going further into the "family" concept and its effect on the aviation world market, I would like to discuss some key aspects of balance of trade, which is, after all, the prime index of whether or not this country is maintaining economic viability and prosperity on an international basis.

The balance of payments problem is amazingly complex. It is virtually impossible to accurately relate one account like aircraft exports to the total balance of payments. Our payments' balance depends upon many interrelated aspects of the financial and economic fibers of our economy and for that reason the U.S. SST Program analyses are in terms of the balance of trade considerations. Historically, this country has had a strong position in its balance of trade that has enabled it to help other countries of the world and in so doing still maintain equilibrium in the total balance of payments picture.

It is very significant that estimates of the magnitude of the SST impact

upon our U.S. balance of trade, made in 1969, were to a large extent, influenced by cables from our overseas embassies indicating the Concorde program would probably not reach the commercially-viable production stage. In 1970, most of the government agencies having concern with SST development, including the State Department, concluded that the Concorde flight test program to date was going better than originally anticipated. It appears that their SST is headed for commercial service in early 1974. United Kingdom and French officials indicate initial sales announcements are expected early this year. The airlines while not completely satisfied with the capacity of the first Concorde nonetheless continue to support the program and both the French and British Governments have made sizable financial investments to get the initial production Concordes underway, in their determined bid to overcome the U.S. lead in air transport sales. If a supersonic transport of British-French design appears on the world airways within three years, a few essential facts and factors related directly to trade balance are worth considering.

In the earlier balance of payments studies there was serious concern that the U.S. SST through its speed would generate increased tourism and that this tourism would have an adverse effect on our total balance of payments picture and negate the advantages the U.S. would obtain in the trade account from selling 500 SSTs. Underlying these studies was a general consensus by those departments having such concern that the Concorde program would not be viable.

However, if there is a viable Concorde this oft-described "speed-induced travel" factor almost disappears since only the difference between the Mach 2.2 design speed Concorde and Mach 2.7 SST is

relevant. The speed-induced travel concept, if accepted, was used to illustrate a potential negative services account impact from travelers' expenditures abroad, port expenditures, and the like that would all be charged to the U.S. SST. Under the assumption of no Concorde, the amount could be sizable. But with the Concorde in airline service, as all responsible agencies now indicate, then the induced U.S. expenditures abroad over the SST time period to 1990 are roughly estimated at about \$3 to \$4 billion as compared to a roughly estimated favorable trade swing of between \$17 and \$22 billion in 1967 dollars. Also, there is considerable difference of opinion as to the validity of speed-induced travel and for this reason we did not include this input in our charts. Additionally, no weight has been given, either in the past or in our present computations, to the positive effects on exports or on overseas investment income from increasing the productivity of business air travelers, a further conservatism.

The trade balance computations used prior to last year did not adequately reflect the "real world" of airline equipment purchases. The assumption that the free world airlines will continue to buy about 84% of American made civil subsonic jets regardless of our action on the U.S. SST is not a valid premise. Airline executives make their purchases only after careful examination of the manufacturer's "family of aircraft." If the United States restricts itself to the jumbo jets and the tri-jets for the 1980s, then the foreign family of civil transports -- the Concorde for "blue ribbon" overwater routes, the A-300 twin engine 250-passenger low-cost airbus (Figure G-6) and the French Mercure replacement for the DC-9/Boeing 737 (Figure G-7) -- may well, and probably will, induce many airlines,

G-6

G-7

especially nationally-owned foreign airlines, to purchase their "family" outside the U.S., in fact, "closer to home." In addition to pressure on foreign flag airlines to re-equip with home-manufactured airplanes, there are many inducements that can make purchase of non-U.S. transports attractive. These include price discounting, trade-in allowances, purchase loans, low interest rates, favorable warranties, and low-cost spare parts and servicing arrangements. The efforts of the Soviets to develop their own family of aircraft for export is shown here in the recent advertisement of E-12 Aviaexport.

When the U.S. technology is matched by the civil aviation industry abroad, the U.S. airplane manufacturers begin to encounter a business arrangement commonly referred to as the "offset agreement." For example, for McDonnell-Douglas to make a Canadian airline sale, they may have to put the wing and tail manufacture into a Canadian plant, or when Lockheed wants to sell to British airlines, a Rolls-Royce engine may be required, and for the McDonnell-Douglas jet to be eligible for Alitalia markings may require fuselage panels built in Italy. These are actual occurrences! The significant impact of this fact (which reaches billion-dollar levels) upon balance of trade was not considered in prior trade balance studies. However, when our technology takes a big jump ahead of foreign technology, this negative offset disappears. We already have an advantage in technology in the U.S.A. The labor and material to build the all-titanium U.S. SST will be all American, an added safeguard to our trade balance and national economy, for no other free nation has the titanium manufacturing technology of the United States.

One thing is clear in the balance of payments area: it is extremely difficult to predict with much precision future developments of the major nations and aircraft companies of the world. We do know that the continuing high GNP growth rate of the developed nations will increase the air travel of foreign nationals and the need for greater capacity and productivity. Note the North Atlantic travel growth in 1970 in spite of domestic travel level off with the business recession. It is questionable that comparison of the U.S. SST versus the Concorde should be done on an all-black or all-white premise. Nevertheless, in order to simplify the presentation of potential trade swings, it is necessary to make assumptions that there would or would not be a U.S. SST competing with the foreign-built supersonic transports. To the best of our ability, our trade balance studies consider real life factors, but, at best, these projections only convey possibilities of what could happen.

A summary of the results of DOT studies shows that if there is a viable Concorde and no U.S. SST, we suffer a trade imbalance from 200 Concordes imported worth \$7.0 billion and lose by not building an SST, \$10.1 billion from sales abroad, for an unfavorable swing in trade balance of \$17.1 billion. (Figure G-8). If a more airline-economical Concorde II G-8 appears, this unfavorable trade impact would grow to \$22.1 billion. This represents our conservative or base estimate and is due to a greater impact upon the jumbo tri-jet market from a more commercially attractive Concorde II. However, taking into account the effect on import sales of a more favorable "family of civil aircraft," this impact G-9 could grow to \$27.1 billion and, when the real world offset agreements

are accounted for, then this trade impact could reach almost \$30 billion, all computed in 1967 dollars, over a 12-year period (1978-1990). (Figure G-9).

When we apply a conservative escalation of 3% per year to current dollars through 1985, only half the life of the production program, the trade impact numbers can rise dramatically from a minimum of \$17.1 billion to \$45.6 billion over a 12-year period, or \$3.5 billion per year. (Figure G-10).

Finally, when aircraft are sold over a time period such as the U.S. SST 1978-to-1990 time span, the spare parts for airframe and engine support can add exports with a value of 50% of the initial sales price. This factor has also been largely ignored in our previous trade balance assessments. If we add this to the above highest estimate, over \$50 billion trade swing can be projected. This does not include U.S. servicing activities worldwide that employ U.S. people and bring revenue into the U.S.A.

Export business of this magnitude is no longer easily attained or duplicated in other product fields. An examination of Commerce Department statistics shows a steady erosion of our export markets and a migration of our technology abroad. Automobiles, for example, passed from a favorable to an unfavorable balance of trade in 1968 and in 1970 we imported \$2.3 billion more than we exported.

G-12

Unfortunately this trend is continuing and information recently available indicates that imported car sales set a new high in July 1970

up 25% from the year ago figure. Imports of iron and steel products are up 145% over a 10-year period. Consumer goods, excluding automobiles, has shown more than a 297% import rise in the same period. Exports associated with our electrical and electronics industries also represent a disturbing situation. Since the mid-1960s, our electronics exports have been growing approximately 15% per year. However, during this same period, imports have been increasing at the rate of 40% per year. Should these trends continue, it appears that by the end of 1972, our imports will exceed our exports in a field in which we originally excelled in technology. On the other hand, the products of American civil aircraft technology have been near the top of the export list for the past 10 years. This is a strong technology base that we cannot afford to default.

It is a significant fact that our exports of civil aircraft are being converted to favorable trade balances at a ratio in excess of 90%. In other words, 9 of every 10 dollars of civil aircraft exports contribute to our favorable trade balance. This point has not been lost in the deliberations of Sir George Edwards, Managing Director of British Aircraft Corporation, who recently said that the economic future of Great Britain is largely dependent upon the advance of aerospace and related technologies, mainly due to the high conversion ratio of exports against imports for high technology items. Quite clearly the \$2.7 billion of civilian aircraft engines and parts which the U.S. exported in 1970 would have a much greater impact on the British economy where the total Gross National Product is less than one-eighth of that of the U.S., should the British be able to achieve this level of aircraft exports.

A high technology base by means of an advanced competitive aerospace industry, provides an advanced technology spillover to other areas such as titanium usage in the chemical industry. The maintenance of an advanced technology base serves to enhance the position of the United States in its dealings with the other nations of the world. Civil aviation leadership means advanced technology unmatched outside the U.S. and promotes a stable trade balance. These attributes work together toward a common end - a sound U.S. economy. Without a sound economy, we can never honor our commitments to better education, better housing, better health, better law enforcement, better transportation, and, to improve our environment, a better quality of life for all.

PRODUCTIVITY

Aside from the need for an SST as an overall U.S. national transportation requirement, there is the very important consideration of the attractiveness of the U.S. SST to the airlines, both U.S. and international, based on its speed and productivity.

Productivity refers to the ability to do work efficiently. In air transportation terms, one measure of productivity is available seats per airplane times the speed. Analyses in these terms show the U.S. SST to be:

- o Three times as productive as the Concorde and the jumbo tri-jets.
- o Almost twice as productive as the 747.
- o Four times as productive as a 707.
- o Sixteen times as productive as a DC-6.
- o About one hundred times as productive as the DC-3.

New productivity levels provide the basis for the airlines to:

- o Accommodate the normal travel growth requirements coincident with attractive service in terms of departure and arrival schedules.
- o Maintain a reasonable financial return in spite of cost escalation.
- o Provide the traveling public with reasonable fares, and
- o Maintain reasonable worldwide civil air transport fleet sizes.

The impact of productivity increases in the light of these factors, is to facilitate international revenue passenger miles' growth, conservatively

projected by Boeing, to be such that by 1985, the SST traffic alone will equal the entire free world traffic of today. This means 260 billion revenue passenger miles or 100 million people traveling by SST -- and this with no supersonic overland flights. Almost 75% of all intercontinental flights are projected to be in SSTs. This would require about 720 additional 747s or about 1,200 Concorde to do the job of 423 U.S. SSTs. As a means of showing how important it is for aviation to plan ahead, and to underscore why we must go ahead now, examine what would have transpired had the aviation industry not been ready, capable and willing to offer the needed advances in aircraft technology, reflected in improved productivity per dollar, through improved models about every 5 to 8 years.

- o Only 345 pre-war DC-3s were built to serve the airlines of the entire world. By 1947 the DC-3/4 and Constellation fleet had grown to 2,000 civil aircraft.
- o At the end of the piston engine airplane era, a total of some 4,500 DC-6s, DC-7s, Constellations and other piston airplanes were in use by the airlines of the world.

Today the airline fleets of the free world number about 3,500 subsonic jets, and these aircraft carry about 3½ times more traffic than the airline fleet at the end of the 1950s. Had the industry not pressed ahead with the jet age, in spite of all the outcry of the critics of progress of the early Fifties, we would today be choking the airways and airports with piston aircraft and be causing significant environmental degradation.

Looking forward to the 1980s and 1990s, if the U.S. aircraft industry does not continue to move ahead with its advanced generations of more productive,

more comfortable, safer, more reliable and cleaner air transportation, then it must fall behind -- there is no standing still. The economic benefits resulting from meeting the increased demand will be reaped by countries currently planning and aggressively pursuing this lucrative market.

Some critics of the U.S. SST contend that international air travel is limited to an insignificant segment of the U.S. population. Consider the composition and magnitude of air transportation projected for the 1980s. It appears this next advance in travel - communication - cultural exchange - business will be of service to a significant segment of our U.S. population. Examination of present day travel and that predicted for the 1980s shows that:

- o Today, some 44.7 million separate Americans (22% of our population) travel by air domestically and over 6 million internationally (3% of our population).
- o By 1985, which is only the mid-life of the first generation of SSTs, 50% of our population, 126.4 million Americans will travel by air domestically and 25 million, or 10% of our population, internationally. This is hardly a "jet set."
- o 62.3% of international air passengers between the U.S. and foreign countries are U.S. citizens.
- o The business/pleasure split of international air passengers is 26%/74% for the North Atlantic and 24%/76% worldwide. Passengers in the Pacific area are split about 50-50, business and pleasure.
- o The North Atlantic routes represent the most lucrative airline route system in the world, carrying over 6 million people in 1969 between North America and Europe and projected to carry 28 million in 1985. About 2 million Americans or 1% of our population flew this route

in 1969, and about 9 million are expected to fly in 1985. During the 1960s, 19 North Atlantic carriers flew 31.3 million passengers. Passenger volume increased 243% from 1960 - 1968. This air communications system links the two most powerful economic communities in world history - Europe and the United States. By shrinking distances on the entire globe to 12 hours or less, the U.S. SST will open up similar traffic in other directions from the U.S. The forecast growth rates shown in Chart H-14 indicate that the Pacific area including Australia and New Zealand will grow at higher rates in the period to 1980 than the North America-Europe traffic. The 1975-1980 period should reflect the initial impact of Concorde and SST operations, yet the growth rate indicates about one-third reduction from the preceding period. This indicates the conservative nature of the SST forecast. It is very significant that although 1970 was a bad year for domestic airline travel, with a growth of only 2%, international traffic on U.S. airlines was up about 19%. H-14

- o From a profit standpoint, the SST clearly aims at the prime market. Long-haul routes are traditionally more profitable than short haul. Most SST flights will be "long distance." International operations have been shown from CAB statistics to be consistently 60% higher in rate of return than domestic operations, returning 9.6% internationally versus 5.9% on total investment, based on the 10-year average through 1969. This is important to the SST program and fleets of the future in terms of:
  - o Repayment of the government cost share.
  - o A healthy airline industry.

A more rapid payoff of the new equipment directly for a greater return on investment.

Greater productivity is also the way the airlines generate the funds to pay back the loans required for new equipment. Much has been said about the potential price of a U. S. SST escalating from a 1970 estimate of \$37 million per airplane to the order of \$50 million in 1978. Historically, new equipment has produced sufficient revenue to pay back its cost in about 5-6 years. The SST is not expected to be an exception in this respect because of its expected very high productivity -- the ability of the airplane to produce revenue. This is strikingly illustrated in Chart H-15, showing that the SST can earn H-15 annually over 2½ times as many dollars per installed seat as the 747, and an even greater margin over the Concorde and other long-range subsonic jets. This comparison assumes no supersonic surcharge and 55% passenger load factor.

There still remains the question of what the U. S. SST productivity will H-10 do for the average traveling citizen, (all 25 million of us) in 1985. H-11

An examination of cost history and projections to 1985 shows a steady rise in costs for all aspects of airline operations -- except for fuel. In spite of this all too familiar trend, airline fares, compared to the Department of Labor Consumer Price Indices, have actually decreased since 1947. The ability of the airplane manufacturing industry, combined with progressive airline management, enables nearly 45 million Americans or about 22% of our population today, to enjoy the phenomenon of one of the few remaining 5 cent cigars in the form of lower air fares while other prices have risen an average of 50%! The U. S. SST will be available to the 25 million Americans who will fly internationally or 10% of our population to further enjoy these benefits in the 1980s.

In summary, productivity has made it possible for the airline industry to accomplish the following:

- o Hold fleet sizes to manageable levels and offset cost escalation.
- o Maintain a low fare level, enabling more people to fly.
- o Accommodate known travel growth trends with adequate service and constantly improving level of comfort and safety.
- o Provide airlines with earnings generally adequate for solvency and continued growth.
- o Keep airway and airport congestion from reaching impractical levels.

THE ENVIRONMENT and the SST

The Administration's position, Secretary of Transportation Volpe's position, and certainly my own position on the SST in relation to the environment is that the U. S. Supersonic Transport must be demonstrated to be acceptable under the terms of the Nation's commitment to higher environmental standards. We do not intend to allow supersonic air transportation to further blemish what astronaut Frank Borman so aptly described as "the good earth -- an oasis in space".

Secretary Volpe made the Administration's position quite clear when he said in a speech last month "that the production program will not proceed if tests of the prototypes indicate serious damage to the fabric of the natural world, or social problems that we can't treat and assimilate".

The apprehensions that have thrust environmental aspects of SST operations into public prominence are based on theory, conjecture or scientific speculation. While many of these concerns are sincere, and while I consider it entirely proper that we examine the potential environmental consequences of our actions, I suggest we should differentiate between fear and fact, and not confuse possibility with probability.

On that basis, I would like to summarize for the members of the Committee the circumstances pertaining to the SST and the environment, as they now stand.

First, the program never has sought to avoid environmental issues or evade environmental responsibilities. For example, the SST contract was the first transportation development program to contain noise objectives, acknowledging that noise has been a common concern and lower noise levels a goal of our efforts.

Similarly, smokeless engines for the airplane have long been a production requirement.

For nearly five years, the Government has acknowledged that flights of civil supersonic aircraft will not be allowed over the United States at speeds that would cause a sonic boom to reach the ground.

Every possible environmental effect -- radiation on passengers and crew, sonic boom, noise pollution, atmospheric effects -- all of these concerns were subjected to inquiry or investigation even before "environment" and "ecology" became household words. Further research in all of these areas is continuing.

Secondly, there is no evidence or likelihood that supersonic aircraft operations will cause any significant adverse effects on our atmosphere or the global environment. That is the consensus of the scientific community at this point in time, based on existing data. Further, there is general agreement that two prototype aircraft will in no way endanger the environment. Mr. Russell Train, Chairman of the President's Council on Environmental Quality, has so testified before the Senate Joint Economic Committee.

The question that concerns all of us is what effects, if any, will large-scale operations by supersonic aircraft have on the environment we all share -- bearing in mind that whether or not the U. S. SST goes into commercial service, the British-French and Russian supersonic transports will be flying in some numbers, in addition to the countless military aircraft operating at supersonic speeds or altitudes. We cannot answer the question completely or absolutely today, but there are certain facts -- presently available -- which provide insight into the problem and indicate to me that the more conclusive answers we all seek are within reach.

First, there are the findings of the MIT-sponsored Study of Critical Environmental Problems (SCEP), a month-long seminar held on the campus of Williams College during the summer of 1970. A portion of the study was given over to the possible impact of the SST on world climate.

F-38

Not surprisingly, the SCEP advocated more research. But equally important, I believe, the chairman of this scientific working group made it clear that there is no reason to halt or delay work on the U.S. SST prototype program. This fact, unfortunately, did not always emerge in the press reports and commentary on the SCEP findings. The misleading accounts of the SCEP's position led the Chairman of the Working Group, Dr. William Kellogg\*, to issue a subsequent statement, saying in part:

"I am very much disturbed over recent gross exaggerations and scientific mis-statements regarding the SST's potentially harmful effects upon the atmosphere and man's environment. Last August a group of scientists at the MIT Summer Study stated that there are indeed environmental uncertainties, caused in no little part by gaps in available information, which require additional research in order that they may be resolved. I pointed out at that time and want to strongly reaffirm that there is no environmental reason to delay construction of the two prototype SST's.

"It is my profound hope that the U.S. Congress will not be misled by these exaggerations or by scientific mis-statements. Dr. Ed David's\*\* statement, which Dr. Walter Roberts\*\*\* and I strongly endorse, says it well: 'Let's not suppress technological advances but through research, development and experimentation make sure that those advances are obtained without undesirable side effects.' I support a vigorous environmental research program in parallel with prototype SST construction. Don't downgrade the ability of American scientists and engineers to apply their genius to the successful resolution of uncertainty."

\* Associate Director of the National Center for Atmospheric Research, Boulder, Colorado.

\*\* Dr. Edward E. David, Jr., the President's Science Adviser, in a statement issued December 5, 1970.

\*\*\*Director, National Center for Atmospheric Research.

Without going into detail, let me enumerate the principal findings of the SCEPT group as they relate to the SST and the environment.

1. The additional carbon dioxide from SST operations at 60,000 feet to 70,000 feet altitudes will cause no problem.

2. The water vapor content of the stratosphere will probably be increased, but the significance of this change is not known. The SCEPT group did express opinions on several possibilities:

- One, that increased winter cloudiness in the polar region might occur.
- Two, the added water vapor may increase the thickness and extent of stratospheric clouds already observed in the polar region at night. However, the direct radiation effects would result in warming of air at ground level in regional areas of peak moisture concentrations by less than 0.1 degree centigrade on a world-wide basis and cooling in the stratosphere by a few degrees centigrade.
- Three, the reduction of ozone due to water vapor interaction would lie well within the present day-to-day and geographical variability of total ozone.

3. The group noted that reduced ozone could admit more ultraviolet radiation to the lower atmosphere. Predicted ozone changes, however, would be insignificant.

4. With regard to particulates, the direct role of quantities of CO, CO<sub>2</sub>, NO, NO<sub>2</sub>, SO<sub>2</sub>, and hydrocarbons in altering the heat budget is small. It is also likely that their involvement in ozone photochemistry is even less significant than water vapor.

5. The Group found that SST operations will introduce particles into the stratosphere in proportion to the sulphur content of fuels and the amount of hydrocarbons and soot contained in the exhaust products. We know, however, that tomorrow's aviation fuels will contain much less sulphur than today's fuels, which contain about 0.05 percent sulphur by weight. Sulphur in fuel serves no practical purpose, and its reduction will result in a significant decrease in the generation of particulates by aircraft engines. In fact, use of jet fuel with a 0.01 percent sulphur content (instead of 0.05 percent) would reduce emissions by 80 percent.

The overall conclusion reached by the scientists who participated in the MIT Summer Study is one of uncertainty as to the extent of effects from supersonic aircraft operations. The course they recommended is very likely the one you and I would propose -- the obtaining of more information on which a factual, well-reasoned, objective decision can be made.

An American Geophysical Union Symposium on environmental effects of supersonic aircraft was held in San Francisco in December 1970. The papers and panel discussions featured during that symposium were in general agreement with the conclusions reached by the MIT study group.

The SCEP and the AGU did not deal with cosmic radiation, but facts are available which show that SST passengers and crew will actually experience less radiation exposure than subsonic jet travelers because of the shorter time duration of travel in supersonic transports.

It is known, for example, that radiation exposure at different geographical locations on the surface of the earth vary from 35mrem to 200mrem per year, showing that human beings are continually exposed to radiation

of varying intensities. In some parts of the world people in their normal environment receive greater annual exposure than encountered in SST or in subsonic jet travel.

A flight crew of the SST, based on an assumed 200 flights a year, F-14 will be exposed to approximately the same radiation as crews of subsonic jets -- generally less than 10 percent of the 5.0 rem per year exposures allowable by the International Commission on Radiobiological Protection as permissible. (Normal international jet flight crews today average about 120 flights per year.)

To evaluate and apply the facts that are known, and to investigate, analyze and advise on the concerns that do not yet have full or final answers, we have -- first -- established the SST Environmental and Noise Advisory Committees, and -- secondly -- assembled a comprehensive research program encompassing all of the areas where more information and data are necessary.

The members of the SST Environmental Research Committee are identified on this chart. The Committee is chaired by Dr. S. Fred Singer of the F-2 Department of Interior. Dr. Singer is a former Dean of the School of Environmental Sciences of the University of Miami, and is Chairman of the American Geophysical Union's Committee on Environmental Quality. His committee includes the most knowledgeable and highly respected professionals in the atmospheric and radiation fields.

I asked Secretary of Commerce Stans to request the Commerce Technical Advisory Board (CTAB), a body of distinguished, non-governmental scientists, to convene a panel on SST Environmental Research. CTAB agreed and the panel is now conducting an independent analysis of SST environmental concerns. It is reviewing the environmental research program to insure

that it is correctly structured to resolve environmental uncertainties. Their findings and recommendations will be most helpful in support of our environmental research effort. CTAB, as you probably know, recently tackled the issue of removing lead from automotive fuels.

Dr. Fredrick Henriques, a photochemist, and CTAB member, chairs its SST panel. The other panelists are listed on this chart. They represent a range of environmental interests and expertise. The CTAB Panel has available to it, government liaison representatives from every concerned agency, including EPA, HEW, CEQ, NOAA, HUD, STATE, DOD, DOT, and INTERIOR. F-2A

Also, in cooperation with other departments and agencies of the Government, we have defined and have underway a program of research into many of the areas where concerned groups, like the SCEP, have indicated research is needed. In the SST Climatic Impact Assessment program, for example, the Government will conduct research to improve our knowledge of engine exhaust emissions, atmospheric monitoring, chemical dynamics, atmospheric modeling, and contrails and polar cloudiness. As information becomes available it will be communicated to the Congress and to the agencies charged with responsibilities for environmental preservation and protection.

Let me turn now to the subject of noise, which has long been a major concern in the development of the SST.

The members of the SST Community Noise Advisory Committee are identified on this chart. The representation is diverse, and includes some of the outstanding authorities in the propulsion and acoustic fields. It is not F-1

only very gratifying to me that these gentlemen have agreed to serve in this important capacity, but I believe their presence indicates the intense desire of people in Government and the private sector alike to overcome the excessive noise which has been detrimental to the broader acceptance and greater progress of air transportation.

The noise characteristics associated with the SST have been perhaps the most misunderstood and generally confused aspect of the various SST environmental concerns. Some apprehension is certainly understandable, but the facts do not support the degrees of concern and emotion that have been expressed.

These are the facts:

First, the SST will be quieter over the community than the typical jet in the present intercontinental fleet. The noise level, at the designated measuring point -- one-and-a-half miles from the end of the runway, approximately -- will be within the limits of the FAA rule for subsonic jets. This means the SST can be expected to relieve, not aggravate, the present noise situation over the community, where people live or work.

Secondly, the approach noise of the SST over the community will also be lower than the present-day 707 and DC-8 jets. The high-pitched "whine" of the compressor of today's jets will not be heard from the SST because of the unique supersonic engine inlet. This inlet prevents the whine from propagating forward, thus reducing annoyance to the people on the ground.

Now, thirdly, we have the question of noise on the airport itself, or what is referred to as "sideline" noise.

In most communities this is not a serious concern with present aircraft, simply because airports are not expected to be quiet places and the people who work there or frequent airports understand and accept this. In fact, the operators of a major international airport have told me they have never had a public complaint attributable to sideline noise.

With the SST, however, because of the size and power of the engines, sideline noise has been a major technical challenge. Based on the propulsion and acoustic technologies then in hand, the sideline noise levels from the SST appeared in the past to be greater than we preferred. We have, however, had intensive and aggressive noise reduction programs under way for a number of years, and these programs are yielding results. F-41  
Recent testing has revealed significant breakthroughs which have dramatically improved the SST noise posture.

Last month I received a letter from Dr. Leo L. Beranek, Chairman of the SST Community Noise Advisory Committee, informing me of his Committee's latest findings on the noise characteristics for the production U. S. SST. Because of the importance of Dr. Beranek's conclusions, I would like to present the letter in its entirety for the record.

"We are pleased to submit this interim report on the activities of the SST Community Noise Advisory Committee, which you appointed in July 1970. Our initial step was to review the SST noise objectives in relation to the noise situations currently prevailing at the Nation's airports together with the projected improvements resulting from the introduction of new, quieter subsonic

airplanes meeting certification requirements of FAR 36 (Federal Aviation Regulation - Noise Standards: Aircraft Type Certification). This review also included meetings with the airlines, airport operators, Boeing, General Electric and representatives of Government agencies active in aircraft noise.

"On September 11, 1970, I reported the first conclusions of the Committee to you as follows:

1. The noise levels for the production SST should be the same as those imposed by FAR 36 for new 4-engine, intercontinental, subsonic transport aircraft.
2. To meet the above objective, added emphasis should be given by Boeing and General Electric in their respective noise programs.

"Since that oral report, the Committee has kept abreast of progress on the program relative to reduction of the noise levels projected for the production SST. On February 4, 1971, we reviewed in detail with Boeing and General Electric the status of engine and aircraft design of the production SST with respect to noise. This review included results of recent tests on a number of jet noise suppressors, aircraft and engine performance, and the adequacy of engineering methods in predicting the noise levels for the production SST.

"We conclude that the level of technology demonstrated by Boeing and General Electric is sufficient to achieve the noise level objectives we recommended. We are available to discuss our findings with you and other concerned parties, as you deem appropriate."

We have discussed these findings with Dr. Beranek, and with Boeing and General Electric. On the basis of the analyses now available, we are confident that prior to production commitment, the capability of the commercial SST to achieve noise levels consistent with those required for certification of new four-engined, intercontinental subsonic transport aircraft will be demonstrated. F-9

The Airport Operators Council International has been sufficiently impressed with the projected SST noise levels to write a letter of endorsement of the SST program to the President. In this letter the

Council says, and I quote: "We see the SST program as a unique opportunity to reduce community noise, air pollution; and congestion while improving air transportation service through an orderly, well-planned program involving international coordination between airport and airline operators, manufacturers, and governments."

There is one other environmental factor that remains to be discussed, and that is sonic boom. Here there is little to say, except that no one I have any acquaintance with advocates flights at boom-producing speeds over the United States, and everyone involved in any way with the program is agreed that restrictions on overland flight are appropriate. The proposed Federal Air Regulation specifically prohibits flights over the United States at speeds that would create a boom on the ground. A law to that effect has been proposed, and the Department of Transportation poses no objection if a law is the desire of the people and the Congress.

I would point out, however, that flights over land area are not, and never have been considered necessary in order for SST operations to be profitable. The economics of the SST are based on the fact that 70 percent of the surface of the globe is water, and that 89 percent of all international airline route mileage (over 700 miles) is over water.

To conclude this portion of my statement, let me summarize by saying that the Department has complied with the terms of the National Environmental Policy Act (Section 102) requiring that new technical developments be demonstrated as being compatible with sound environmental practices. Our SST Environmental Impact Statement was submitted, along with the comments of the reviewing agencies, on December 7, 1970, to the Council on Environmental Quality. We have discussed the environmental issues with members of the Council and with the Administrator of the Environmental

Protection Agency and his staff. We have considered carefully the findings and opinions of qualified environmental authorities, such as those engaged in the SCEP, and all concerns are being given the close attention of our Advisory Committees. We are continuing the research necessary to enable us to determine the environmental acceptability of the SST before any commitments are made for commercial production.

As I mentioned earlier, the question that concerns us all pertains only to large-scale operations. The prototype program, rather than a threat, is a means by which environmental questions can be better answered and unknowns resolved.

EMPLOYMENT

Gentlemen, as we are all painfully aware, aerospace employment and more specifically commercial transport aircraft development and manufacturing employment has been experiencing a sharp downtrend since its mid-1968 peak. Elements contributing to this include declining sales of large civilian transport aircraft as well as reduced expenditures for military aircraft, missiles and space programs and the civilian space program.

Aside from the international balance of trade implications of the U.S. SST Program, I would like to emphasize the very important consideration of the domestic economic impacts. Certain sections of the country are already experiencing significant economic problems and with increased employment stability, these can be expected to multiply. Inherent in employment losses, of course, are other material considerations, such as personal hardships including severe relocation expenses and increased burdens on state and local governments which tend to compound rather than alleviate the problems.

The foregoing factors should be considered in evaluating the U.S. SST's contribution to the overall good of this country. During the production phase, the SST Program will provide a direct labor force of 50,000 jobs. Through the multiplier factor, the impact more reasonably can be expected to concern 150,000 jobs in the next 15 years if we fail to respond to the foreign SST challenge which is being posed. In this way, we will contribute to a "brain drain" on the aerospace industry specifically and on the technological expertise inventory of the U.S. in general.

Foreign Impacts

We have already experienced some labor impacts growing out of the business arrangements commonly referred to as "offset agreements." Basically, these come about when U.S. technology is matched by the civil aviation industry abroad and in order for U.S. aircraft manufacturers to sell their export products, a portion of the plane is required to be manufactured in the purchaser country, as I have already pointed out.

Quite obviously in these circumstances, U.S. aircraft manufacturers were placed in a position of having to adopt a "half a loaf" approach in dealing with these agreements. However, in the SST program we are now dealing with the whole loaf, since we alone possess the necessary titanium technology.

As opposed to the feeling which has persisted in some quarters that the Concorde would never be a viable product, there is ever increasing evidence that this program is for real. Given the opportunity to extend the initial Concorde effort into a second-generation aircraft which could be more competitive with the U.S. SST, it is wishful thinking to assume that the British and French will not do so.

SST Employment Potential

The significance of the SST upon our aircraft employment, is shown in this chart. This indicates a loss of 28% of all jobs available at the end of 1979 if we do not have the U.S. SST Program. If we have a less favorable family of civil airplanes to offer to the airlines of the world and if, as a consequence, future subsonic sales are filled by foreign aircraft such as the A-300B and the French Mercure, then the 28% can be much larger and represent a material employment loss.

Current Aerospace Employment Downtrend

Perhaps the present condition of aerospace employment in the United States can be used as a mirror of the future. In current perspective, as shown in the chart, employment in the aerospace industry is already suffering from declining sales of large civilian transport aircraft coupled with reduced expenditures for military aircraft and missiles and space programs, because of the conversion from stepped-up production for the Vietnam war to essentially a peacetime basis, and because of the end of hardware development and production for the Space Program. For the year ending September 1970, employment will have dropped by 12½% from a year ago -- a loss of 168,000 jobs or one out of every 8. J-6

Contrary to popular misconceptions that the aerospace industry employs only white collar workers, I would like to point out that this job loss is not restricted to any particular type of employee but rather has an across-the-board application. Scientists and engineers who comprise only 15% of the work force will lose 28,000 jobs, down 13.8% from the year-ago level, production workers representing 51% of the force will lose 89,000 jobs, a drop of 12.8% and technicians representing 5% will lose 10,000 jobs, a drop of 14.1%.

Accompanying Consequences

Impressive as these statistics appear in totality, they tend not to convey the true import of the situation. For example, the 168,000 jobs comes more into perspective when viewed in light of the fact that this is roughly comparable to the population of Arlington County, Va.

which according to the 1960 census was slightly more than 163,000 persons. Quite obviously, the loss of this number of tax-paying Americans, if even for a limited time, must have repercussions in various segments of the economy.

#### Present Mirrors Future

The present aerospace employment picture, depressing as it is to all of us can be useful in that it can be a mirror of the future, if we experience the loss of employment from having exported one of our best national resources -- which is what will happen if we fail to answer this foreign SST challenge. I feel that there is a very important message for us here, that our aircraft industry is an essential force in our overall economy and a substantial contributor to our well being.

#### Program Support

That this fact has been recognized by others is evident in the following sections of a "Statement by the AFL-CIO Executive Council on SST." At their meeting on August 3, 1970 in Chicago, the Council in supporting this program said in part..."Today, the USSR and the French and British are developing airliners that will fly at supersonic speeds on trans-oceanic flights. These nations, using government funds, have produced prototypes and are now well along in their testing programs.

"Without an SST, the American aerospace industry will be unable to maintain its leadership in world aviation, losing most of the market for trans-oceanic airliners.

"American aerospace workers will also lose sorely needed employment.

"We urge the United States Senate to vote funds for the development of an American SST. The age of supersonic travel over water will soon be here. The United States cannot afford to be left in the lurch."

BENEFITS FOR THE NATION

I have discussed at some length how the SST vitally affects our national aerospace industry and how essential a successful SST program is to the health of this major United States industry, with major effects on future balance of trade and employment.

Now I would like to concentrate on the government-industry partnership involved here and show that a most beneficial result should be expected, both for the government and for the aerospace industry.

The American SST Program is a unique government-industry partnership more in the nature of an investment than a direct Federal subsidy. This is, of course, the American way of doing business, for the U.S. SST is a civil transport in the business sense and the Government is most certainly not to be involved in competing with private industry for profit. The contract arrangements provide for both parties to realize a reasonable return as follows:

- o The Government's prototype investment will be returned by the time the 300th airplane is delivered.
- o When the 500th airplane is delivered, the Government's investment will have been recovered along with a projected additional billion dollars. None of this, of course, includes any consideration of the tax revenues which will accrue. Inclusion of taxes calculated from SST employment (50,000 direct jobs and 150,000 total jobs, including indirect) would add an additional \$6 to \$7 billion to be returned by 1990.
- o Returns to the manufacturers are sufficient to cause them to actively pursue the program's objectives.

The planning for financing of the production phase has not assumed Government participation nor was it, nor is it, intended to do so. A finance plan is evolving with discussions already in progress with financial organizations, industry, labor, CAB, etc. The present timing for a plan is June 30, 1972. It is hoped that this year an outline of the plan can be developed; however, the success of the prototype design and the associated research and development are the keys to attracting the private financial community to this program. As one leading financial expert put it, "with a proven successful prototype flying and the prospect of more than \$25 billion worth of business, someone will find the cash to promote this business."

The industrial financing of a program as large and with such national economic impact is a truly U.S.-wide project. Labor, the airlines, the manufacturing industry, the lending institutions, the government fare-route regulating authorities and the international fare-route regulating authorities will all be directly involved in developing the necessary actions to assure:

- o A healthy airline-industry economy.
- o An attractive economical design.
- o A well-managed, imaginative total transportation system to accommodate the SST.

Two important factors, normally representing the only requirements for private financing assurance, are implicit in the SST Program --

- o A willing buyer (10 airlines have invested nearly \$60 million of risk money to show their support for the program).
- o A proven vehicle which this prototype program is designed to demonstrate.

From a study of previous commercial transport development, it is apparent that commercial aircraft development has been Government supported one way or another many times. Government participation in the U.S. SST prototype program should not, therefore, be considered either extraordinary or as a detriment. The \$1.7 billion required to develop the U.S. SST prototype is simply too large a price tag to expect contractors and financial concerns to underwrite, particularly in view of the long "dry spell" before return on investment is realized. Government financing of other transportation programs in shipping and railroads has occurred many times in the history of our country, when the magnitude of the effort was beyond industries' financial capabilities.

The one unique feature of the U.S. SST prototype financial arrangement is that the taxpayers will get their investment back, with interest. By the time the 300th airplane is built, the government will, through royalties, get back its \$1,342 million. The manufacturers will put up \$322 million, including \$132 million in new facilities and commercial costs. The airlines will have invested \$81 million, \$59 million at risk and \$22 million for delivery position deposits. By the sale of the 500th airplane, it will receive another billion. Under terms of the contract, the government will pay for about 78% of the costs. The remaining 22% is being financed by the participating contractors, Boeing and General Electric.

In comparison to the amount of money the Government provides in grants, aide and assistance programs across-the-board, the investment in the American SST Program is small indeed. For example, during Fiscal Year 1971, the \$290 million required for the U.S. SST, a revenue-producing program that will provide

many nationally important benefits, is only 6% of the \$4.5 billion in Federal aid highway grants. The Government finances many other sizable programs such as foreign aid, shipping, agriculture price support, urban mass transport, and military support to other nations.

Considering the \$25 billion market available to the SST when it is put in service, the 150,000 to 200,000 jobs associated, the \$6.2 billion tax revenue benefits, the \$22 billion favorable balance of trade features and the continuation of world leadership in commercial aviation that are at stake, the SST Program becomes a very attractive and nationally important program for the Government to provide financial assistance.

There is nothing new or novel in providing Government financial assistance to a major U.S. transportation development program. Most commercial air transport advancements were based on some type of Government support. The one element of the American SST Prototype program that is different from past Government assistance is that the investment will be returned to the taxpayers with interest.

Direct Government involvement in civil aviation includes the following:

- o Conduct of advanced aeronautical research through NACA and NASA since 1915.
- o Development of the airways, navigation aids, and air traffic control, and certification of aircraft and crews.
- o Development and subsidizing of the airlines.
- o Expenditure of \$400 million for development of airports during WWII, many of which were turned over to local governments after the war.

- o Aid to airport development from 1946 to present was approximately \$2.2 billion. With the enactment of the airport and airway development and revenue act of 1970, Federal funds of \$2.5 billion are authorized for airport development over the next ten years. When matched by local and state governments over the next ten years, these funds will total \$5 billion.

As a result of the powers of the FAA to certify aircraft and operate the airways, and of the powers of the CAB to control the routes, fares, and subsidies of the airlines, the government in fact is involved and always has been. It is entirely logical that government, which has sponsored the development of air transportation in the U. S. and inspired its continuous growth, should take a hand in the industry's future. It is inevitable if present economic realities are realistically appraised and the attendant benefits to the nation recognized.

The Government's involvement in the financing of the prototype program has always been based on these economic realities and benefits to the nation:

- o The size of the financial burden exceeds the capabilities of any single or joint private U. S. industrial aerospace concern.
- o The 100% Government-subsidized French-British Concorde is already at least 4 years ahead of our SST and has completed more than 400 hours of successful prototype flight testing.
- o The potential adverse impact upon our nation's balance of trade if we forfeit the SST market to the foreign manufacturers precludes our not building the prototype if we are to protect our future options. To forfeit the SST, in the face of intense and dedicated foreign subsidized civil aircraft competition, could well lead to a serious erosion of our total civil aviation market and aircraft employment.

The cost-sharing nature of the prototype U.S. program features:

- o A 90% Government - 10% industry cost share up to a cost incentive

point of \$625 million for Boeing and \$284 million for General Electric after which industry shares 25% of added costs.

- o Industry bears the burden of all facility costs, about \$54 million for the prototype and \$100 million for production. The manufacturers also will spend about \$7<sup>1</sup>/<sub>2</sub> million in commercial costs during the prototype time period.
- o Prototype Cost Summary

	<u>U.S. Government</u>	<u>Manufacturers/Operators</u>
Government	\$1,342 Million	\$322 Million
Manufacturers		
Airlines, for Building Two Prototypes		59 Million
Airlines, for Delivery Positions		22 Million
	<hr/>	<hr/>
TOTAL	\$1,342 Million	\$403 Million

#### SUMMARY

Gentlemen, I want to assure you that the United States SST program is in a "go" status. As you have seen, the hardware construction of the aircraft is well underway with strong activity at the contractors' plants and at the many subcontractors and suppliers located all over the country. Further, the actual flight test engine is now running on the test stand and all performance objectives have been equalled or bettered.

The program is essentially on schedule and within cost.

Keen competition is expected from the Russian and British/French SSTs. Unless we produce a better SST, the United States is likely to incur severe adverse effects in the future:

Balance of Payments Loss

Aerospace Industry Decline

Disbanding of the Most Advanced Technology Aerospace Team in the Industry

Unemployment Increase

Strong charges have been raised that the American SST will adversely affect the environment. I have been in contact with the best scientific authorities in the country in all these areas and have yet to find a reputable key authority that would recommend against the American SST prototype program on consideration of environmental effects. We have established highly-qualified scientific committees in environmental effects, including noise. They will carefully monitor the extensive research work that will be carried out to ensure that our knowledge is complete in all these areas. The U.S. SST will not be approved for production until these environmental committees are satisfied. In the area of takeoff and landing noise, I am most encouraged. Our recent breakthrough in noise reduction, due to improved engine characteristics, better aircraft aerodynamics and advanced suppression technology, gives me great confidence that the production SST will comply with the same noise regulations as the future subsonic jets in all respects.

As to the program progress, we are proceeding on schedule and within cost. However, we are now faced with crucial options, depending on our allotted funding for this year and next. I believe the urgency of this program is such that we should press for the \$290 million amount for 1971 as I discussed. This will allow for an orderly buildup after March and would minimize slippage in the program. With this amount we can move ahead with a strong program.

Mr. Chairman, this concludes my statement. My staff and I will be happy to answer any questions the Committee may have and to provide such further information as may be desired.

## PROGRAM ENDORSEMENTS

Mr. MAGRUDER. Thank you, sir. Also I would like to say, since I have been the Director I have sought out experts within and outside of the Government in the agencies having a voice on this matter. I would like to submit, for inclusion in the record, the endorsements of the following offices which have considered the program over a period of approximately 1 year. These include the Council on Environmental Quality, the Department of Interior, Department of Health, Education, and Welfare, Council of Economic Advisers, the Export-Import Bank of the United States, the President's Science Adviser, the Office of Management and Budget, Departments of State, of the Treasury, Commerce, Labor, Defense, the National Aeronautics and Space Council, the National Aeronautics and Space Administration, the Civil Aeronautics Board, the FAA, and the Department of Transportation.

I have also gone outside of the Government and have statements, based on thorough consideration of the available data on the SST, from the following airlines:

From their board chairman and presidents: Pan American, Trans World Airlines, American Airlines, Delta Airlines, Continental, Northwest, Eastern, United, Braniff, KLM, Qantas, and Alitalia.

Further, I asked those persons concerned with the program to consider all the available details, and I would like to submit endorsements from Mr. George Meany, the President of AFL-CIO, the American Legion, the Airline Pilots Association, the National Chamber of Commerce, the Air Force Association, the Air Transport Association, the Aerospace Industries Association of America, the Airport Operators Council International, the National Aeronautics Association and the National Center for Atmospheric Research. With your permission, I will simply submit those for the record, and their information will be included in the brief summary that I am about to give.

Mr. MAHON. Mr. Chairman, may I inquire as to how we may be able to handle all of this material. I don't know to what extent we can put everything in the record. We have to get this bill through the House, and we have to get this record printed. It seems to me that we are going to have to use some discretion in the material that we include.

Mr. McFALL. Mr. Chairman, I thought perhaps we could put a summary in the record. The staff could examine all of the material, and make sure that we have included the important parts of what Mr. Magruder is submitting. Rather than printing each letter, we might put in a summary of all these endorsements which Mr. Magruder has submitted.

Mr. MAHON. I think that is well said.

Mr. McFALL. Without objection, our staff will work with your staff, Mr. Magruder, and we will clear a summary of this, so that all of the information that is necessary will appear in the record at this time.

(The information follows)

CABINET AND EXECUTIVE OFFICE ENDORSEMENTS

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Russell E. Train Council on Environmental Quality	8/12/70	"The Council has pointed out the various environmental factors to the Department of Transportation. The Department has developed a proposed research program that would accelerate work towards a quieter engine and would examine the atmospheric effects. This program calls for the expenditure of \$26.68 million over the next three years. The Council has reviewed and supports this research program and believes it to be responsive to the environmental concerns and uncertainties which the Council has identified.  "As my testimony before the Joint Economic Committee sought to make clear, the concerns and uncertainties which this Council has identified relate solely to the possible future operation of a fleet of commercial SST's. The two prototype SST commercial aircraft, as proposed by the Administration, would not in themselves give rise to any significant environmental problems."
Walter J. Hickel Secretary of the Interior	8/3/70	"I am pleased by the strong efforts being undertaken by Secretary Volpe in environmental research on these issues. I agreed with the Council on Environmental Quality that the two prototype aircraft in themselves represent no threat to the environment."
Elliot Richardson Secretary of Health, Education and Welfare	8/3/70	"We have been pleased to learn that the Department of Transportation has developed a research program, utilizing outside experts, designed to resolve the environmental and sociological problems. ... completion of this work will be programmed to coincide with completion of the development of the prototype model of the SST. ... information derived from this research will be utilized in the design and operation of the SST and will be taken into account in determining whether to proceed with production of the aircraft.  "This Department ... fully supports your decision to proceed with the SST development program, with this new research component."

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Paul W. McCracken Chairman of the Council of Economic Advisers	7/31/70	'Economic considerations point strongly in the direction of continuing the SST program through the production of a prototype. The probability of ultimate economic success for the plane is high enough to warrant carrying the project through to that stage and cancelling the SST project now would prematurely close off our options. ...  "... On balance, therefore, a decision to terminate the project now would carry with it a significant risk that our balance of payments position would thereby be adversely affected when this generation of aircraft matures into the market. ...  "... As for the domestic economy, cancelling the SST project at this date would apparently lead to a layoff of approximately 5,000 engineers and skilled workers. Most of these are employed in Seattle and the layoff would aggravate an already difficult unemployment situation."
Henry Kearns Chairman, Export-Import Bank	8/3/70	"Estimates recently have been made available regarding the significance of the SST to the U.S. balance of trade, considering both exports from the U.S. and imports of such aircraft into the U.S. These estimates indicate that, if the SST is not developed and sold, the net loss to the U.S. balance of trade over a twelve-year period would be on the order of \$20 billion."
Caspar W. Weinberger Deputy Director Office of Management and Budget	8/6/70	"The SST program should have a very favorable effect on our balance of payments. As you know, we have maintained a favorable net balance of U.S. aircraft exports averaging over \$1-1/4 billion a year for the decade from 1960 through 1969 while other trade categories have declined. Most of the decline, including such major product items as automobiles, were caused by the high cost of American labor. The principal offsetting factors to such a high cost are expert technology and productivity and certainly the SST program offers both.

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Caspar W. Weinberger (Cont.)	8/6/70	<p>"We believe that the prototype program for SST involves at least 20 thousand professional and technical jobs, 6 thousand of them in the Seattle area alone. ... If the SST program were eliminated, additional severe cutbacks to the whole industry would be experienced.</p> <p>"... SST employment would substantially increase the personal and corporate tax collections of the government. In fact, the aerospace industry has long been known as one of those that produce some of the dollars in our economy necessary to pay welfare costs and other human resources needs.</p> <p>"... Thus, if we do not develop an SST as part of a 'family aircraft package' and European manufacturers do, we are likely to lose not only the SST sales but also sales of existing subsonic aircraft types."</p>
William P. Rogers Secretary of State	7/30/70	<p>"The best information available to the Department indicates that technical aspects of the Concorde program are progressing favorably. Flight tests to date appear to have been satisfactory. In fact, greater speeds than planned were attained with the first generation engines. As a result, the construction of 12 aircraft has been authorized ... . ... the Federal Republic of Germany may decide to join Britain and France in the Concorde project. ... A successful SST program would tend to preserve both the fact and image of U.S. aircraft leadership and thus could support our competitive position in the overall commercial aircraft market."</p>
David M. Kennedy Secretary of the Treasury	8/1/70	<p>"In the ad hoc review committee for the SST last year, Treasury did not support heavy further commitment of Federal funds at that stage. ... Since Treasury's recommendation in the ad hoc review committee,</p>

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
David M. Kennedy (Cont.)	8/1/70	we have followed developments affecting the SST with considerable interest. ... The key to these assumptions, of course, rests on whether the Concorde will be a commercially viable aircraft. That now appears to be the case. Consequently, Treasury reservations expressed previously to going forward with the SST program have been significantly altered. ... You have my strong endorsement for the project."
Maurice H. Stans Secretary of Commerce	8/3/70	"Attached are two memoranda ... . One, ... treats the economic aspects and recommends strongly that the SST program proceed. The other, ... concludes that present environmental data do not justify a suspension of the program while further desirable scientific studies continue. ... we recommend that the SST program go forward."
J. D. Hodgson Secretary of Labor	7/31/70	"Three reasons prompt me to favor proceeding with this program. ... aircraft production has contributed greatly to its economic strength. ... Clearly our leadership position will be forfeited if Federal Government support for the SST is not forthcoming. Second, a considerable interrelationship exists between commercial and military aircraft ... requires skilled employee teams ... In keeping such teams together, the SST Program serves as a form of national security. ... Third, the basic manpower talent needed for production of this product is now available in abundance and can be expected to so continue. ... Many local and personal employment and economic situations may thus be kept from becoming critical. For the foregoing three reasons, the SST program appears to be a wise investment for the Nation."

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Melvin P. Laird Secretary of Defense	7/31/70	"Accordingly, there are clear national advantages to the further development and growth of aeronautical technologies such as titanium, propulsion, operational techniques, etc., that are inherent in supersonic cruise vehicles such as the Supersonic Transport, and which are currently not available elsewhere in the free world, and to an aircraft industry kept healthy, viable, and responsive to technical challenges and opportunities. Once such a national resource is allowed to weaken and become diffused, it is exceedingly difficult and costly, to re-establish. ... we recognize that the country's position, both civil and military, will be enhanced significantly in meeting the challenge implicit in the Supersonic Transport program."
William A. Anders Executive Secretary National Aeronautics and Space Council	7/30/70	<p>"We believe that the technology at this stage of development is sound and that it will lead to a successful commercial program. ...</p> <p>"Moreover, the SST is the most advanced aeronautical program now in existence in the free world. Our country's strength in both civil and military aeronautics will definitely be enhanced as the industry meets the technological challenges set by the SST.</p> <p>"... the level of 1150 'hard core unemployables' presently in training by these companies is forecast to reach 2350 at the peak.</p> <p>"... This balance of payments situation could be reversed to a 16 billion dollars deficit if the U.S. program is not pursued. The British/French Concorde is here.</p> <p>"... Riding strongly upon a growing public concern for the nation's ecology, objections to the SST for environmental considerations have been raised. These objections appear to be exaggerated and premature. They are being addressed through comprehensive U.S. Government-sponsored research programs which we judge to be scientifically and technically sound.</p> <p>"... The SST program needs to be viewed against the background of an aerospace industry that has an unemployment rate approaching 18% as</p>

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
William A. Anders (cont.)	7/30/70	compared to the national average of 5%, or a housing industry average of 7%. ... In this climate, the SST is more than an economically and technically sound venture. National leadership in the SST is vitally important."
George M. Low Deputy Administrator National Aeronautics and Space Administration	7/30/70	"... the definition and resolution of problems associated with the development of this aircraft clearly require the flight test of a prototype vehicle. The current review has also reaffirmed our view that the prototype development and flight program as planned should provide the basis for production of an operational aircraft meeting airline requirements."
Secor D. Browne Chairman Civil Aeronautics Board	7/29/70	"The United States has enjoyed a strong position of leadership throughout the history of air transportation. ...  "We lead because the United States possesses the strongest capability to develop, produce and operationally support aircraft of improved efficiency. We are also the only nation to date whose industry can offer complete families of transport vehicles from a single source, a vital factor in the equipment selection of the world's airlines. The Supersonic Transport will be a key component in the aircraft family.  "Our dominance was not easily won, and it is doubtful that, once lost, it could ever be regained. ... It is, for example, a great support when negotiating bilateral air rights with foreign governments. ... will contribute to the maintenance of a reasonable international fare level."

Source

Date

Quotation

J. H. Shaffer  
Administrator  
Federal Aviation  
Administration

7/28/70

"I consider it most unfortunate that a relatively few but extremely forceful individuals and groups appear to embrace the thesis that the Supersonic Transport is being developed in conflict with, or in isolation from, the other needs of the Nation.

"... Performance advantages of the SST over subsonic jet transports will be strikingly apparent to airport neighbors who complain about today's planes; it is the first new aircraft to be designed from the outset stressing environmental considerations, with noteworthy success. ...

"The SST will be sorely needed to transport the 56 million Americans and the other millions of non-U.S. citizens who will be traveling internationally by 1980. Its greater productivity will also keep fares in line with the world economy and, even considering inflation effects, the SST promises lower total costs than even the newer subsonic "wide body" jets by the end of this decade. ...

"The two SST prototypes, which are the only vehicles to be produced by the presently committed program, will provide the means for final test, evaluation and confirmation of operational characteristics and ecology impact."

John A. Volpe  
Secretary of Transportation

8/3/70

"... a number of developments have occurred during the past year, both here and abroad, which reinforce my conviction that the Supersonic Transport program is compatible with our National environmental and economic objectives, and that an American SST is essential to the continuing leadership of the United States in the world aviation market.

"... the unfavorable trade balance could reach \$22 billion. ...

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
John A. Volpe (Cont.)	8/3/70	<p>"This research activity also acknowledges the presence of thousands of other supersonic aircraft, including Soviet military planes, operating in the same airspace regime where SST's will fly. The numbers of such aircraft can be expected to increase and the environmental effects of their operations (if any) would be universal. ...</p> <p>"Grants for federal assistance to the developers of new airports will be awarded only when environmental safeguards are assured, and when compatible land use concepts are prescribed. The Act, therefore, provides additional assurance that airports, like aircraft, will be developed to minimize environmental conflicts. ...</p> <p>"... I respectfully urge that the U.S. SST development program be continued at the pace which will insure the 2707-300 a place in the world market not later than 1978."</p>

NOTE:

COMPLETE COPIES OF THE CABINET AND EXECUTIVE OFFICE LETTERS ARE AVAILABLE ON REQUEST FROM THE OFFICE OF SUPERSONIC TRANSPORT, DEPARTMENT OF TRANSPORTATION.

AIRLINE ENDORSEMENTS

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
N. E. Halaby Chairman & President Pan American World Airways	5/4/70	"Pan Am has the alternative of relying solely upon supersonic airliners built by the manufacturers of some other country. This company already has options to purchase eight Concordes. ... Pan Am believes that a supersonic transport must be socially acceptable and operate without damage to the public and the environment, and we believe that the best chance of having a supersonic airliner that conforms to the proper social and ecological standards is to have it built here under American control. ... Time is running against the United States aerospace industry and, to the extent it can produce a superior SST, against the United States airlines, Mr. Chairman."
	12/3/70	"A development program leading to construction of a production aircraft is essential if the American flag airlines are to remain competitive with foreign flag carriers. ... That is why Pan Am has invested \$15 million dollars in American SST development."
F. C. Wiser President Trans World Airlines	5/20/70	"It is our strong view that the best interests of the United States require that the U.S. Supersonic Transport Program be carried through to completion vigorously and expeditiously. ... The real issue which confronts the United States is whether this country will be an active participant in the development and sale of this new family of aircraft, or whether we will turn over to other countries the leadership in aeronautical technology which we have so long held."

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
G. A. Spater President American Airlines	6/19/70	"A satisfactory SST is an inevitable development. Some nation will produce the vehicle and the nation that does will have a double advantage over the rest of the world: it will have a large production potential, employing thousands of people, and it will have world leadership in the transportation of people and goods.  I hope that our nation, rather than some other, will have this production potential and this world leadership."
	12/3/70	"Am deeply concerned that opponents of Government support for SST prototype development continued to make assumptions which only prototype programs can establish as valid or invalid."
C. H. Dolson Chairman of the Board & Chief Exec. Officer Delta Air Lines, Inc.	6/18/70	"The period of 1972-1978 does in fact already appear lost to our manufacturers. But, based upon all of the factors known to us, we seriously urge that our government now proceed with all deliberate speed toward construction of a U.S. SST prototype that, hopefully, will permit our country to recapture its rightful position of aeronautical leadership in the late 1970's and the decade of the 1980's."
R. F. Six President Continental Airlines	6/26/70	"Should the United States not proceed with this project along the lines of the timetable currently being studied, I sincerely believe that the second generation Concorde will be developed and will obtain all the commercial airline market in the 70's and 80's ... ."
D. W. Nyrop President Northwest Airlines, Inc.	6/19/70	"A prototype of a supersonic transport is in our opinion a necessity if we are to determine the terms and conditions of supersonic flight, its economics and its place in world transport aircraft competition. Enough money has already been spent on the drawing board and it is now time to proceed with hardware and flight testing."

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
S. L. Higginbottom Exec. V.P. & Gen'l. Man. Eastern Air Lines, Inc.	6/24/70	"The U.S. SST prototype program should go forth as rapidly as possible, or we run the risk of allowing our competitors sufficient time to develop and produce more attractive versions of the present design."
G. E. Keck President United Air Lines (Reported in <u>Aviation Daily</u> )	7/10/70	"The supersonic transport 'is an essential industry-government investment that will significantly advance the standards of air transportation, benefit thousands of workers and exert positive effects on the nation's balance of trade. ... I, for one, believe it will be a great, efficient and superior aircraft.' Keck contended that critics of the SST have brushed aside valid arguments in its favor, including the obvious importance to our national economy."
H. L. Lawrence Chairman of the Board and President Braniff International	6/29/70	"... it is unrealistic to assume that supersonic transports will not be built and flown in substantial numbers over the world's airways. We further believe that the United States has the technology and the manufacturing capability to produce a superior SST that will find wide acceptance in the world market for this aircraft."
F. Besancon Deputy President KLM Royal Dutch Airlines	6/29/70	"KLM has options on 6 Boeing SST aircraft and is the only non-U.S. carrier to have invested risk taking capital in this project. ... It is most likely that the Concorde is going to be a reality and that this type will be produced in quantities. As a user of exclusively U.S. aircraft KLM is very much in favor of building a SST in the USA."

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
P. W. Howson Deputy Gen. Manager- Technical Qantas Airways	7/3/70	"There is little doubt now, we feel, that the Concorde will go into production. ... a payload of about 25,000 lb. should be achievable with an airline equipped aircraft over ranges of the order of 3500 n.m. ... It should be possible for the large SST to make a significant impact on the growing traffic congestion over the Atlantic and Eastern Pacific ... Above all, we would regret to see the United States sacrifice the pre-eminent position it has held for so long in a very important area of advanced technology - commercial air transport."
B. Velani Chairman of the Board Alitalia (Reported in <u>Aviation Daily</u> )	7/26/70	"Alitalia would 'like to see the American supersonic transport proceed.' ... The United States SST, under development by The Boeing Co. 'has the range, size and economy we need,' Velani said, adding that Alitalia would want the airliner for operation beginning in 1978."

NOTE:

COMPLETE COPIES OF THE AIRLINE LETTERS ARE AVAILABLE ON REQUEST FROM THE OFFICE OF SUPERSONIC TRANSPORT, DEPARTMENT OF TRANSPORTATION.

ORGANIZATIONS' ENDORSEMENTS

National management and labor organizations have also gone on record for the program. The AIA representing some 56 aerospace firms, the United States Chamber of Commerce representing about 4000 chapters, the ATA representing 32 air carriers and the Air Force Association with 106,000 members endorsed the program. The AFL/CIO, representing nearly 16 million people and ALPA with its 40,000 members have indicated their strong support.

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Homer B. Anderson President Airport Operators Council International	12/7/70	<p>The General Board of Directors of the Airport Operators Council International (AOCI) is shocked by the recent action of the Senate in declining further funding for the supersonic transport (SST) development program.</p> <p>In reviewing the record, we note there have been many allegations by program critics that relate to the airport operators' domain. These critics show little understanding of the airport progress is accomplished.</p> <p>In the specific area of environmental quality, these critics claim the SST will contribute to the problems of community noise, air pollution, and congestion. These are problems we have today that can be minimized in the future with proper planning and that can be minimized in the future with proper planning and coordination. We see the SST program as a <u>unique opportunity</u> to <u>reduce</u> community noise, air pollution, and congestion while improving air transportation service through an orderly well-planned program involving international coordination between airport and airline operators, manufacturers and governments.</p> <p>It is difficult to believe that the Congress of the United States would be responsible for cancelling this international cooperative effort based upon the unsubstantial allegations of ill-advised critics.</p>

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Chamber of Commerce United States	2/70	<u>Policy Declaration on Development of Supersonic Transport Aircraft.</u> The development of a successful supersonic transport has great potential benefit to the United States. Because of the magnitude of the cost involved, government assistance is required and warranted. To be successful, the plane must be efficient and able to operate in the framework of the national aviation system, including air traffic control and the airport complex. Therefore, the historic pattern of manufacturer development with airline consultation, must be adhered to as closely as possible.
Karl G. Harr, Jr. President Aerospace Industries Association of America, Inc.	12/4/70	Apparently on the basis of total misuse of scientific information and completely unfounded speculation about the ecology, the Senate yesterday delivered a devastating and long lasting blow to the national economy.  In voting against the SST it voted to export 150,000 American jobs, many of them highly skilled, for at least two decades. It voted to cripple our strenuous national efforts to restore a favorable balance of payments posture at least until the end of the century. It voted not only to abandon the predicted return to the Government (through direct revenues and taxes) of the 6 billion plus dollars promised by the program, but also to deny to the American taxpayer any chance of recouping the investments already made. It voted to forfeit to Britain, France and Russia, perhaps permanently, America's painfully acquired preeminence in aviation, held for 40 years. It voted to insure, not that the world's passengers will not fly in SSTs, but that they will fly in British, French or Russian SSTs. Finally, it opted to withdraw the United States from technological advance of a most important kind and export the attendant technological advantage to other countries including the Soviet Union. This withdrawal cannot help but have drastic adverse effects on our economy for decades to come.

<u>Source</u>	<u>Date</u>	<u>Quotation</u>
Charles H. Ruby President Air Line Pilots Association	7/29/70	<p>It is our opinion that various people have attacked the United States effort in this development in areas they are unable to support with basic facts but are utilizing any avenue within their reach to block this development and construction.</p> <p>It is imperative that the United States as a nation retain its commanding lead in the development and construction of commercial aircraft including the entire stable from VSTOL to a supersonic. The United States faltered in the space program and was obliged to institute a crash program that was designed to catch up with and pass the USSR. If the United States fails to meet the challenge at this point in the case of the SST, this country will become third-rate behind the British-French combine and the USSR. It is our opinion that the United States must maintain not only a competitive position but a superior one.</p>
George Meany President AFL-CIO	8/4/70	<p>The AFL-CIO Executive Council representing the largest number of labor organizations and the largest number of labor members has strongly endorsed the SST. The Airline Pilot Association (ALPA) representing the men who will fly the SST also is solidly behind the SST.</p> <p>The AFL-CIO and ALPA represent a membership of nearly 16 million people, many of whom are affected in some way by the SST program. In its statement concerning the SST adopted by the AFL-CIO Executive Council on 3 August 1970, it was pointed out the "need for new and more productive aircraft...The USSR and the French and British, using Government funds have produced prototypes and are now well along in their testing programs...Without an SST the American aerospace industry will be unable to maintain its leadership in world aviation...American aerospace workers will also lose sorely needed employment...We recognize some of the reservations about the possible effect supersonic flight might have on the quality of the earth's environment. However, no environmental harm can come</p>

Quotation

from the production of two prototypes...research will provide further assurance that there will be no degradation of the atmosphere from the American SST...We urge the United States Senate to vote funds for the development of an American SST...The United States cannot afford to be left in the lurch."

NOTE:

COMPLETE COPIES OF THE ORGANIZATIONS' ENDORSEMENTS ARE AVAILABLE FROM THE OFFICE OF SUPERSONIC TRANSPORT, DEPARTMENT OF TRANSPORTATION.

## PURPOSE OF THE PROGRAM

Mr. MAGRUDER. Very good. I understand no microphones are working in here today, so if my voice gets thin, I will expect you to apprise me of whether or not you can hear me. I will use these charts, and for the press and the public, Colonel Rundell will use the same charts over there.

The first point I think that needs to be made in clearing up any confusion on the program, Mr. Chairman (fig. 33) is to define the purpose of the program. The purpose (fig. 34) is to build and test two developmental airplanes. Sometimes the word "prototype" is misunderstood. The prototypes are developmental airplanes to validate whether or not the aircraft will have airline economics, whether it can operate from present-day type airfields satisfactorily within the air traffic control environment that present-day airplanes operate from.

(NOTE: The figures referred to in Mr. Magruder's testimony are included in the record beginning at p. 261.)

We will acquire technological and environmental data. Yesterday I heard some comments that might be assumed to be at odds with each other about the value of the SST prototype program with respect to helping us on the environment. What we are going to get from this program in detail is range-payload data, operating economics, actual noise measurements, actual sonic boom overpressure measurement, safety of flight characteristics, and the ability to certify the airplane for carrying the traveling public. We will also get actual full-scale data on some environmental emissions and weather modifications.

I want to make one point very clear with respect to the latter. We are going to carry out a \$27 million environmental research program. We will have U-2 aircraft, SR 71's, B-57's and balloons flying at very high altitudes. We will also do numerical computer modeling of the atmosphere, and some laboratory research. I expect that these data will provide a good indication of whether or not the airplanes will have an impact on the environment, adverse or favorable. We don't know if all of the effects are bad; however we will be in a poor position in 1973 or 1974, and I think this was what Congressman Steed was driving at yesterday, if we in effect face the international scene with nothing but laboratory data, to back up our decision on whether it is going to be acceptable or unacceptable to have fleets of SST's flying in the future.

If we have nothing but laboratory data, and the others—the British, the French, and the Russians—have been flying their airplanes for 4 or 5 years, and have, in addition to their laboratory data, full scale operating data, then we could not enter the international scene with an argument that says we in America think they should not fly fleets of SST's. If we back that up with nothing but laboratory data, the other people would say, "But we are flying full scale airplanes, and we have laboratory data also, and our indications are that we should continue to operate the SST's." I think on the international scene Mr. Ruckelshaus and Secretary Volpe would be in a very weak position to make their case about environmental pollution.

I don't say that the reason we are building prototypes is to get environmental pollution data. It is primarily to prove out the economic, the operating, and the safety characteristics of the airplane. It will strongly enhance our position to go ahead or not go ahead based on

environmental data gathered in full scale testing. If we have to argue on the international scene about the acceptability or unacceptability of SST's, I think that point comes first.

#### VALUE OF PROTOTYPE AIRCRAFT

I have asked several experts in the field to comment on the need and the value of prototype aircraft. Among the people that I went to was Mr. Charles Harper who is now at NASA Ames Laboratory, and until late last year was the Director of Aeronautics at NASA. I went to Mr. C. L. Johnson, the director of the engineering-corporate for Lockheed, the only man in this country who has ever won two Collier Trophies. He is the designer of the SR-71, the U-2 and the first American jet aircraft in service, the P-80. He was the designer of the P-38 Lightning of World War II fame and also the designer of the Constellation.

Also Prof. Rene H. Miller of MIT; Prof. Wilbur C. Nelson of the University of Michigan; and Mr. Maynard L. Pennell, who is the father of the jet transport age in this country, and the man at the Boeing Co. that designed and built the first prototype 707. Dean Courtland D. Perkins of Princeton; Mr. Arthur E. Raymond who was the corporate director, vice president of engineering at Douglas through the entire DC series, from the first DC-1 through the DC-8, and Mr. John Stack, former scientist at NASA, now director of engineering at Fairchild-Hiller. I would like to submit their endorsements for the record. We can do this in summary form, showing their endorsements of the prototype program as it has been envisioned by the U.S. Government.

(The information follows:)

Mr. Charles W. Harper  
NASA Ames Research Center

A confusing part of Mr. Eads' testimony arises from the discussion of various prototypes. As you know, even within the industry the use of the word "prototype" requires very careful definition each time it is used since it can mean anything from a demonstration of technology to a first production machine. Your office has stressed repeatedly that the national SST program is leading to two aircraft which will provide the information necessary to design and build a successful commercial transport; although the information gained should provide the confidence to undertake the venture there is good reason to expect that the production machine will differ in many ways from the machines built by the government.

It appears also that Mr. Eads does not recognize that this program is designed to provide that "basic" technology which, he argues, will enable industry to find the resources to proceed on its own with production. In several places he makes the point that when the technology is available to build an economic aircraft, the industry will do so. Implicit in his arguments, however, is that this technology can be made available without flight operational experience. Such a conclusion is in error. The technology that made the 707 and DC-8 acceptable economic risks came from many hours of flight tests and operation of the B-47 and B-52 even though these looked quite different. The void in technology that stopped the Comet development in midstream came from the lack of flight tests to uncover the disastrous effects of pressure and temperature cycling on fuselage fatigue life. Sophisticated as ground test research has become, the final assurance that all of the sub-systems of an advanced system can be made to work together satisfactorily can only come after they are assembled and tried; in a first try even partial failure can have tremendous value as it usually points out clearly the path to success.

The industry is asking for support in a major commercial venture for the first time because for the first time the advance is led by civil not military demands.

16 million dollars was sufficient to develop a jet transport prototype because of the prior vast military experience and engine development paid for by the government.

No commitment to production is made in this program. It is an investment in technology to be exercised when circumstances are right; most signs point to that situation existing after the program is complete.

The VC-10 and Super VC-10 are good aircraft, in some ways better than U.S. competition. They were not enough better to replace a whole fleet or support a fleet having two logistic support systems. This could be a problem for future concern in the U.S. program if the Concorde succeeds in becoming operational as it gives every sign of doing.

Mr. Eads is correct in replying to Senator Case that the size of the aircraft fixes the engine size. He errs, however, in saying that an engine change requires a redesign of the whole aircraft. In fact it would be very surprising if the SST did not undergo several engine changes in its lifetime just as the subsonic jets have done.

In his reply Mr. Eads refers also to the disastrous experience of Convair in connection with a minor change to the 880 aircraft. As he describes these changes it is clear he had the Convair 990 in mind. This was not a minor change but a whole new aircraft. I think a study of this case would show that the problem developed from not allowing sufficient time for pre-production flight tests to refine the design to meet the guaranteed performance.

In a later reply to Senator Case, Mr. Eads states that an SST aircraft is not needed to study noise suppression, that this could be done with an SST engine on a B-52 as was done for the 747 engine. For studies of engine noise suppression, ground tests will suffice and will be used to evaluate the several possibilities. An equally important aspect of reducing noise exposure to the public is the aircraft operating procedure. This also affects the choice of noise suppression technique to be used. The real goal of continually reducing public noise exposure, rather than just reaching some level chosen for the moment, can be reached only through operational studies of an aircraft very similar to the SST production aircraft. Flying an SST engine on a B-52 cannot accomplish this.

Actually, the KC-135, funded completely by the Air Force, was essentially the prototype for the Boeing series of jet transports starting with the 707. Had the B-70 program been carried forward by the Air Force a great deal of information applicable to the SST would have been obtained. However, as it now turns out, the SR-71 series of aircraft have pioneered the technology both in power plants and high mach number flights of a titanium aircraft, which does take much of the gamble out of the Boeing SST.

When people discuss the ecology effect of the SST, particularly as regards sonic booms, contamination of the upper air and noise, not many have the knowledge that, as of the middle of January of this year the Blackbirds have made approximately \* flights. Most of these of course go to much higher speeds and altitudes than would the supersonic transport. I believe it is also true that very few people know that we have flown the U-2 series of aircraft for a total of approximately \* hours at altitudes above 60,000 feet. I have been totally unable to discern any adverse effect on the ecology caused by these two types of aircraft whose performance straddles that of the proposed Boeing SST.

Mr. Eads' statement that the titanium technology remains a problem is refuted by the large scale production involving over 10 million parts which we produced here in the Skunk Works for the SR-71 type of aircraft. We have transferred a great deal of this knowledge to Boeing for their vendors. Having been instrumental in the design and development of 43 various aircraft during my career beginning in 1933, I would like to state that, the only way for making an economical supersonic transport will be to produce prototypes so that we can reduce to practice all phases of developments required to make a successful and safe supersonic transport.

On Page 1742 I would also take exception to Mr. Eads' comments regarding the use of prototypes generally in solving technical problems. All of us in the aircraft industry involved in building advanced aircraft have found it absolutely necessary to build prototype aircraft to apply advanced technology before we commit to large scale production. I would certainly not recommend that we go directly into production of a SST without constructing and testing the prototypes as outlined in our current SST program.

\* Classified Information

I remember very well when the first Boeing and Douglas jet transports came out; neither was able to fly the north Atlantic in competition economically with propeller driven aircraft. And, I believe the airlines actually charged a ten to fifteen per cent added fare to the early jet flights. It was not long however, before the engines improved and the aircraft themselves were upgraded so that in a matter of a few years the propeller driven transports were driven from the air by the superior speeds, comfort and economy of the pure jet aircraft. Philosophically, I hold the same to be true for the supersonic transport.

Prof. Rene H. Miller  
Massachusetts Institute of Technology

Design teams in the aerospace industry are highly skilled groups and our tendency in the past to bypass prototype development, particularly in the military area, has made it increasingly difficult to keep these design teams together. We should have many more prototypes in progress for this purpose, as is the case in the USSR, since research, development and engineering are inexpensive compared to production. By building prototypes, discarding those which are less successful, and learning by our mistakes we insure a strong commercial and military posture in the air at a far lower cost than is the case for the concurrency programs which we have tended to follow in the past. For this reason I strongly support prototype development with production decisions made on the basis of proven flight performance. In the case of the SST, my opinion is that the eventual payoff is very great indeed and the government as an investor of public funds in this particular instance stands to benefit greatly from a continuation of the program.

The economics of air transportation are such that speed will always be desirable. Because of the greater productivity of high-speed aircraft it is possible to pay a high premium in price in terms of initial investment in order to attain this speed while still realizing an appreciable reduction in the cost of transportation. This was graphically illustrated when the jets, which cost several times the price per seat to procure than the propeller aircraft such as DC-6 which they replaced, nevertheless changed air transportation from a subsidized marginally profitable business to a non-subsidized reasonably profitable endeavor and reduced the direct operating cost from a little over two cents an available seat per mile to a little over one cent.

Supersonic flight promises a similar advance in air transportation. Detailed analysis of the economics indicate that when the total cost picture is taken into account including indirect costs it is highly probable that a reduction in the ticket price will be possible in the long run. But quite apart from these technical concepts it is clear to us that there is a tremendous demand for speed on the part of the traveling public such that almost certainly people will gravitate toward the higher speed vehicle if available and even if they must pay a premium price. To us this

means that, as in the case initially of the jets, the supersonic aircraft will operate close to 100 percent load factor during the first few years. Because of the tremendous leverage of the load factor on profit it should be possible to depreciate the aircraft over a much shorter time period than is presently planned.

Since economics and passenger demands drive us toward supersonic flight it is imperative that we make every effort to insure that such flight is acceptable to the community it serves. This means continued research leading to a reduction in engine noise and a better understanding of the effects of the deposition of water vapor at high altitudes. I am convinced that the noise problem will be solved well before the SST becomes operational if enough effort is put in this area and indeed the solution is already apparent by the elimination of afterburning during takeoff and increasing the bypass ratios of the engines. Our experience in the past has been that propulsion systems improve over time which will insure that the performance of the aircraft will be at least as good as is presently predicted.

Prof. Wilbur C. Nelson  
University of Michigan

The crux of the argument lies in the fact that this country does not have either a powerplant or an airframe developed by the Department of Defense to draw upon for the U.S. - SST program. This was not true, of course, in an airplane such as the Boeing 707. Hence the need for the remainder of the government loan to complete the development of the prototype program.

The prototype program is obviously needed to validate the complete design in such critical areas as performance, reliability, environmental compatibility, and economic viability. Assuming these critical factors are favorable, the SST proceeds along the route of private enterprise. The airlines must decide to buy them and the public must decide to fly them in order to end up with an operational system.

The present supersonic transport, as laid down for prototype flight tests, will certainly handle the basic requirement of transatlantic operation and also transpacific operation with the Tokyo leg broken by a required fueling stop at Honolulu. The inevitable technical refinements and improvements with time will certainly occur and very possibly radically improve both the range and performance. This will act to greatly expand the utilization curves and decrease the operating cost curves. As of the date, it should be noted that General Electric have already exceeded the contracted thrust levels and decreased their guaranteed specific fuel consumption values for the GE4 turbojet engine. Any prediction of extreme performance increases for 1978 would be ridiculous. However, one can look back over past history and look ahead with confidence!

In the preceding discussion, I have attempted to show that the major considerations are dominantly favorable in all categories with some inevitable residual doubts to be clarified and analyzed concerning stratospheric contamination which can certainly be done during the 4 years of prototype construction and test and during the 8 years preceding the actual initiation of scheduled airline operation. This leaves the final consideration, which is so very critical, to industrial and governmental management--namely timing. Right now the United States supersonic transport program is where it should be. In December of 1966, our Supersonic Transport Advisory Committee recommended a program stretchout to allow more thorough

Mr. Maynard L. Pennell  
The Boeing Company

As an active participant in the development of the 707 prototype and the follow-on production programs, I can state without hesitation that the situation at that time was very different in several important respects than that which prevails today with regard to the SST.

In the first place, there had been at that time several prototype and production military airplanes of high enough quality to give us a firm technical basis for a commercial jet transport. Most important of these programs to Boeing were the XB-47, the B-47, the XB-52 and the B-52 airplanes. We studied the possibility of a commercial product using the technology of the B-47 as a basis for our design, and concluded that the airplane, although attractive, would not long remain competitive commercially, especially since the engine technology was improving rapidly. Later the technology embodied in the larger and more efficient B-52 and its engines was judged to be satisfactory for the start of a commercial program.

Fortunately we were realizing modest profits from rather large military programs at the time, so financing of the prototype was practical without direct government involvement. It should be emphasized, however, that the government military programs had provided and demonstrated all the basic technology and had even resulted in the development of engines appropriate for the initial jet transports.

Many believed the airplane would be uneconomical; some thought it would have limited range; others thought it would be unsuitable for commercial passengers, or unsafe, or too noisy. These concerns, even though frequently voiced by respected technical authorities, have proven to be almost totally untrue. And today the impact of jet transportation on modern life has been such that it would be difficult to imagine the modern world without it.

The airplane whose intended mission was most like that of the proposed SST was the XB-70, but development of that airplane was cut off when it was decided that military mission was more effectively performed by ballistic missiles. No subsequent airplane, developed or in development, has been optimized for an operation similar to that of the SST because military

needs are different today than they were in the early 1950s. As a result neither a proven technology nor an appropriately designed engine exist today. They must be developed and proven directly by the SST prototype.

Lacking this heritage from forerunner military programs and giving consideration to the more difficult technical goals of the faster airplane, the funds required for the SST prototype are many times those for the original 707 prototype.

The aerospace industry is not in robust health today. Our three primary markets - space activities, military aircraft and missiles, and commercial aircraft sales - are all undergoing severe cutbacks. Although the industry is making the tough-minded decisions required to adjust to the much reduced level of business, the overall effect is such that total financing of the SST prototype by industry is out of the question now and for the foreseeable future. It is therefore not true that "when the technology has advanced to the point - perhaps with some government assistance - where a commercially viable and ecologically acceptable SST can be built, .. no doubt .. the U.S. commercial aircraft industry will be able to build it with no support." On the contrary, we believe that technology has already advanced to a point where a commercially viable and ecologically acceptable SST can be built, but we need to demonstrate this fact by building actual prototypes.

Dean Courtland D. Perkins  
Princeton University

First of all, Eads is represented as an expert on the economic viability of the supersonic transport. He makes the usual mistake of expert witnesses in spending most of this time on aspects of the problem on which they are not experts. In this case he submits no hard evidence on economics, but spends a great deal of time on the technical viability of prototypes - an area in which he is evidently not expert. It is therefore very difficult to follow his economics argument for in point of fact he presents none. As a director of American Airlines, I am vitally concerned over the economic question. This input is trivial and seems to be only a matter of opinion. Certainly the subcommittee deserves better information than this.

Professor Eads spends a good portion of his statement on prototypes. It is hard to follow whether he is for them or against them and under what conditions. As an aeronautical engineer who was deeply concerned with the development of the Jet Transport and the Boeing decision to build the 707-80 prototype, I find his observations superficial and confusing.

The famous decision made by Boeing in the early fifties to build a jet transport prototype was made in a very different environment than today. Eads correctly states that it was based on the emergence of a remarkable gas turbine - the P&W J-57 which had a thrust level and specific fuel consumption that permitted great improvements in performance potentials. He does not say, however, that The Boeing Company had built and was building large quantities of large bomber aircraft for the Air Force (the B-47 and B-52) in a performance area exactly similar to the possible jet transport. This program involved solutions to the actual building of larger aircraft and uncovered structural concepts and airplane performance capabilities (drag) that were equally important as the engine. This new technology permitted the preliminary designers at Boeing to conceive of new transport capabilities that were very attractive.

I think that no one feels that an airplane company, even if it could, would strike out on a fully concurrent supersonic transport development program. The stretch in the technological state of the art from the subsonic jet transport is too great and our supersonic cruise technology is very limited - tests on the B-70 prototype - the Lockheed F-12 and now the Concorde. We need to know the answers to many questions that can only be answered through a prototype development.

There are many unanswered questions that can only be resolved by the development and testing of a prototype. Certainly included in such tests will be engine noise, environmental problems, and fuel reserve realities. A great deal needs to be learned and these answers will be obtainable through flight testing the prototype.

Another problem confronting this program is that there is no parallel USAF program that can lead the commercial venture. The Air Force has some data from the B-70 tests and its F-12 fighter but its new airplane, the B-1A, will be different in too many aspects. The commercial venture must go it alone and it will be very expensive.

If we are to have an SST, it is absolutely certain that we must build a prototype of the system first, and as close to a realistic ultimate solution as possible. It will be expensive and it is also certain that the ultimate production aircraft will have to incorporate changes uncovered by the prototype testing. If the production aircraft and prototype are too far apart, the program will be a failure.

The decision to have a Government-Industry SST prototype program was made years ago, and the evolution of a prototype design has been worked on and refined with great care. The government has already invested nearly one billion dollars in the program and industry a substantial sum. We are now seeing the light at the end of the tunnel. To stop this program now would be foolhardy indeed.

I think the Boeing prototype design is now a good one and will lead to a supersonic transport that can make the required range with a significant payload. The community noise problem will be solved by the use of non-afterburning turbojets and the environmental pollution arguments cannot be substantiated. The great speed advantage of this aircraft will make it competitive economically and the economic viability of the supersonic transport will be assured when the public demands to go on the SST as I am sure they will when the airplane has been proven safe, comfortable and reliable. The factor of one-half in block times will be an overwhelming appeal.

This country has developed a tremendous lead in aeronautical technology through our jet transport program and we must not lose this advantage for many reasons. I hope the Congress will recognize this and not be swayed through presentations such as made by Professor Eads.

Mr. Arthur E. Raymond  
Consultant

Views on February 7, 1969

The configuration selected by Boeing is probably optimum or very close to it. All reasonable alternates have been studied sufficiently to ensure that the one chosen possesses the best combination of characteristics throughout the subsonic and supersonic regimes. It is unlikely that further study will show any but minor changes as being desirable.

Early flight demonstration and refinement should be given precedence over all else at this stage. The airplane must first of all prove its suitability as a flying machine, and its compatibility with its environment. Growth and improvements in efficiency will come later in natural evolution, as they always do.

While this airplane is right up against the boundaries of current technology, its design is well-balanced, with logical tradeoffs established. Government evaluation teams have done a good and thorough job in pinpointing the elements of highest risk. No insurmountable problem is evident that might prevent the completion of a reasonably satisfactory prototype.

Present View

I considered Boeing's SST design far enough advanced two years ago to warrant proceeding with the prototype. I feel even more strongly now, considering the refinement, study, and testing that have taken place since then.

As you know, I was in charge of engineering at Douglas during the entire period of development of their commercial airplanes from the DC-3 to the DC-8. I have never known an airplane to be subjected to as long and thorough a period of preliminary design as the Boeing SST. No matter how much effort and time are devoted to this initial phase, it is, of course, impossible to eliminate the technical risks completely; but they have, in my opinion, been reduced to a level consistent with, if not lower than, that prevailing on previous airplanes when the decision to prototype was made.

Certainly, to delay longer would increase the eventual cost with little, if any, gain: by and large, such uncertainties as remain can only be resolved by building and flying a physical article.

Mr. John Stack  
Fairchild Hiller Corp.

It is indeed shocking to see what is happening to the supersonic transport program. Reams of incorrect information are being supplied to the Congress by all sorts of people from all sorts of lines.

One wonders as to the competence of these people. As for Mr. Eads, his major claim is to have written on airline cost and demand, which I must say anybody can do based on the compilation of statistics done by the Federal Government.

His testimony contains quotes on aviation publications and from individuals who have a great background in the airline field. These quotes are 1948 statements, that is 23 years ago, and those statements related to improvement in the now obsolete piston engine-propeller driven aircraft.

Nowhere in these statements has anything been presented that is pertinent to the fundamental question, and that is should or should not we apply our advancing technology to improving the "quality of life". Statements were taken out of context, such as those attributed to Mr. C. R. Smith to the effect people will not pay for speed alone. Smith was making the point that speed is only a part of the picture and the airplane must at the same time be economical, have low maintenance, be easier to operate than those which we then had. Rickenbacker was making the same sort of a point at that time. The way in which these statements have been distorted is truly amazing.

It is, of course, easy to cite various designs of aircraft that never got off the ground, which Mr. Eads has done, but without any understanding or showing any apparent knowledge of the history of those projects or the reasons why they failed.

Transoceanic air transport first started with flying boats and this was because of certain definite technological limits of land planes and the difficulties that could be encountered if such a machine had to ditch. The Princess Flying Boats were developed for the Australian routes for Great Britain, really not (as claimed by Mr. Eads) for balance of payments, but rather to keep the Empire Air Routes in better shape. This occurred at about the time that development in land airplanes and in reliability of aircraft made the flying boat a bit obsolete. The Princess was just the last of the line, so to speak, just as the Hindenberg was the last of the line of the airships.

Mr. Eads also speaks much of the Comet and again without understanding the problems. The British, because of the severe cost of war, had gotten rather well behind in commercial air enterprise from a position of leadership that they once held. In an effort to regain the position, some significant or important, far-reaching decisions had to be made. Their decision was that the jet engine would be the engine for the transport of the future. They thus selected the jet engine for the Comet and, except for the short range aircraft like the Viscount, departed from the turbine-prop. History has proven that to be a wise and intelligent decision.

The reasons for the failure of these airplanes to go into use had nothing whatsoever to do with the causes cited by Mr. Eads. A very courageous step taken by the British in producing the Comet was their effort to re-establish themselves in the world's trade routes, just as they had established themselves in the world's trade routes with their maritime enterprise. The Comet was a good airplane and it was well ahead of its time. Though not many were built, some are still in use on the world's routes. The difficulty with the Comet was in no way related to certain of the causes Mr. Eads notes. The real difficulty with the Comet was more associated with the manner in which the government handled the unfortunate structural difficulty they had in the first ones. The everlasting credit is to the British. They found the cause, corrected it, and out of this came the very methods by which we now test all of our aircraft that are to fly with pressure cabins at very high altitudes. Out of it has also come many of the fail safe techniques for aircraft structures. The Comet was not in any sense a failure as indicated by Mr. Eads, but it was the pioneering commercial jet aircraft.

We come now to the American effort. Following the Eads' testimony, one is given to believe it is a concoction of Boeing and the General Electric companies. This is so far from the truth that it demonstrates the fact that Mr. Eads knows nothing of the history of the supersonic transport program in this country. In the late 1950's, assessments were made of the technological knowledge in this country under the auspices of Federal Aviation Agency and the National Aeronautics and Space Administration, formerly National Advisory Committee for Aeronautics. Contributing to this study were the lessons learned by the U. S. Air Force and its technical side which at that time was experimenting with the B-70. It became very clear that we were on the verge of the ability to build a supersonic transport. On December 11, 1959, a summary presentation was

made in the offices of the Federal Aviation Agency and at the National Aeronautics and Space Administration Headquarters in Washington, D. C. The summary in somewhat shortened form was later published as a NASA Report D-423 in the spring of 1960. As a consequence of this work, a task force was set up in February of 1960 and a year's study was given to all the many facets. By this, I mean technical and economic problems. There evolved from this study in 1960 a plan out of which the present operation has grown.

The inference in the Eads testimony is that this is some scheme of the industry to get itself subsidized. We should point out that in the 1960 studies, examination was made of the various ways in which the Federal Government supported various activities - dairying, farming, maritime and the rest. It was generally agreed, and I must say almost unanimously at that time that such schemes as the maritime subsidy were totally wrong and absolutely unacceptable to the aircraft industry or the airlines. Similar conclusions were reached in respect to other subsidy systems such as appeared in agriculture and dairying. There was then evolved a participation scheme where the government was to be reimbursed for its share. This scheme was reviewed and felt by even banking experts to be a sound proposition. Such men as Mr. James Mitchell, Vice President of Chase Manhattan and Mr. William Harding, now deceased, a senior partner of Smith-Barney, were involved in such deliberations. Later the program was reviewed by Mr. Eugene Black and Mr. Stanley Osborne, both of whom had distinguished careers in banking, finance and economics generally. Their recommendation was "go". All of this is documented and in the record. It seems apparent to me that the opposition we now hear while well-meaning perhaps certainly has not done its homework.

You hear much about this from some economists that say it is not good. Now I think there is something we need to recognize here. Economics is still a "soft" science and as such it builds itself on statistics of history. This isn't to say that much can't be learned. On all the Mondays during the fall, the Monday-morning quarterbacks discover what was wrong with some of the plays that failed on Saturday and Sunday afternoon. Of course, this causes some changes in the details of the plays as they occur on the field on following weekends but the basics of the game are not so determined. Economics is just such a thing. From the hard sciences, however, on the principles so stated by Newton and in the first and second laws of thermodynamics really has to come the basis for determining the range-efficiency factors of any machines.

In properly designed machines, it is inherent that the higher the speed the better will be the propulsive efficiency. In order to get a better machine, therefore, one must go to higher speeds. We have now a better aerodynamic efficiency product and a better propulsive efficiency. We come now to the other term, the logarithm of the weight ratio. We are in this country very advanced in the use of titanium. This being a better material for higher temperatures than aluminum and the manufacturing techniques being well-developed, one should then go to the speed permitted by the use of titanium which in general is a Mach number of about 3. Having done this, we end up with a weight ratio term that is indeed comparable to present air transports and with later production versions will very likely be better than that which exists with our current aluminum airplanes that run at high subsonic speeds. Herein lies the fundamentals of the economics of the whole thing and the proof of this lies with the "hard" sciences and not with the "soft" science of economics. I call your attention to many of the "soft" science analyses that predicted that jet transports would be uneconomic because of fuel requirements. Today's jets on an economic basis have demolished those analyses of the 1950's. We can add to this better range efficiency factor a higher productivity per day because of its speed; thus a remarkable edge over today's jet aircraft can be expected. This edge may be even greater than that of today's jets over the best propeller aircraft they displaced.

We need to recognize that the application of the fundamental laws of "hard" science have built a very fine quality of life. This is the life that has taken the work off the backs of men. Nowhere has it done it so well as in the United States. You may be assured that so long as further progress is not hamstrung by unthinking opposition or unknowing opposition, the very same talents that have taken the work off the backs of men, will be applied to our so-called pollution problems.

I urge, therefore, that constructive attitudes be taken. Short of the discovery of a perpetual motion machine of the second class, this is one that can violate the second law of thermodynamics and mechanically have zero friction, there will be a residuum. The industrial revolution takes first things first. It has taken work off the backs of men and given us the highest quality of life in history. The same diligence in technological application is now and will continue to improve the quality of life.

Mr. MAGRUDER. It is also an item that will demonstrate to the financial community the viability of the SST program. If we are going to attract private capital we must do it by having the three things that will attract it in the U.S. financial community. That is, a proven article and a willing buyer—both of which we will have. By definition the prototype will prove a satisfactory article to the airlines. We have already demonstrated, by the airlines putting up \$81 million of their money 10 years before they received the article, that we have willing buyers. The third thing that is necessary is for all of us in government, in industry, and in labor, to work together to attain a healthy air transport manufacturing industry. If we can do these three things, I have the assurance of the financial community that they will indeed be available to privately finance the SST production program.

They said, "If you question that fact, then just look at what is going on now. The private sector is financing over \$5 billion worth of wide body jets in the greatest recession we have had in over 10 or 12 years in the airline industry." They feel that with a proven article, a willing buyer, a healthy industry, and all of us working hard to make that happen, they will be able to finance the production program.

#### COST SHARING

The SST program is a cost-sharing program. The prime contractors on the SST are not making a profit on the prototype program. For example, the airframe contractor shares 10 percent of the cost to a cost incentive point of \$625 million after which they share 25 percent of the cost. That is an incentive to keep their costs under control. This has been a remarkable program in this regard. It is also not generally understood that the industry pays for all of the facilities, and furthermore, for all of the commercial cost. Now this means costs of getting together with the airlines, bringing together specifications, performance reviews, going all over the world with their engineers, scientists and marketing people to explain the SST. That will amount to approximately \$78 million, and the facilities are in the \$54 million class. When all of this is added together, the prototype program share will be approximately 22 percent by industry, and about 78 percent by the Government.

#### INVESTMENT RECOVERY

The third key item is that the funds that are loaned by the Government will be returned by a simple royalty formula. Divide the \$1.3 billion by 300 airplanes, and that royalty, about \$4 million, is applied to the cost of each airplane. Every time an airplane is sold, approximately \$4 million will come back to the U.S. Treasury. By the time 300 airplanes are sold, the entire investment of \$1.3 billion will be recovered. Then, depending on the rate of production, either 6 percent or \$1 billion in profit is recovered by 1990. It is a unique cost-share, as well as a unique recovery of investment. The Congress has recognized, since 1950, that a healthy air transport industry is in the public interest. We have obtained our advanced technology directly off the shelf from the Defense Department throughout the history of commercial aviation until now. This is the first time that has not happened.

## PROGRAM FINANCIAL STATUS

The program's financial status is shown on this chart (fig. 35). Phases 1 and 2 are the early research and competition program. Phase 3 covers the construction of the two prototypes and 100 hours of flight test. The Government's share of the early phases 1 and 2 cost \$291 million. The total appropriated through phase 3 is \$417 million. As of the 30th of March, \$156 million will have been obligated under the joint resolution, so that as of that date \$864 million will have been appropriated and obligated for the entire program.

The contractors have spent approximately \$164 million, and the airlines have contributed their risk share, \$60 million. In addition, \$22 million has been deposited with the Treasury, from which the taxpayers get interest. The airlines do not get that interest, and they remind me of that about once a month. This is a total of \$82 million from the airlines. As of the 30th of March, approximately \$1.11 billion in Government and contractors funds have been applied to the program.

## ENGINEERING DRAWING RELEASES

The progress of the program is shown here in terms of numbers of engineering drawings released as a function of calendar years. (fig. 36). Approximately 64 percent of the engineering drawings have been released to the shops. That means that probably by the end of this calendar year, we will be very close to the 90-percent drawing release point. All of the subcontractors are building the parts and the shops are primarily bringing on board production, tooling, and manufacturing people. I might point out that the dark continuous curve is the schedule. As I have said before, this is a very unusual program. It is on schedule, is meeting cost estimates, and is attaining performance objectives.

## ENGINE TEST HOURS

Turning to the engine manufacturer, we see the cumulative test hours that have been developed to date, approximately 1,900 hours. Of this total, 38 percent has been accumulated since March of last year. Since we appeared before you last year, a great deal of progress has been made (fig. 37).

The total number of equivalent engines committed to date is 38.5 with 13 equivalent engines actually built. The total number of component testing hours completed to date is about 118,000 hours. The design thrust goal has been achieved. In fact, this engine has demonstrated a record thrust of almost 70,000 pounds. The actual flight test engine that is going to fly on the first airplane, just about 24 months from today, has demonstrated approximately 8 percent more thrust, and almost 14 percent lower specific fuel consumption than specified.

Normally that would be considered a remarkable achievement. I am sure G.E. deserves great credit for that. We are in the 10th year of a 12½-year program, with 13 equivalent engines built, nine prototype engines already run, and the flight test status engine now running, this is the kind of progress you can expect.

## NOISE REDUCTION

I think the most remarkable thing that has been done on this program has been the reduction of noise. Speaking as an engineer, and one who started on this program with the Douglas Co. in 1960, and went through the entire program with the Lockheed Co. totalling some 10 years on the SST development program, I would say that this is almost a miracle. What I have shown on this chart (fig. 29) is the noise level in the accepted term, EPNdb, effective perceived noise level in decibels, for the takeoff and sideline noise.

The sideline noise is measured about 2,100 feet directly to the side of the runway. Approach noise is measured 1 nautical mile before touchdown, and takeoff noise is measured 3.5 nautical miles after brake release. Both of these are out over the community. You will notice a steady improvement in noise, starting about 1966, which is when the SST contract awards were made. You will notice tradeoffs. It was about that time that the first attention was given to sideline noise.

I don't know if this committee knows this or not, but there is not a single airport in the free world that I know of that has a requirement on sideline noise or measures sideline noise as a criterion for lawsuits or for prevention of excess noise in the community. I might also say that I know of no airports in the free world that measure the approach noise as a critical point. The FAA, the airlines, and people in the Department of Transportation in the acoustic field, have recognized that all three of these together will represent, in the future and in the present, what bothers people in the community. So the FAA has proposed regulations taking into account sideline noise, noise out over the community on approach, and over the community on takeoff. They have issued a notice of proposed rulemaking, and now a rule for the new subsonic jets which requires them not to exceed 108 EPNdB at any of these three measuring points. This is not being met with present day jets.

The present rules at JFK, La Guardia, L.A., and other airports around the world are less severe.

When we testified before Congress last year, the best technical knowledge available indicated we could meet the requirement of 108 EPNdB for takeoff and approach. We felt that we could get down to approximately 112 EPNdB on the sideline noise.

If you could stand one the end of a runway, and listen to airplanes that produced 108 and 112, EPNdb, I doubt if your ear could distinguish the difference. Nevertheless it has been a strong urge of everybody in the Department, FAA, and the aeronautical community to get noise as low as humanly possible.

We announced last week, after our noise committee had been to Boeing and GE, and had completely validated these results, that we could now meet sideline, takeoff, and approach requirements. I would like to read you this letter for the record from Dr. Leo L. Beranek, who is probably the outstanding acoustic engineer in the free world. We are fortunate to have him as the chairman of our Noise Advisory Committee. The letter is dated February 5, 1971, addressed to me.

On September 11, 1970, I reported the first conclusions of the Committee to you as follows:

1. The noise levels for the production SST should be the same as those imposed by F.A.R. 36 for new four-engine, intercontinental, subsonic transport aircraft.
2. To meet the above objective, added emphasis should be given by Boeing and General Electric in their respective noise programs.

In conclusion Dr. Beranek says the following:

We conclude that the level of technology demonstrated by Boeing and General Electric is sufficient to achieve the noise level objectives we recommended. We are available to discuss our findings with you and other concerned parties as you deem appropriate.

It took several weeks for us to meet with them and make sure we were in agreement. I am happy to report today what I consider a breakthrough. The SST will meet the new noise requirements. Gentlemen, that is a noise one-half as great as present intercontinental jets you hear today. That should put to bed all the erroneous, mischievous, and inaccurate charges that an SST will make the noise of 50 simultaneous takeoffs of subsonic jets. Those charges have never been true. We have submitted them to many acoustic engineers throughout the United States and without exception they have said the charges are not true. Our SST will be better than any intercontinental four-engine jet flying today, and that is why the Airport Operators Council International sent me a letter saying that:

We look upon the SST as a means of eliminating and diminishing airport and noise pollution in the future, and therefore endorse the program.

This endorsement is a very exciting development.

#### EMPLOYMENT

At this point in the third quarter of fiscal year 1971, we have 13,000 people directly employed on the SST (fig. 38). We have seven major subs starting a slow buildup while awaiting, frankly, favorable congressional action from this committee and the Congress. These charts show only direct people. In times of normal employment, there is approximately a 3-to-1 impact on the total. Whereas in fiscal 1972, at the peak we have 24,000 people directly employed, we have 13,000 now. One can multiply that by a factor of 3 to get the total direct and indirect employment. Since unemployment is high now, that might be conservative. This factor could be as high as perhaps 4 or 5. So we are going up the manpower buildup curve quite rapidly. As I said they will be flying approximately 24 months from today.

#### FACILITIES STATUS

I would like to ask Mr. Parsons to run through some slides to give you a feeling of how much hardware has been built throughout the United States. We are not talking about preliminary design and drawings. We are now talking about engines that are built and running, major parts of the airplane that are in the subcontractor plant, or built and delivered to Boeing.

Mr. Parsons.

(NOTE: A series of slides were shown to the committee.)

Mr. PARSONS. Thank you.

Mr. Chairman and members of the committee, as Secretary Volpe and Mr. Magruder have indicated, with respect to the engineering

part of the program, we are essentially on schedule. This short presentation will give you some feel for the manufacturing progress going on across the country.

The SST manufacturing effort is distributed approximately 60 percent at Boeing and 40 percent with cost-sharing subcontractors, all of whom are making extensive investments in new facilities. Most of these facilities are complete.

First, Boeing's \$35 million investment in new facilities at the development center includes a \$6 million titanium processing facility that was designed and built by the Austin Co. of Chicago, Ill., a \$2 million high-bay extension built by Baugh Construction Co. of Seattle, Wash., and a \$2¼ million control development facility also built by Baugh. The latter facility is necessary in design and development of flight control systems and in the operation of flight simulators driven by \$1.7 million computers leased from the C.C. Leasing Corp. of New Jersey for \$30,000 per month.

While the simulators were designed by Boeing, the test rigs are built by Berteau of Irvine, Calif., and General Electric Co. of Waynesboro, Va. Additional efforts of many companies were required in making this facility fully operational.

The facility is computerized and has extensive flexibility for simulating the many flight conditions. Over 100 of the world's airline pilots have already flown these simulators and the prototype design reflects their inputs.

The \$6 million titanium processing facility has extensive hot-work capability for the manufacturing of aircraft parts. Special-purpose machines for hot forming were made jointly by Boeing of Seattle and Loma, Inc., of New York.

This facility can also produce body frames and includes a special stretch straightener capable of handling sections up to 50 feet long.

Airplane frames are hot formed on standard machines built by Cyril Bath Co. of Cleveland, Ohio, which are fitted with special adapters for titanium. A processing method developed by Boeing uses resistance heating and is now ten times faster than the older conventional methods.

Heavy wing spars made by Curtiss-Wright of Buffalo, N.Y., are formed in Boeing's \$½ million large furnace specifically made by Lindberg Co. of Chicago, and subsequently machined in large multi-million dollar spar mills made by Cincinnati Milling Machine Co.

The Boeing cleaning and chemical milling facility also built by the Austin Co. of Chicago, represents a \$1 million investment for processing large titanium airplane panels.

The facility is capable of processing parts over 50 feet in length. Another large bonding furnace facility at Boeing was also built by Lindberg Co. and is used in manufacturing body panels. Supporting equipment includes a new \$1.5 million electron-beam welder built by Sciaky of Chicago, Ill., which has been installed and operating in Seattle, Wash. Another \$1.3 million Sciaky electron-beam welder is currently being installed in the same plant.

The first part of the prototype airplane wing has been produced recently using these electron-beam welders, and is ready for assembly.

The \$76,000 new plasma arc welder made jointly by Boeing and Sciaky Co. has a 65 foot capacity for splicing wing skins and was used

to make the first integrally stiffened panel for the prototype airplane last fall.

Integrally stiffened skins for the wing have been formed using heated ceramic tools which match the required contours for the part.

Over 54 percent of the wing tool assembly models have been completed at the Boeing Seattle plant and the first assembly tools for the lower wing have been completed. Actual parts assembly started on February 22 of this year.

The Boeing \$2 million high-bay facility has been designed for assembly of the prototype hardware. Currently, the full-scale airplane prototype mockup is the largest tool in place at Boeing and is in this facility. The mockup provides for engine fit-up and space checks, system installations and wire bundle verification, and operation of the main landing gear in the extended position as well as the retracted or up position.

Boeing also has extensive facilities supporting the development center effort in Seattle, such as the Auburn plant for making detailed airplane parts.

The multimillion dollar Auburn plant has some of the world's largest machining facilities such as large spar mills built by Giddings and Lewis of Fond du Lac, Wis., and Cincinnati Milling Machine Co. of Ohio.

The Auburn plant also has extensive numerical control milling capability produced by Sundstrand Co. of Rockford, Ill., Kearney & Trecker Co. of Milwaukee, Wis., and Cincinnati Milling Machine Co.

These machines along with the titanium facility at the development center have already produced some of the world's largest titanium aircraft components. You may be aware, but for example, the 20-foot titanium landing gear beam used on the 747 was developed in the SST facility.

#### SUBCONTRACTOR SUPPORT

The subcontractor support to Boeing is quite extensive, and I would like to highlight it briefly. A \$5.6-million cost-sharing contract with Aeronca of Middletown, Ohio, for various airplane components includes parts for tail control surfaces and brazing tool grids for control surfaces and tools for the wing. Part of Aeronca's \$1.3-million facility investment for phase III includes a \$22,000 argon gas system which was installed by Air Products of Middletown, Ohio, for fabricating titanium wing panels, a new breakthrough in technology by Aeronca for the SST program.

One of the larger subcontracts is with two divisions of the Fairchild-Hiller-Republic Co. for \$34 million, all of which will be cost shared.

Body skin panel assembly models have been completed in their Hagerstown, Md. plant, and the vertical tail skin panels machined to the required contours at the Farmingdale, Long Island, plant.

Fairchild's new facilities investment for the SST program in the two divisions exceeds \$2½ million.

Out on the west coast, North American Rockwell Co. of Los Angeles, Calif., has completed most of the work on tools for a wing assembly fixture which is part of a \$32.2-million cost-sharing contract with Boeing.

A portion of the assembly model tools for the leading edge control surfaces has been completed in their Tulsa, Okla., plant. Their first aircraft part, a 4-foot wing rib, has been completed at North American Rockwell in Los Angeles, as has the outboard wing panel.

North American has invested more than \$4.2 million of their own money in new facilities such as a special brazing facility made by Lindberg Corp. of Chicago.

At the Northrop Norair division in Hawthorne, Calif., the cab major assembly tool is rapidly approaching completion as part of their \$12-million cost-sharing contract for the nose and forward section of the prototype.

Test hardware has also been completed at Northrop, which was used for verification of the new manufacturing process. Northrop has invested approximately \$1½ million of company money for the new facilities to date. Further south in Chula Vista, Calif., the Rohr Co. has a \$17.8-million cost-sharing contract with Boeing for the engine pods and landing gear doors. Test inlets have been completed and delivered to Boeing for the engine test program, and several, inlet-door assembly models have been completed for the prototype airplane.

Up the coast, Heath Tecna of Kent, Wash., has a \$1.8-million contract with Boeing for the SST aft body section. Forming tools have been completed as has the polyimide bonding tool. Prototype parts for a 5-foot section of the tail cone have been completed on these tools already.

At the Ladish Co. in Cudahy, Wis., forging dies and forgings for the landing gear have been completed on the world's largest counter-blow hammer. We also use the Air Force largest forging press in the world at the Wyman-Gordon Grafton, Mass., plant, for forgings. These landing gear forgings weigh over 16,000 pounds and are part of a \$½-million contract. Forgings have been inspected and shipped to Cleveland Pneumatic, which has a \$2.1-million contract with Boeing for fabricating the landing gear.

There are several thousand other smaller subcontractors on the SST program, producing thousands of additional parts, components, and systems just too numerous to name. Airesearch of Torrance, Calif., the Berteau Co. of Irvine, Calif., and Hydro-Aire of Burbank, Calif., are typical of the many that are producing parts to date.

Approximately 6,000 items have already been received by Boeing from these subcontractors and vendors throughout the country and are awaiting assembly of the prototype airplane.

#### ENGINE STATUS

Now I would like to switch to the engine status, and report on General Electric's program. Their jet family includes the world's largest engine, the GE4, which will power the prototype SST. Some highlights of their progress to date include engine No. 6 which has logged a constant run of 82 hours at cruise and power conditions equivalent to nearly 30 nonstop trips across the Atlantic.

Exhaust nozzle and reverser testing on engine No. 7 demonstrated the smokeless performance of the prototype engine, and this engine also holds the world's record thrust of nearly 70,000 pounds, established on September 10 of last year.

Additional testing is performed at General Electric's Peebles, Ohio, facility in rural Ohio, where extensive crosswind and noise testing is performed. The first flight engine No. 9, the one that will be used on the first prototype, went into test in December on schedule. To date, over 38 hours have been accumulated; and the engine performance has bettered both thrust and fuel consumption targets.

Much of the General Electric testing is performed in their \$12-million high altitude test facility which was fully paid for by General Electric as part of their \$20-million commitment for new facilities, to support the SST prototype program.

A large effort has gone into noise research. As Mr. Magruder mentioned, GE has conducted many full-scale suppressor tests. This research has been partly responsible for our ability to announce that the production SST will be able to meet the noise level requirements for the new subsonics.

General Electric is also supported by several thousand suppliers scattered throughout the country.

As of last month, all work was on schedule and within cost estimates in the manufacturing area.

In closing, however, I would like to point out that at present there are 2,000 to 3,000 work orders at Boeing waiting to be approved for the need of more funds.

#### EFFECT OF STOPPING PROGRAM

Mr. MAGRUDER. I wanted you to see that to get the same feeling as those of us closest to the program that the airplanes are being built from parts all over the United States, in practically every State. I want to leave with you a couple of messages. No. 1, practically everything you saw there was an advance in the state of the art, either in technology or manufacturing or tooling. Any thought that you could stop that sort of an effort, abandon that kind of a team at this point in time, and do some laboratory research on environmental areas and still keep the team together is wrong. We have no facts to say there are problems; there are only questions and concerns. If we try to stop, and go into a research phase today, we will definitely lose our subcontractors. To reassemble the former team would cost an enormous amount of money at a much later date, with great hazard for the marketplace.

#### SST DEVELOPMENT OFFICE ORGANIZATION

Mr. Boland mentioned yesterday, I believe, that last year in the committee, he directed us to do certain things. One was to reorganize my office (fig. 39) to place greater emphasis on controlling this billion dollar national program. I have done several things.

First of all, I have created two deputies. Mr. Vierling, who was the Acting Director up until the time I came on board, is now responsible to me for working with the financial community, providing communication with government agencies and with the public. He is charged with the responsibility to insure that by 1 year before we get our 100-hour test program we have a viable, useful financial program that will bring the private sector into the production phase.

Mr. Parsons is in charge of policy and programing activities. It is his job to work with the vendors, the major subcontractors, Boeing and G.E., to make sure we are on schedule, on performance, and under cost. As I said several times before, I think this is a very unusual program. We are at this time on schedule on cost and on performance, subject to the funding from this Congress.

I have also formed an office in Seattle but have not completely manned that office, because of the present uncertainties of the program. I don't want to bring on board anyone less than the very best people available, and not until we resolve the future of the program.

I have made a 10-percent increase in my staff since last year. We have on board 97 people now. I think we had 89 people on board when we reported to you last year. We still have an authorization for 117. I have also increased my divisions by one. Both the House committee and the Senate committee have reminded me that we have done a very poor job of getting the data to the public, to the news media, and to the Congress and to various people in the Government. I have created a new division, titled, Data Management. Colonel Rundell is the Acting Chief of that Division. His responsibility is to make sure the facts are distributed to the concerned organizations, individuals, and people inside and outside of government.

#### PROGRAM FINANCIAL STATUS

The program financial status is shown in this next chart (fig. 40). As of March 30, the Government has invested \$864 million, the contractors have put in \$164 million, and the airlines \$82 million, for the total of \$1.1 billion that I indicated earlier. If it is the will of the Congress that we should terminate, I need to include an additional requirement of \$85 million of Government money to take care of the cost sharing of the contractors. We have additional administrative and close-out costs of about \$12 million. We will have to refund to the airlines \$22 million, which was put up for reservation of delivery positions. So there is a total then of about \$983 million cost to the Government, in the event of a program close-out. The contractors will get back the \$85 million in termination costs, since it would be for the convenience of the Government and not be because of default by the contractors. The airlines have put up approximately \$82 million of which \$60 million in risk contribution would likely be lost in case of program termination. If the program were terminated by the 30th of March, it would amount to a total loss to Government and industry of \$1.11 billion.

The termination costs have increased over last year as follows:

The contractor shares to be returned would be \$85 million. Additional appropriations would be required to cover what has been spent under the continuing resolution of \$156 million. There is an additional termination liability of \$10 million plus program office costs of \$2 million. The minimum appropriation required would be \$253 million. The airline escrow in the Treasury of \$22 million would be a cash outflow, so the minimum Treasury outlay would be \$275 million for fiscal year 1971.

Secretary Volpe said yesterday the airlines have contributed \$60 million to Boeing to build the prototypes assuming that we would

go ahead with this program. Shortly after the Senate vote last year, two of the airlines notified us publicly that they might sue for their risk money if the Government terminates for convenience.

There is even an international problem here in that one international operator, KLM, who has in the past bought most every commercial transport model this country has produced, has not reserved positions for the Concorde. They would be put in a noncompetitive position if we were to abandon the program. So there might be a further liability of \$60 million. There is then a possible total Government commitment on termination of \$334 million. As I have just outlined; fiscal year 1971 requirement to stop is about the same as the fiscal year 1971 funding originally requested.

#### BALANCE OF TRADE

That is the progress of the program. I would like to take you very quickly through several areas of the program to clear up any confusion. I am not an economist by trade. I am an airplane designer, an aviator and a program manager with 28 years in the aviation business. When I first came to Washington I was a little bit surprised to find that there were questions by some people, and I am continually surprised today to hear that the balance of trade discussion is sometimes called a "red herring" by some economists.

The things that I am going to present here today have been submitted to the Treasury Department, to the Commerce Department, the State Department, the Council of Economic Advisers, the Export-Import Bank, the Federal Reserve, the CAB, and to my own Department. All of their comments have been included in this testimony. I found it a great benefit to me in communications with these other Departments if I worked that way.

Here is what has been said about balance of trade by all of us together, and I became very well known for a few months after asking all of these great agencies a number of simple questions. I asked every agency, "Who ought to have a favorable trade balance?" (Fig. 41.)

I also went to many economists, including Mr. Milton Friedman and asked the same question. And the answer comes back very simply that the United States of all the nations probably ought to be the one that has a favorable trade balance, and you notice I say favorable trade balance. I don't say balance of payments or gold flow because, frankly, the balance of payments are for total trade accounts, which are very complex. I talked trade balance because I was simply talking the difference between export and import, and everybody seems to be able to understand that and very few people disagree with the computation.

The United States has made the unselfish and moral commitment over our history to help underdeveloped nations help themselves. We think that is in the interest of every citizen in this country and we have the unselfish aim in life to share some of our resources with the less fortunate nations of the world. Not everybody makes that attempt, but we have. That has been our national commitment.

The way that you do these things is by having a favorable trade balance. If you do not have it, you cannot afford to do those things.

## BALANCE OF TRADE—STATEMENTS

These are the statements I got from the various departments. (Fig. 42) I will not read them. You can read them on the chart. I went to Treasury, to Commerce, the World Bank, Federal Reserve Board, the Export-Import Bank, and I asked what is good about a favorable trade balance. You will note they didn't all say the same thing but there is absolutely no disagreement among them that a favorable trade balance is in the interest of the United States and every citizen.

I also went to Eugene Black, former President of the World Bank. I also went to the Office of Management and Budget. I went to Stanley Osborne who was on the President's Advisory Committee for the SST and is also a member of Lazard Freres and a very well known financial expert on Wall Street. I went to the Council of Economic Advisers and again you find while they don't all say exactly the same thing, there is complete agreement that favorable trade balance is good for this country.

## BALANCE OF TRADE-SIGNIFICANCE

I asked another simple question. I said why? (Fig. 43). And again we get from all these agencies pretty good agreement. A favorable trade balance is good in that it permits removal of the restraints on the U.S. by capital investment abroad, such as the interest equalization tax on foreign stocks and bonds. If you want to buy foreign stocks and bonds from a highly developed country today you have to pay a tax. A favorable trade balance helps eliminate that kind of restraint. It helps on the voluntary foreign credit program, U.S. bank loans, et cetera. If you want to start a drug company in a developed country such as Germany you pay a tax. A favorable trade balance helps to remove those restraints, and we are essentially a free trade nation.

It also offsets various U.S. expenditures abroad by financing U.S. direct investments abroad such as military aid, aid to underdeveloped countries, world-wide pollution control, development of the Mekong River Valley, something that is very attractive in the peace negotiations in Vietnam. Private industry has developments abroad, and I might say it also maintains the stability of the dollar, which is the free world's monetary standard.

It provides the capabilities (Fig. 44) for us to help underdeveloped nations and it also gives us an adequate level of international reserves such as gold, foreign exchange and drawing rights on the International Monetary Fund. So it is good for all those reasons.

## BALANCE OF TRADE-METHODS TO IMPROVE

There are other ways that you can do those things. You can help a favorable trade balance by deflation and it does certain things but it does depress profits. (Fig. 45). The same thing applies for devaluation, but that is just not an option open to the United States. You can impose import restrictions but that leads to retaliation. You can encourage exports but that can't do the job alone. You can have capital controls but that is contrary to our U.S. national policy, and you can restrict tourism but again that is an irritating source to our citizens.

## BALANCE OF TRADE-STUDY

Then you might ask: Why is there any argument? All of the people agree that it is good. Well, one of the arguments came up in 1969. Some of the studies done by the Treasury Department and by the Council of Economic Advisers said, "Maybe if you build an SST there will be a thing called the tourist account." In other words, historically we have shown in aviation that if you put a faster airplane on the market, and we are a tourist nation, it tends to stimulate tourism. You can roughly equate what that tourism stimulus is, and it may offset the sale of equipment abroad.

This is the kind of calculation I am familiar with so I went through the 1969 calculations. (Fig. 46.) I found that they were based on the fact that there would be no other SST anywhere in the world and that speed-induced travel impact would indeed offset the sale of equipment, and it was based on 1967 dollars.

But I had spent the last 15 years as a businessman all over the world and I knew that the Concorde was real, so I asked the State Department, the Commerce Department, to send their experts to Europe. They did so for 4 months. They came back in 1970 and they said, "Yes, we agree with you." While they didn't agree in 1969, there is a consensus in the Government now that the Concorde is going ahead (Fig. 47). In fact, it would be hard to argue against that. They have been flying it for 2 years and probably will have within 60 days their first sale or letter of intent. So the Concorde I is real, and the Concorde II has been reported by the State Department to be on the drawing boards.

I know that there is a family of airplanes abroad and the fact that the SST is in being abroad has more than an impact on just the SST itself. If we let go our leadership in commercial aviation it will erode down into the subsonic fleet. I have to reveal something—that as a businessman from industry I had been told not to do when I came to Washington. I had to get permission to do it from my former employer. If you let your technology be matched by the rest of the free world, and all those slides that you were shown earlier showed our advanced technology—no other nation in the world can match that kind of manufacturing and aeronautical engineering—but once you let them match you, you face a thing called the offset agreement. When I was at Douglas, in order for us to sell the DC-9 to Air Canada we had to agree to build the wing and the tail in Canada. That was the second sale.

To make the third sale, to Alitalia, we had to agree to build fuselage panels in Italy. And when I was at Lockheed in order for us to get a 50-airplane sale of a Lockheed L-1011 with Britain we had to agree to put the Rolls Royce engine on. That was a favorable trade balance for Britain of over \$1 billion. You read a lot about that in the newspapers today, which is in concert with the problems of building a commercial airplane that costs over a half billion dollars. Nevertheless, once the rest of the free world can match your technology, there is just no way not to have a quid pro quo. If they are going to buy your airplanes you better give them something off that airplane, such as an engine.

For example, when GE sold the engine to the French for the A-300B, it is the exact same engine and pod nacelle that is on the

Douglas DC-10. They had to sign an agreement to build 40 percent of those engines in France.

What that means to France is that with a stroke of the pen, they got the technology directly off of our C-5, because the engine on the DC-10 is a natural commercial derivative to the military engine on the C-5A. All of the technology, the noise, the engine emissions, and the advanced performance and efficiency went to France in that agreement.

It is still a good business deal. GE has to sell engines and that is what it takes. So I put the offset agreement in my calculations.

And I also used inflation. I didn't use constant dollars, and I pointed out that any time you sell aircraft over a period of 10 years, sales of spare parts would increase the impact of that sale by almost 50 percent.

The Concorde is in being. All of our indications here through NASA and through the proper agencies in the Government indicate meeting or exceeding their performance guarantees.

Recently the Washington Post carried an article on the front page which implied that BOAC would not buy the Concorde. It happened I was in New York at that moment and knew that Anthony Wedgewood-Benn, who is a Member of Parliament, former Minister of Technology, was in town. I know Mr. Benn so I got together with him. That night he assured me from a Parliament standpoint there was just no basis in fact in this article which, by the way, was quoting an article from a London newspaper. The following day, news releases were issued by both Air France and by BOAC saying they not only wanted the Concorde and intended to buy it, but were looking forward to it and were in process of negotiation. That should be brought out clearly on the record.

Now, the calculations are in harmony with Treasury, Commerce, CAB, Council of Economic Advisers, and the Department of Transportation.

#### BALANCE-OF-TRADE IMPACT OF U.S. SST AND CONCORDE

I think the easiest way to show that is on this chart (fig. 13). Below the line are imports. Above the line are exports. On the far left you see what the impact would be with an SST program. On the right you see what the Concorde I impact would be on our trade balance if we have no SST program.

If we have an SST we would expect, through 1990, to export 270 SST's. Since we are 4 to 5 years behind the Concorde we will still have to import approximately 60 Concorde. If we delete the SST program this country would import about 300 Concorde through 1990. That difference in trade balance is \$17.1 billion.

If we consider the fact that the State Department and airlines reported the Concorde II is on the drawing boards, then we are talking about the same base case, 270 if we go ahead with the SST versus 60 Concorde. If we defer our SST then we will probably import approximately 380 Concorde and that is because of a bigger penetration of our subsonic jet market by a better, more efficient foreign SST. That is a favorable trade balance of \$22.1 billion. That is what we call our base case, and on that number I can get complete agreement within the Government.

## FOREIGN FAMILIES OF AIRPLANES

However, there is another family of airplanes in being. Through the 1990 time period there is something between \$50 billion and \$100 billion worth of commercial airplane business at stake. The Europeans are not unaware of that and they are building the A-300B (fig. 10). This is a two-engine Jumbo Jet, wide body, with engines, as a matter of fact, the same as on the DC-10, low-noise, low-pollution engines.

It is being built and is recognized abroad by the national treasuries of France, Germany, Holland, and the British through Hawker Siddeley as a private enterprise. So there are four nations' industries and three national treasuries involved in this airplane alone. It is supposed to fly late this year or early next year and goes into service in 1973 and 1974.

This is a definite threat to the sales potential of the DC-10 and the Lockheed L-1011 since we do not have a competitor for it in private industry in this country.

Also abroad being sponsored by the national treasury, I believe, of five countries is the Dassault's Mercure. The ad reads as follows (fig. 11).

Flat in Italy is constructing the rear fuselage and the tail unit, CASA in Spain the forward fuselage. SABCA in Belgium is also on the job.

This airplane is being put together by five national treasuries in Europe, manufacturers, through Dassault. It is the replacement for the Douglas DC-9 and the Boeing 737 and is again a recognition of the fact that for the first time in aviation history the Europeans recognize the way to penetrate the civil market is to have a complete product line, family of airplanes. Mr. McLellan referred to this yesterday in the commerce testimony, so obviously they have recognized it and are going after the market.

This is the same ad that Secretary Volpe showed yesterday (fig. 12). The Russians are recognizing that they have to have a family of airplanes. On that score I would like to read Mr. Richard C. Cohen's comment in a report on the bilateral airworthiness agreements from the Commerce Department, Consideration of the Airworthiness Agreement with the Soviet Union, Provision of Recommendations for the Department of State:

The Soviet commercial aircraft have been underrated in the international scene on the basis of evaluating their purely economic competitiveness. However, Soviet transport equipment has penetrated beyond the Bloc to Africa, India, Latin America and the Middle East. In these areas the problem of providing adequate air transport services outweighs favorable operating economics of route application and the current Soviet aircraft export drive is aimed at more than 40 countries of the West, with publicity demonstration tours of all types of Soviet aircraft, including helicopters.

With permission of the Committee I would like to insert the entire Department of Commerce letter.

(The information follows:)

U. S. DEPARTMENT OF COMMERCE  
COMMERCE - IGIA LIAISON OFFICE

## REQUEST FOR APPROVAL OR COMMENT

1. TO: Mr. Richard E. Cohen Aerospace Equip. Br. Room 5093, Main Commoro	FROM: COMMERCE - IGIA LIAISON OFFICE ENVIRONMENTAL SCIENCE SERVICES ADMIN. ATTENTION: IA (ROOM 818, BUILDING 8) ROCKVILLE, MARYLAND 20852 Richard E. Cohen	DATE 23 June 1970
2. TO: COMMERCE - IGIA LIAISON OFFICE ENVIRONMENTAL SCIENCE SERVICES ADMIN. ATTENTION: IA (ROOM 818, BUILDING 8) ROCKVILLE, MARYLAND 20852	FROM: Aerospace Equip. Branch Transp. Products Div./BDSA U. S. Dept. of Commerce Washington, D. C. 20230	DATE 7-14-70
SUBJECT <u>IGIA 1/3</u> - Bilateral Airworthiness Agreements -- Consideration of a Bilateral Airworthiness Agreement with the Soviet Union -- Provision of Recommendations to the Department of State		
IF THE ABOVE DOCUMENT IS NOT ATTACHED HERETO, IT HAS BEEN PREVIOUSLY FORWARDED TO YOU		
THE SUBJECT DOCUMENT IS UNDER CONSIDERATION IN THE INTERAGENCY GROUP ON INTERNATIONAL AVIATION. YOUR APPROVAL OR COMMENT ON THIS DOCUMENT IS REQUESTED IN ORDER THAT A UNIFIED DEPARTMENT OF COMMERCE POSITION MAY BE FORMULATED. PROPOSALS FOR AMENDING A DOCUMENT SHOULD BE ACCOMPANIED BY SPECIFIC LANGUAGE SUGGESTIONS.		
PLEASE RETURN TO:	COMMERCE - IGIA LIAISON OFFICE ENVIRONMENTAL SCIENCE SERVICES ADMIN. ATTENTION: IA (ROOM 818, BUILDING 8) ROCKVILLE, MARYLAND 20852	BY: <u>9 July 1970</u>
APPROVED:		
COMMENT: (as of September 1970 redesignated Bureau of Domestic Commerce)		
The Business and Defense Services Administration/Department of Commerce offers the following comments regarding IGIA 1/3:		
The BDSA is primarily concerned over the potentially adverse impact on the U.S. aerospace manufacturing industry which could result from the negotiation of an airworthiness agreement with the Soviet Union.		
(1) Recognizing that the Government's policy is to favor an expansion of trade in peaceful goods with the Soviet Union, it is still necessary to evaluate the consideration of such an agreement in terms of mutual benefits. Soviet aircraft export efforts pose a potential competitive threat to the U.S. aerospace industry's domestic and foreign markets. For more than 10 years the U.S.S.R. has been exporting fighter and transport aircraft and helicopters, with the sales comprising an instrument of national policy. Prices and financing terms are set according to the desire to displace other suppliers from a market, particularly if the customer also is interested in U.S. aircraft.		
(2) Soviet commercial aircraft have been underrated in the international scope on the basis of evaluating their purely economic competitiveness. However, Soviet transport equipment has penetrated beyond the Bloc to Africa, India, Latin America, and the Middle East. In these areas the problem of providing adequate air transport services outweighs favorable operating economics or route application.		

2

The current Soviet aircraft export drive is aimed at more than 40 countries of the West, with publicity/demonstration tours of all types of Soviet aircraft, including helicopters.

(3) Since the state has rigid control over aircraft production, the Soviet aviation export agency can offer whatever deliveries, terms or services is deemed necessary to satisfy customer requirements or desires. If deliveries to Aeroflot, the Soviet state airline, or other Soviet-bloc airlines have to be changed to meet export commitments, national export policy reportedly dictates that this will be done.

The selling price of Soviet aircraft is obviously not established at a commercial level, but prospective customers have been aware of problems relating to international standards, spares provisioning and prices, component lives, availability of support equipment, and field technical assistance.

The Soviet aviation export officials have indicated that they recognize that to be competitive with U.S. aircraft exporters they must offer adequate support for their exported aircraft. They have developed a logistics support system offering normal delivery times of seven days, and 48 hours express deliveries for spares required by customers on an urgent basis.

(4) Theoretically, there has been no reason why any Western country should not buy Soviet transport aircraft, but the Soviet types have not provided serious competition primarily because they have not conformed entirely to international standards.

A U.S.-U.S.S.R. bilateral airworthiness agreement leading to the granting of an FAA airworthiness certificate to the YAK-40 would be viewed in most other countries as an approval of standards of quality and safety which would make the YAK-40 more attractive to potential foreign purchasers. Reportedly, Colombia, which had ordered four YAK-40's last year, has cancelled its order because there has been no formal airworthiness approval of this aircraft by any major Western aviation authority.

(5) There does not appear to be any significant market potential for the sale of U.S.-manufactured aircraft in the Soviet Union, which could result as a reciprocal benefit from an airworthiness agreement.

Aeroflot, the Soviet air service monopoly operates a well-equipped fleet of modern Soviet-built aircraft. Its expanding worldwide services have created the demand resulting in the development of a full line of transport aircraft from subsonic to supersonic. It is questionable whether the Soviet aviation authorities would dissipate their long-fought for gains in world aviation by flying foreign-built aircraft in the state-owned Aeroflot services. Furthermore, the Soviet aerospace industry has been receiving priority in allocation of the resources it needs to fulfill the ambition of competing effectively with the Western industries and it is unlikely that the Soviet Government would cut into its potential production programs by authorizing significant aircraft imports.

Reportedly the re-equipment requirements of the Bloc airlines are being closed to Western suppliers by Soviet pressure to take Soviet aircraft.

(6) In summary, the subsidized price, terms, and production of Soviet aircraft along with a U.S. quality approval in terms of U.S. airworthiness certification could result in substantially increased competition against U.S. aircraft in the world market at a time when the U.S. industry is undergoing disruptive domestic economic pressures. Export markets are essential to the success of U.S. transport aircraft production programs and competition is already strong and effective from European suppliers.

The request for certification of the YAK-40 could be a serious precedent for further increases in competitive pressures. The Soviet industry is capable of competing with U.S. suppliers across a full range of commercial aircraft, including a supersonic transport, at terms and conditions of sales completely without economic relevancy. We do not see any economic benefit from an airworthiness agreement on the YAK-40.

Mr. MAGRUDER. Mr. Beggs reminded me last night to be sure to say to you that all of the information we have indicates that the Soviets are offering their equipment with no prepayments and interest rates are between 1 and 2 percent. Now, our country in negotiating sales with foreign operators requires prepayment before delivery of between 30 and 50 percent of the value of the airplane and, as you know, interest rates from the Export-Import Bank run around 6 to 7 percent with payback periods of 7 years. So the Soviets have a strong ability to make a wedge in underdeveloped countries if they choose to do so, and all the evidence is that they have chosen to do so. I am not saying that we can't beat this but we should not take it lightly.

#### BALANCE OF TRADE-CURRENT DOLLARS

I have shown you the base case on the balance of trade (Fig. 15). If we take into account all those factors I mentioned, the offset agreement, spare parts, constant dollars, not 1967 dollars, but just a 3 percent escalation, then that base case of \$22.1 billion you will see changes such that with the Concorde I and II program only but with a constant dollar change to 3 percent inflation, we get a favorable trade balance of not now \$22 billion but as high as \$35.3 billion. Now if we take into account the Concorde I and II, and the fact that A 300 B might penetrate our subsonic market to the tune of 50 percent in that area alone—I haven't taken the penetration of the Mercure and other family account—and we take into account the offset agreement, then that case can get as high as \$45.6 billion. If I take into account and add on top of that the sales of spare parts, the favorable trade balance can go over \$50 billion.

That is why in all of our testimony I have said that the trade balance impact on the basis of, what is going on today, can be between \$22 billion and \$50 billion. That is a big number.

#### BALANCE OF TRADE—USA TODAY

How are we doing on trade balance today? Well, that is shown in these Commerce Department figures (Fig. 16) showing that of all the items that we export the only thing that outweighs civilian aircraft is all other industrial machinery and parts put together. We averaged somewhere between \$1 billion and \$2.5 billion in the past 5 years on civilian aircraft engines and spare parts.

With respect to automotive vehicle parts and engines, we are now at almost \$2.3 billion negative trade balance. The aircraft alone have been the major portion of our favorable balance over the past five years. Remember, we have been averaging somewhere over \$2 billion a year, based on the Department of Commerce quotes.

#### BALANCE OF TRADE SUMMARY

So I would say in summary (fig. 48) that the favorable trade balance is critical to the holding of the value of the dollar, price stability, maintaining the stability of our world monetary system, keeping our international borrowing or lending capability sound and helping to provide a high standard of living.

Civil aircraft are critical to the trade balance because they have been near the top of the list for the past 10 years and represent almost \$100 billion in business through 1990.

#### PRODUCTIVITY

The next thing I wanted to cover was the subject of productivity. I don't think there is anything that is more poorly understood about aviation than the reason for speed. You might ask why don't people print this story, why isn't it showing up in the press. I like to kid my good friends in the news media on this score because productivity is the thing that helps you to offset increases in costs of materials and labor. I often engage in editorial board debates and remind them as I did very recently one major newspaper here in town. When I was in high school in 1937 I got my Sunday paper for 10 cents. I got the daily paper for 3 cents. Today I haven't noticed that the newspaper industry has done anything remarkable with the printing presses or the delivery systems. Today it costs me 40 to 50 cents to get a Sunday newspaper and my daily papers are 10 cents.

I am not decrying the newspapers. They have their own problems. But let's take the other side of the coin and look at what the telephone system has done. Here is a communications system that has taken advantage of the avionics and electronics business which, by the way, is a fallout from the aircraft industry, and by improving their productivity you make calls back and forth across the country today at about the same price as you did in 1945, 25 years ago. If we tried to use the same technology in the telephone system today that we had just 10 years ago it would take the equivalent of every man, woman, and child in the United States work force to man the telephone communications system. With computer technology and electronics we do it at the same price in spite of costs having gone up.

I think the most magnificent industry in the world is the aerospace/air transport industry. Productivity shows how they have given us the biggest bargain in the last quarter of a century (fig. 49).

Productivity permits the airline business to have manageable fleet sizes. Secretary Volpe said yesterday that if we tried to do today with DC-3's it would require about 50,000 DC-3's to do what we are doing today with 3,000 jets. It gives us efficient and improving service, reasonable cost-fare relationships, and reasonable earnings.

Productivity measure is the available seat-miles per hour per airplane and you notice the improvement over the years in aircraft (fig. 50). The SST is over 100 times as productive as the DC-3. It will be twice as productive as the 747. It will be three times as productive as the Concorde, the jumbo jets, the DC-10 and L-1011 which haven't even gone into service yet. It will be the most productive, efficient mode of transportation ever built, five times as productive as the 707 and the DC-8.

#### PRODUCTIVITY—FREE WORLD TRAFFIC

The market as shown here is a conservative market (fig. 51). It shows a growth of about 9 percent for jet traffic. Starting from an actual 1967 and projecting to 1969, it is about 25 percent below what

actually happened, so it is conservative. This is the total free world projected revenue passenger-miles in billions for these years.

Notice something that is interesting. If you just take the SST traffic out of the international market and project it to 1985—that is just the seventh year of operation—you will find that the SST's will be carrying about 80 percent of all of the international market in 1985. That is because about 80 percent of all of the free world's international markets are over water and this is assuming no sonic boom flights over land anywhere in the free world.

Also notice that the amount of traffic projected by the SST in 1985 is the same amount of traffic carried by all the free world's airlines, local, domestic, and international, today, 256 billion revenue passenger-miles. This makes it hard to understand why anybody would refer to the SST as a thing of the jet set. It will be carrying as many people in revenue passenger-miles in 1985 as are carried today on all the free world's airlines, local, domestic, and international.

#### PRODUCTIVITY—WORLD FLEETS

Secretary Volpe mentioned yesterday, if we tried to do today what we did with the DC-3 back in 1935 and 1947, that it would require a fleet size of about 50,000 DC-3's today to do what we do with about 3,000 mixed fleets of jets (fig. 52).

To make it even more ridiculous, if you went to 1990 and kept the DC-3, it would take 285,000 DC-3's, assuming the DC-3 had a 5,000-mile range, which it does not.

So the point I make here is you want to have productivity to keep your fleet size manageable. We already have congestion in air traffic control and a mixed fleet of our jets and jumbos in 1990 is how we are going to keep the aircraft compatible with air traffic control at that time.

#### PRODUCTIVITY—WHO FLIES

Who flies today? Twenty-two percent of our population fly domestics—almost 45 million Americans (fig. 53). Six million Americans, (3 percent of the population), fly international, and that does not include 3 million Americans who fly to the Caribbean, to St. John's, to Honolulu, and that number is going to triple by 1985. So by 1985 50 percent are projected to fly American domestics or 126 million Americans, and 25 million, or 10 percent of the population of this country, will fly internationally, not including approximately 9 million who will make these flights to the Caribbean and to Honolulu. So it is over 30 million Americans, and the pleasure-business split is about 75-25 percent on the North Atlantic, and 50-50 in the Pacific.

#### PRODUCTIVITY—RETURN ON INVESTMENT

Why do we build the long-range SST before we build domestic urban short-haul vehicles? (fig. 54) The answer is shown here. We have never built the short-haul airplanes first. That is the best way to go out of business. We always built the long-range DC-6, the long-range 707, the DC-8, and the long-range 747, first. The reason is shown

here. Over the past 10 years the rate of return on investment comparison for the international, and domestic routes shows that the international profit is about 60 percent higher. That is not too hard to understand. As you make long-haul flights you get your fares and earnings up and don't have to have a whole lot of people, baggage carriers, maintenance people, and operators on the ground every 100 miles to sustain it. Everyone in the airline business understands it is the long-haul blue ribbon routes rather than all of the short-haul domestic routes that come first, so we always build the long-haul blue ribbon airplanes first, and then comes the medium airplane, and the last airplane in the fleet is the short-haul DC-9 and 737. That is classic and we shouldn't disturb that as good businessmen.

#### PRODUCTIVITY—PAYBACK CAPABILITY

The question is often asked how on earth can you pay for an airplane that might cost \$40 to \$50 million. The answer is on this chart (fig. 55). The same question was asked back in 1958 and 1959 when we were talking about 707's and the DC-8. They cost \$6 million and now cost \$8 to \$10 million. You will note the match of productivity of the airplane and its ability to make earnings in line with its price. It always pays for itself in about 5 to 6 years. All these airplanes have been very well matched on their productivity, number of seats, and the speed, to the price. The SST at \$40 million will be no exception. In fact, even if it is up to \$50 million it will still be within the 6-year payback time.

#### PRODUCTIVITY—COST ESCALATION

I think one of the most magnificent industries in the world is the combination of aerospace and air transport industry, and this is why (fig. 19). Between 1955 and 1970, all costs have gone up because of flightcrew cost, employee cost, material cost, with the single exception of jet fuel which has stayed constant and even gone down some, have gone up from 50 to 150 percent. Nevertheless, in spite of the fact that the Consumer Price Index has gone up by some 50 percent, Americans today travel back and forth across the United States 5 percent cheaper in equivalent dollars in 1970 than we paid in 1945, a quarter of a century ago. That is a bargain. The reason is that the aerospace industry together with the air transport people design a new airplane every 5 or 6 years that increases the productivity.

This has been true of the DC-3, DC-4, DC-6, the 7, the Constellation, the 707, the DC-8, and the stretch DC-8. There are some 49 different models of the DC-8 today and 49 of the DC-9. As a result of the improved productivity to offset these costs, we get a break in fares for the traveling public and reasonable earnings for the airlines. Today the airlines are having a temporary setback due to the economy. As a result, domestic travel instead of going up a projected 9 to 10 percent, only went up 1½ percent. However, the international travel abroad increased between 15 and 20 percent last year while the domestic travel stayed at about 1½ percent. That kind of productivity is what helps to answer the question: Is the Concorde an economic threat? Does it have the ability to earn money?

## COMPETITION—CONCORDE ECONOMICS

Well, on the basis of 120 seats, 15 percent surcharge, the same surcharge that was applied to the subsonic jets in 1959, the return on investment as a function of seating capacity shows the Concorde could have about a 12.8 percent return on investment (fig. 4). Now, that is not enough because that doesn't carry its fair share of overhead of the rest of the fleet, but look at what happens if you compare the return on investment. At a 75-percent load factor and a price of \$20 million, there will be about 25 percent or more return on investment (fig. 5).

You will notice the ability the British and the French have to negotiate a return on investment. A slight reduction in price could offer 5 percent more return on investment. That is why you read in the newspapers some of the statements that have come out in the last hours of negotiation about the operating economics of airplanes. They are trying to negotiate the airlines back and forth across this line.

I also believe that it would be fair to say when the Concorde goes into service as the only supersonic transport it will probably enjoy a 75-percent load factor. Pan American for the first 2 or 3 years of jet operation across the Atlantic enjoyed between a 70- and 80-percent load factor, and with the new equipment cutting times to abroad in half I would fully expect that for the first 2, 3, or 4 years the Concorde will have a 75-percent load factor. As a matter of fact, with current yields it only has to have 75 percent of its seats filled to break even.

## COMPETITION—BREAKEVEN LOAD FACTORS

Presentday jet yields are somewhere between 30 and 36 percent (fig. 6). If you put a 15-percent surcharge on the Concorde, it is going to break even at about a 39-percent load factor, so it is not completely out of line. It is not as good as our airplane but it shows real potential for earnings.

## ECONOMICS—TOTAL OPERATING COSTS

You have also read of the operating economics of the SST. This is a chart (fig. 56) showing the total operating cost through the years of the early jets. The reason the operating costs are down and revenues are up in the early days is the introductory advantage and high load factors. As inflation takes over, costs get out of hand, and you have to come in with a new 707-300 series, a 747, a DC-10, and L-1011. But the SST will come into service and have a lower slope in total operating costs and the rest are back here with the steeper slope.

The SST can go to Europe carrying 300 people, come back carrying 300 people, start again with 300 people, while one DC-10 carries 250 people to Europe and one 747 carries 360 people to Europe.

## COMPETITION—PROFITABILITY

As we can see now, the 747 in the early 1980's will probably be better than the tri-jet, the L-1011, and the DC-10 (fig. 8). If I put that story together now in annual operating costs over an international route using the normal international mix, 120 seats, and just the 55 percent load factor, here is the U.S. SST earning potential, much better than a 747, two or three times as much earning potential as

the DC-10 or L-1011, and three or four times the earnings potential of the present day jet. But notice the Concorde with a 15 percent surcharge and 55 percent load factor is right in there with everybody except the 747 and our SST. If it operates at a 75 percent load factor, which we think it will, it will have the same earnings capability as the 747 but not as good as our SST.

So the Concorde is a definite economic threat. It is not as good as the U.S. SST for which people would rather wait. There is a KLM representative here this morning and the first thing he said to me was that they prefer to wait for the U.S. SST. They are here today to see what your decision is going to be and that of Congress.

#### SST FUNDING

The SST funding we support is the base case. We recommend the full \$290 million for fiscal year 1971 (fig. 57). This means a new obligational authority in fiscal year 1971 of \$290 million is needed. We would keep to our fiscal year 1972 requirement of \$235 million. The \$290 million would allow us to hold the first flight date of March 1973 and we believe hold the total Phase III cost of \$1.283 billion. That is just the Phase III cost. This is the same first flight date that we alerted you to last year.

You recall the manufacturers said they could hold to the November date of 1972 but because of the funding limitations under the joint resolution I think that even they will now agree that it will slip probably to the first quarter of 1973.

We don't consider Option 1 to be very satisfactory or one we would recommend. This option would have the \$210 million continue for 1971 but then increase the allocation in 1972 to \$275 million. You will notice the total impact on cost of some \$90 million, which would require a first flight slip from March to August of 1973. These are preliminary numbers because we have not had an opportunity to get back with the contractors and make sure that we have firm figures.

Option 2 assumes \$210 million for fiscal year 1971 and no change to the 1972 figure of \$235 million.

With this option over approximately a year or more in timing is lost and the increase in funds would be somewhere between \$200 million to \$300 million in total program costs. We must be very candid and say that if decisions are made that increase the program costs on the order of \$200 million, a requirement is also being made that Boeing and GE and the subcontractors, those that have cost-share contracts, will share in about 25 percent of that cost overrun. Those companies are not in any position to take on that kind of obligation just for delaying the program and hurting the marketplace.

So our firm recommendation to you has to be that program which is of least cost to the taxpayers, and that would be the \$290 million program. This would be the peak requirement, and hold the \$235 million for fiscal year 1972.

#### SST PROGRAM SUMMARY

I had intended to go through some of the environmental topics but instead tomorrow Dr. Kellogg, Dr. Singer, and Dr. Beranek are going to testify, and I think I will leave that entire environmental discussion for those environmental experts, with your permission.

I would like to summarize at this point (fig. 58). The thing that I think is outstanding about the SST program is that it is in harmony with what Congress likes to do and with what we in the Government like to do, and that is look ahead and plan ahead.

From 1960 to 1978, is an 18-year research and development period before the first traveling passenger is carried in service on the SST. It will be an integral part of the U.S. transportation system for the 1980's and 1990's. It meets the airlines' requirements of productivity to keep their fares down and their earnings up so we have a healthy air transport system in the eighties and nineties. Without an SST the only way to get that productivity is to build 1,000-passenger jumbo jets. That is probably the least cost effective thing we could impose upon the air transport system. Not one free-world major international airport can sustain 1,000-passenger subsonic jets. It would mean new property, new facilities, new zoning laws, and through the decade of the eighties and nineties to the year 2000. A mixed fleet of jumbo jets and SST's appears to us to be the most economical, the most productive, the most convenient, the least polluting, the cleanest mode of air transportation systems.

It is an aid to the U.S. economics, a significant balance-of-trade impact agreed upon by every agency in the Government that has authority. It maintains dollar value and stability. It helps make possible a national revenue generator of a billion dollars in profit, \$6.5 billion to \$10 billion in tax revenues, 150,000 direct and indirect jobs in the production program, and \$22 billion to \$50 billion in trade balance. This is the kind of national revenue that is going to allow us to take on all of the social reforms that some people think are at odds with the priority of the SST, things like law enforcement, health, education, welfare, pollution control, and better transportation systems. It is going to be the national revenue earned by programs like the SST not the SST alone, that will make those things possible.

I think also important is the unique financing arrangement. Always, commercial aviation has been recognized by the Congress as an essential public service. Since 1915 and the generation of research of NACA through the CAA, I think we recognize that the Federal, county, city, and State taxes have built all the airports.

We have manned all the control towers. The entire free-world air traffic control system was generated by Federal funds from this country, eventually turned over to other nations. Certainly the air traffic control system in this country is a Federal responsibility, so we have maintained a unique financing arrangement that does not destroy our private enterprise. The SST appropriation is a loan, not a subsidy, \$1.3 billion, all of it coming back through a royalty fee, and \$1 billion by the 500 airplane sale, and the total Government return can be computed with \$1 billion in profit plus tax money as a 17-percent return on investment, a very healthy one, I think.

We recognize that this is just a prototype program. Foreign airplanes are already flying.

Mr. Chairman, that completes my testimony, and I am available for questions.

(The figures referred in Mr. Magruder's statement follow:)

## COMPETITION - CHARACTERISTICS

1. MAXIMUM T.O. GROSS WT., LB.	750,000	385,000	230,000
2. ENGINE			
3. SPAN			
4. MATERIAL	TITANIUM	ALUMINUM	ALUMINUM
5. THRUST (MOUNTAINS)			
6. RANGE, STATUTE MILES	4,000	4,000	4,000
7. PASSENGERS	200	120	80
8. CRUISE SPEED, MACH NO.	M 2.7 (1,782 MPH)	M 2.05 (1,350 MPH)	M 2.00 (1,500 MPH)
9. MEAN CRUISE ALTITUDE (FT.)	80,000	80,000	80,000
10. TAKEOFF DISTANCE, STD. RWY	10,000'	10,000'	10,000'
11. LANDING DISTANCE	8,200	8,200	8,200

## COMPETITION - STATUS

1. FIRST FLIGHT DATE	11-30-72	3-2-60	12-31-68
2. OPERATIONAL RANGE			
3. SPEED (MOUNTAINS)		M 2.00	M 2.00
4. EST. IN-SERVICE DATE	1978	EARLY 1974	1971/72
5. NUMBER OF AIRCRAFT	72	74	7
6. AIRLINES	12 U.S. 14 NON-U.S.	7 U.S. 9 NON-U.S.	INTERESTED: JAL KLM AIR INDIA PAKISTAN

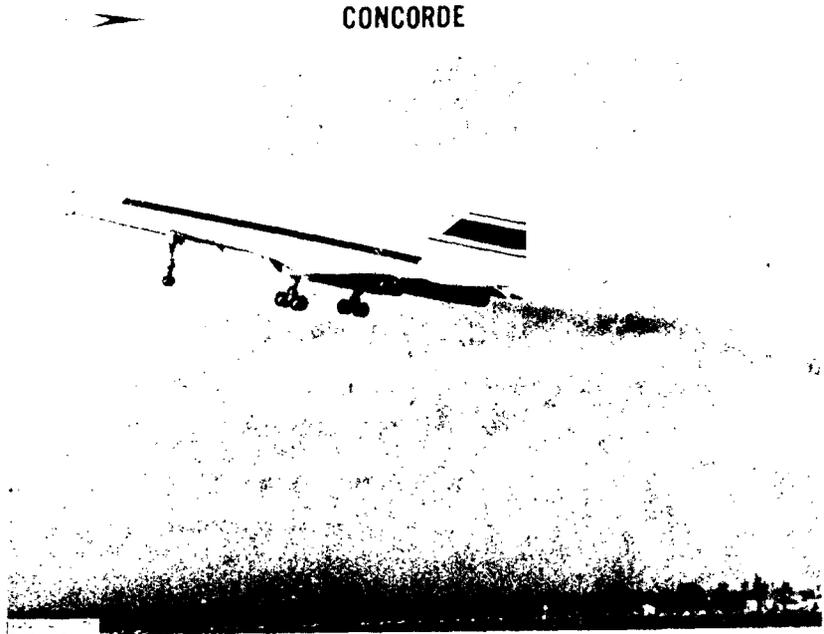
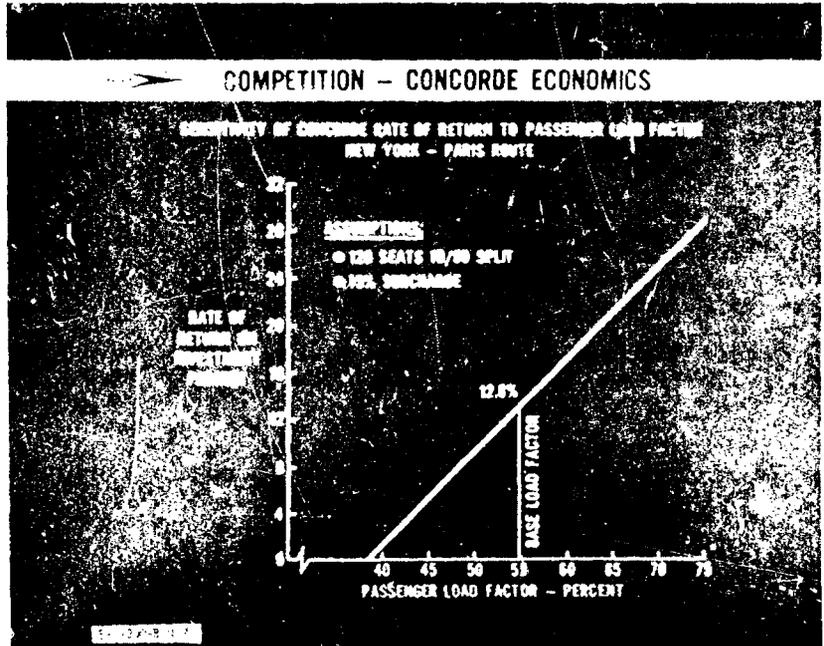


Fig. 3



**COMPETITION CONCORDE ECONOMICS**

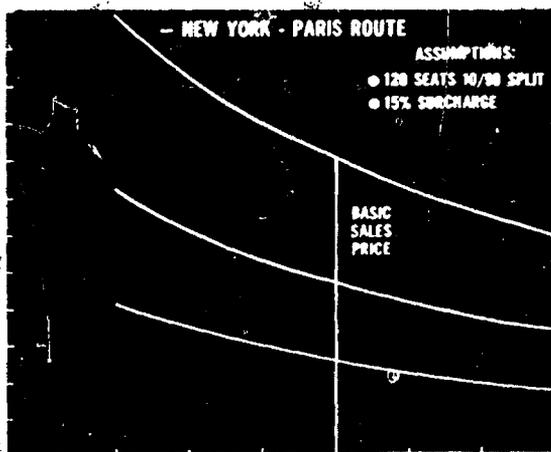


Fig. 5

**COMPETITION - BREAKEVEN LOAD FACTORS**

	NEW YORK - PARIS ROUTE	
	CURRENT YIELD	15% SURCHARGE
CONCORDE	44.8%	39.0%
SST	35.3	30.7
747	31.5	-
707	36.5	-

Fig. 6

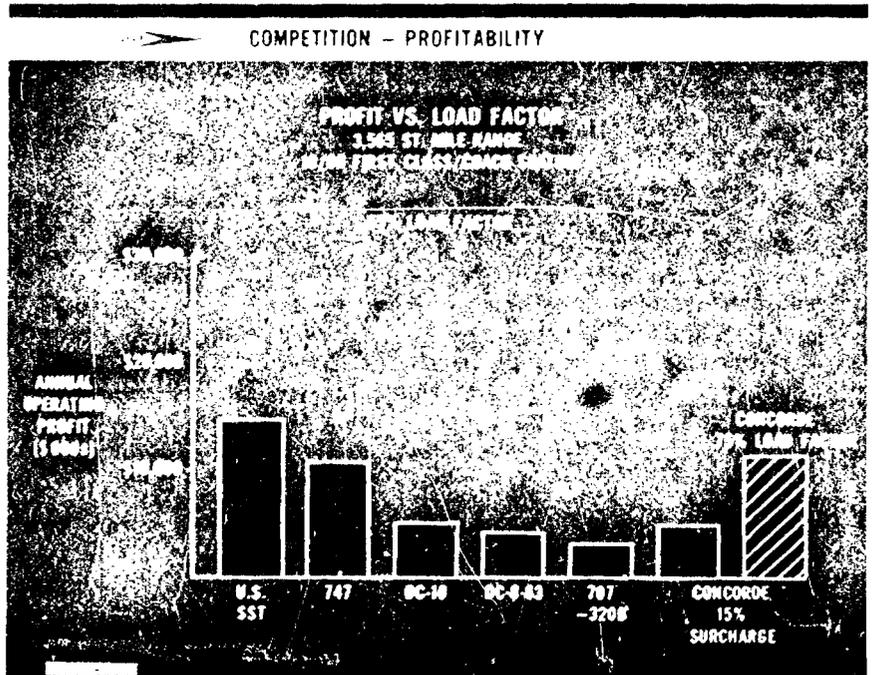
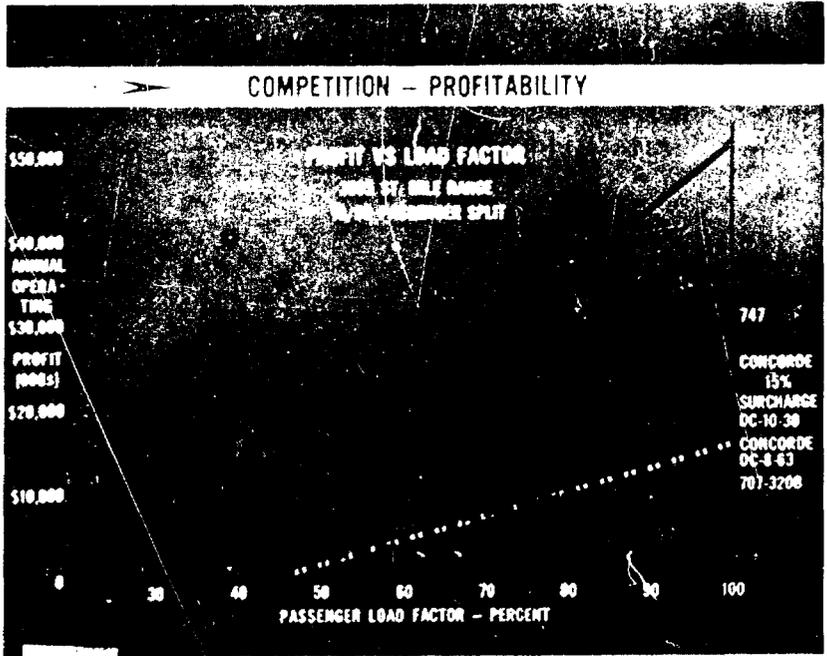


FIG. 1

Tu-144

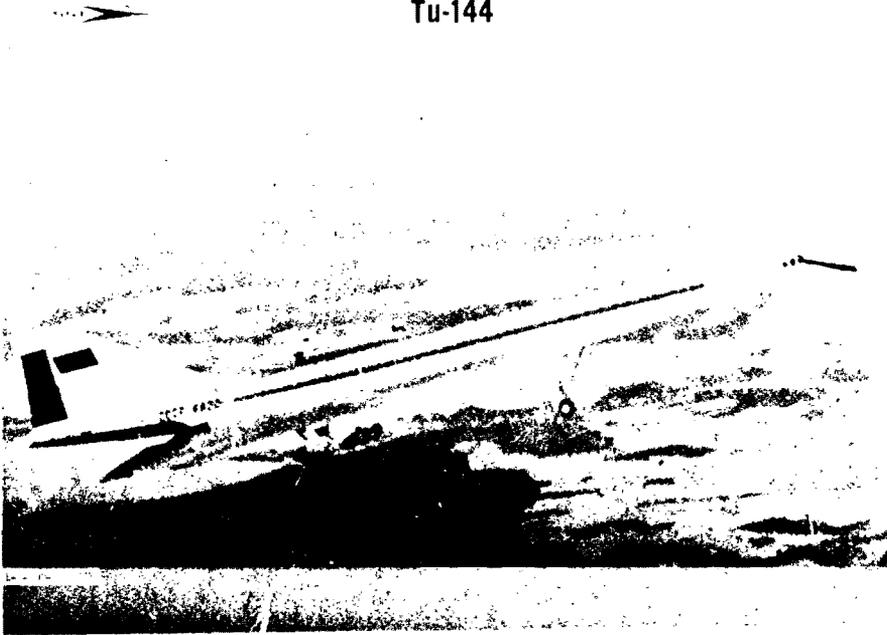
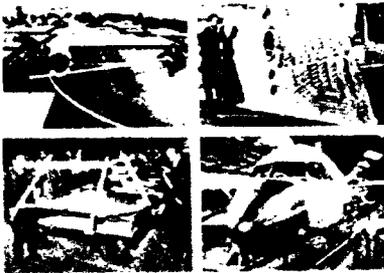


Fig. 9



IT'S COMING FAST NOW!

IN THE MAKING!



6-6306779/89

Fig. 10

# day after day Dassault's Mercure keeps its promise.

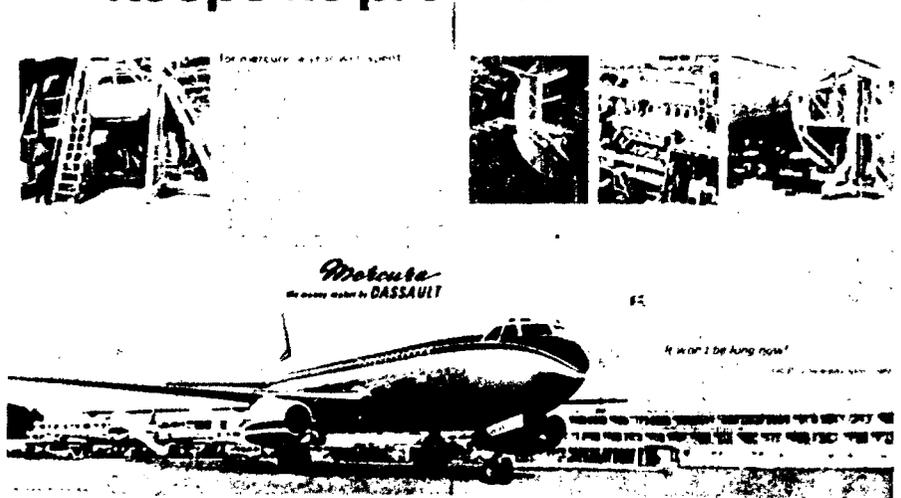


Fig. 11

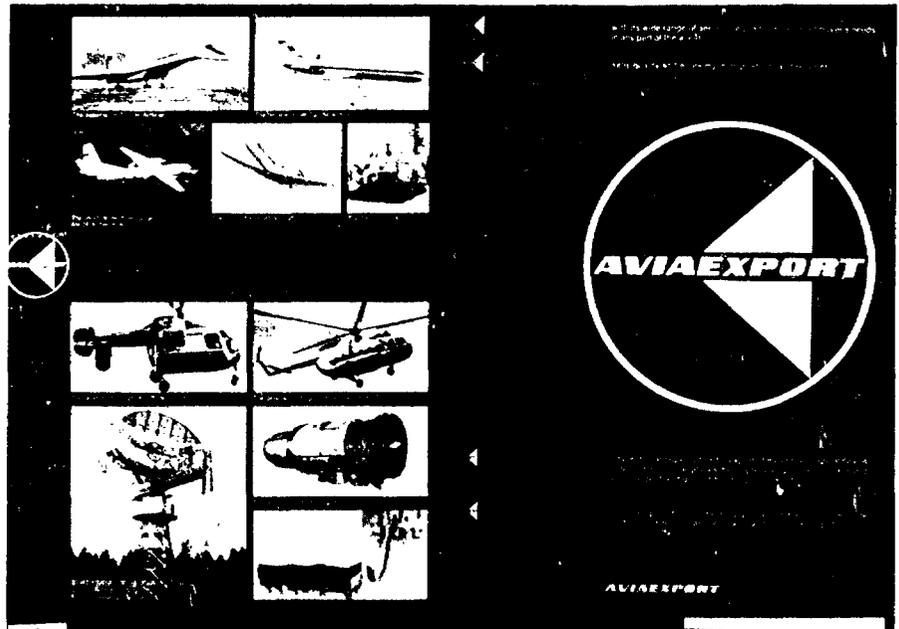
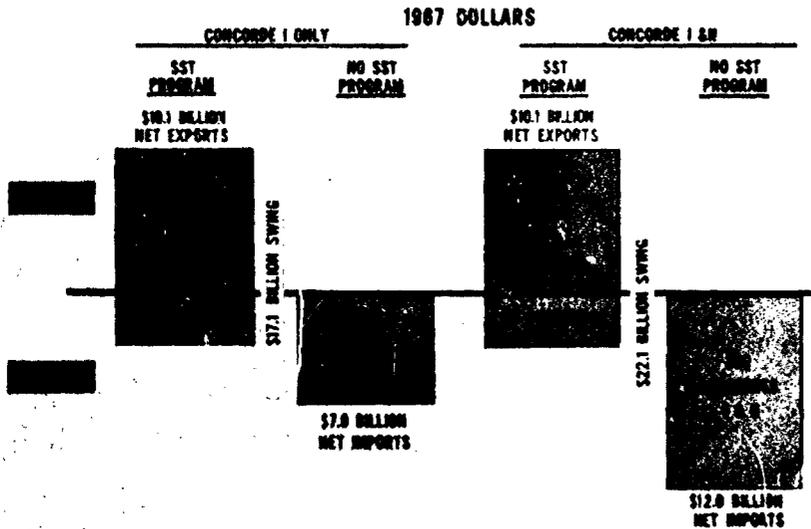


Fig. 12



**BALANCE OF TRADE - 1967 DOLLARS**



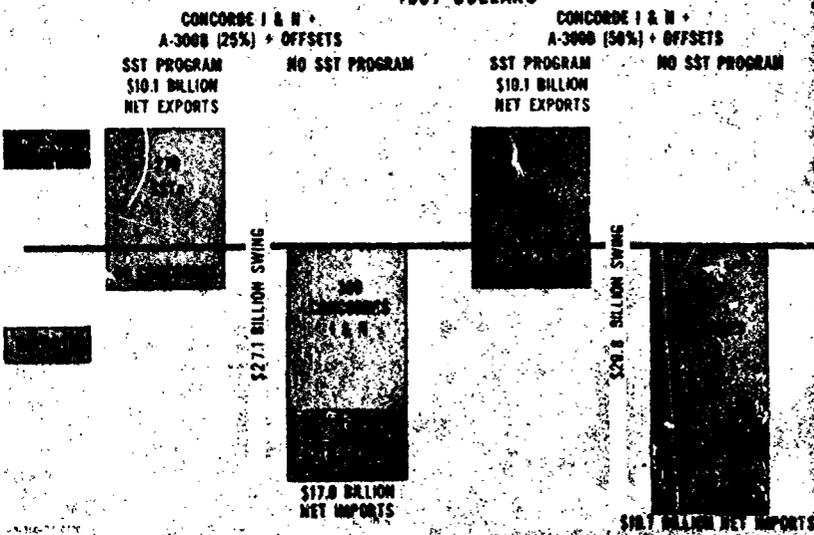
64-505-718170

Fig. 13



**BALANCE OF TRADE - OFFSETS**

**1967 DOLLARS**



64-505-718170

Fig. 14



### BALANCE OF TRADE - CURRENT DOLLARS

IMPACT-1985 @ 3%

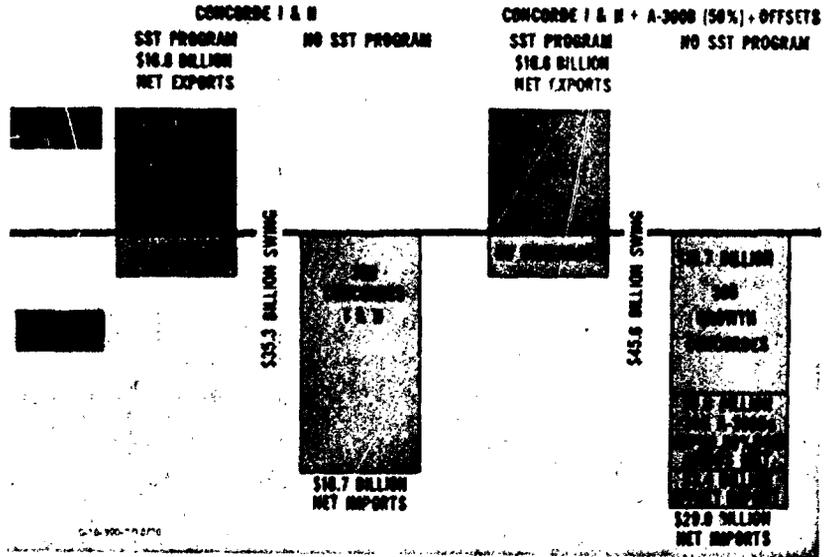


Fig. 15



### BALANCE OF TRADE - HOW U.S.A. IS DOING

(DOLLARS IN BILLIONS)

	1985	1986	1987	1988	1989	1979
IRON, INDUSTRIAL MACHINERY AND PARTS	2.1	2.2	2.2	2.4	2.6	3.3
CHEMICALS, EXCLUDING MEDICINALS	1.4	1.8	1.7	2.0	2.1	2.6
CONSTRUCTION AND NON-FARM MACHINERY	1.6	1.7	1.7	1.7	1.9	1.4
HIDES, MINERALS, WOODS, ECT.	1.3	1.4	1.5	1.6	1.7	1.5
BUSINESS AND OFFICE MACHINES, COMPUTERS	.8	.9	.7	.7	.9	1.2
TOBACCO UNMANUFACTURED	.3	.3	.3	.4	.5	.4
SCIENTIFIC, PROFESSIONAL EQUIPMENT	.3	.4	.4	.4	.5	.5
CONSUMER GOODS, EXCEPT AUTOS	-1.5	-1.8	-2.1	-2.0	-2.6	-4.8
FUELS AND LUBRICANTS	-1.3	-1.3	-1.1	-1.4	-1.7	-1.9
BUILDING MATERIALS, EXCEPT METALS	-.8	-.8	-.8	-1.1	-1.2	-.8
TIRES, RUBBER, RESINS, TYRES, ETC.	-.7	-.7	-.7	-.8	-1.0	-.3
IRON AND STEEL PRODUCTS	-.8	-.8	-.7	-1.4	-.8	-.5
OTHER METALS	-.7	-1.0	-1.1	-1.2	-.9	-.7
PAPER AND PAPER BASE STOCKS	-.7	-.6	-.7	-.8	-.7	-.4
FOODS, FEEDS AND BEVERAGES	1.0	1.0	.4	-.9	-.5	-.3
TEXTILE SUPPLIES AND MATERIAL	-.3	-.3	.1	-.3	-.3	-.4
STEEL MAKING MATERIALS	-.4	-.4	-.4	-.4	-.2	-.2
OTHER	-.3	-.3	-.1	-.1	-.1	-.1
<b>TOTAL</b>	<b>4.4</b>	<b>3.9</b>	<b>3.9</b>	<b>4.4</b>	<b>7.4</b>	<b>2.1</b>

Fig. 16



**PRODUCTIVITY - TRAFFIC GROWTH RATES**

**ANNUAL RATES IN PERCENT**

<b>BETWEEN U.S. AND CANADA AND:</b>	<b>ACTUAL</b>	<b>FORECAST</b>	
	<b>1966-1968</b>	<b>1966-1975</b>	<b>1975-1980</b>
<b>EUROPE</b>	18	14	8
<b>CENTRAL AMERICA</b>	16	13	9
<b>HAWAII</b>	21	17	12
<b>FAR EAST</b>	17	19	13
<b>SOUTH AMERICA</b>	13	14	10
<b>AUSTRALIA AND NEW ZEALAND</b>	24	20	13

SOURCE: BOEING



**PRODUCTIVITY - PROFIT POTENTIAL**

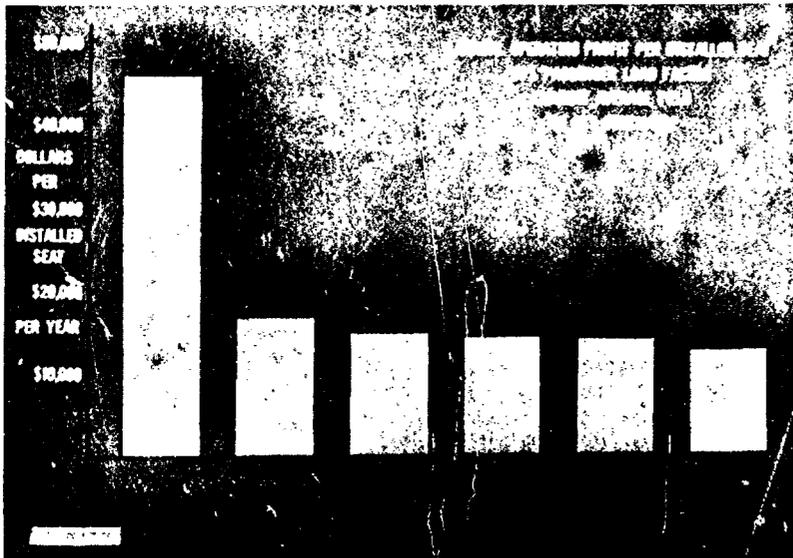


Figure 10

**PRODUCTIVITY - COST ESCALATION**

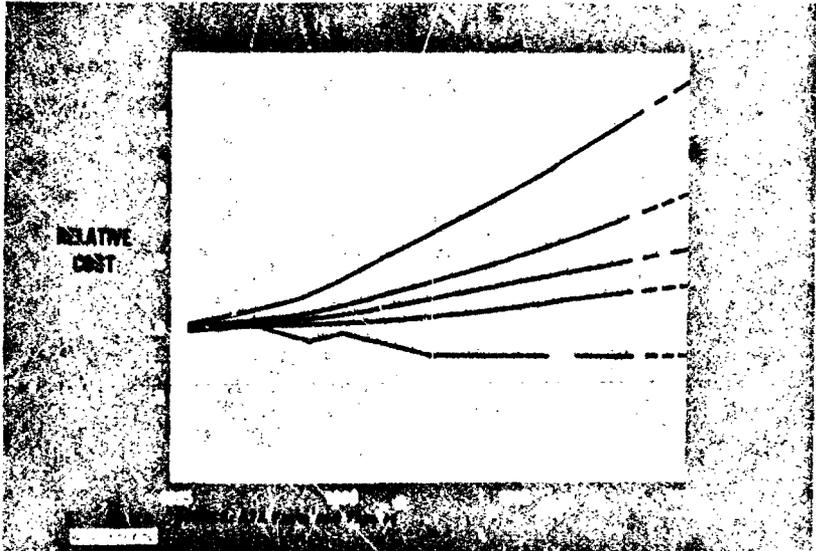


Fig. 21

**PRODUCTIVITY - PRICE TRENDS**

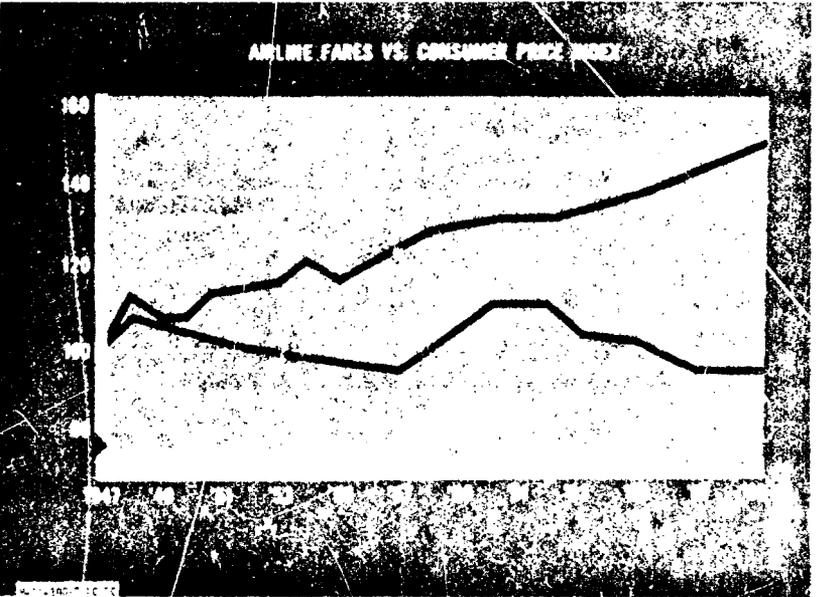


Fig. 22

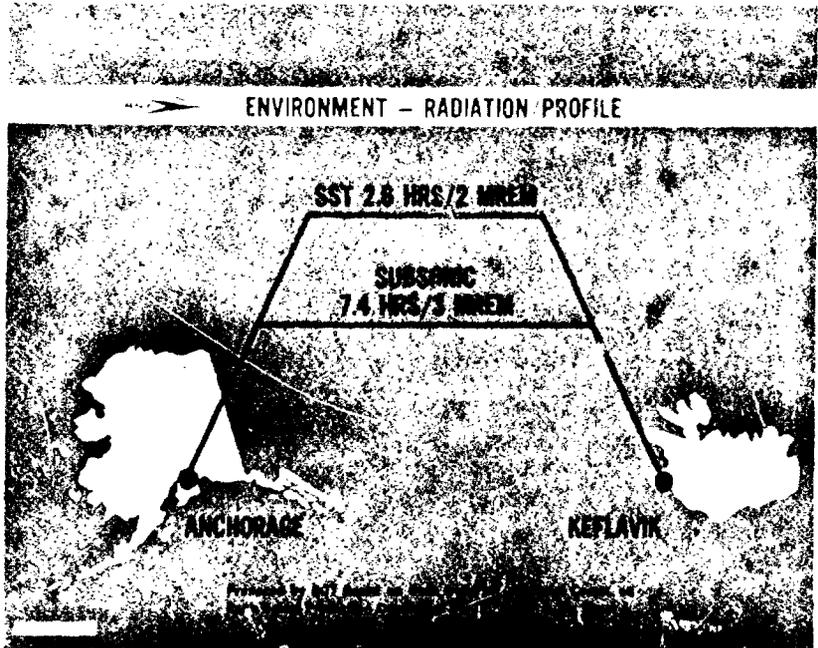
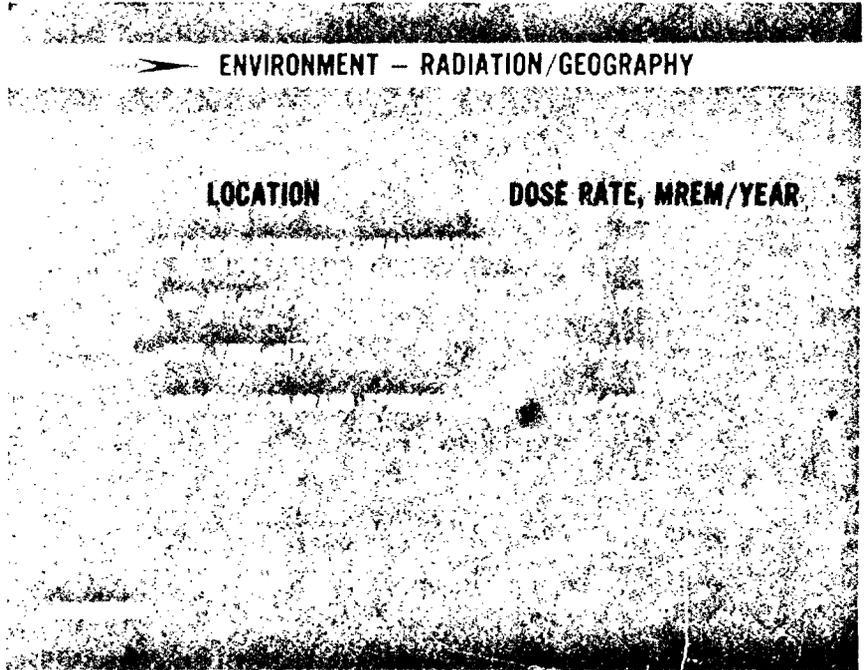
ENVIRONMENT - NOISE OBJECTIVES

7. ACHIEVE NOISE LEVELS CONSISTENT WITH STRESS  
 DEMONSTRATED (SEE FIG. 1) AND WITH  
 (1) ...

Fig. 2:

CLIMATIC EFFECTS

CONCERN	CEEP REPORT	REF. PAGE
CLOUDY SKIES	NO PROBLEM	75
INCREASED ...	1.1 PPM INCREASE (1.0 TO 1.1 PPM) IN WATER VAPOR IN ALPINE ... AND 2.0 PPM INCREASE (1.0 TO 1.0) IN NORTH TEMPERATE LATITUDES.	76
INCREASED ...	MAY INCREASE FREQUENCY / DENSITY AND EXTENT OF THICK CLOUDS ... CANCELLATION OF SST WILL INCREASE CLOUDINESS IN NORTH ...	76
WORLD'S ...	REDUCED OZONE COULD AFFECT ...	76
WINDS ...	WINDS ...	76
PARTICLES ...	WILL CAUSE CONCENTRATIONS OF CO, NO, SO <sub>2</sub> , HC AND SOOT ... FROM FRACTIONS OF A PPM TO 60 PPM IN NORTH TEMPERATE ... ABLE OF PARTICULATES IN ALTERING HEAT ... EMISSIONS OF PRODUCTION ... THAN USED IN STUDY.	76
TEMPERATURE ...	THE ROLE OF PARTICULATES IN ALTERING HEAT ... WOULD TEND TO WARM THE STRATOSPHERE.	76
LARGE SCALE SST OPERATIONS	WATER VAPOR WILL INCREASE TEMPERATURE AT ... 1.1°C AND COOL STRATOSPHERE A FEW DEGREES. CANNOT BE CERTAIN ABOUT ... IN AVAILABLE INFORMATION. UNCERTAINTIES SHOULD BE RESOLVED BEFORE LARGE-SCALE SST OPERATIONS.	76 77 107



ENVIRONMENT — ENVIRONMENTAL ADVISORY COMMITTEE

- DR. S. FRED STONE — CHAIRMAN, BOARD OF TECHNICAL OPERATIONS, INTERNATIONAL  
 CHAIRMAN
- DR. MYRON STREIB — SENIOR VICE PRESIDENT FOR RESEARCH AND DEVELOPMENT,  
 FORD CORPORATION
- DR. WILLIAM W. KELLOGG — ASSOCIATE DIRECTOR, NATIONAL CENTER FOR ATMOSPHERIC  
 RESEARCH
- DR. LESTER MACHTA — DIRECTOR, AIR RESOURCES LABORATORY, NATIONAL OCEANIC AND  
 ATMOSPHERIC ADMINISTRATION
- MR. H. J. MASTENBROOK — ATMOSPHERIC PHYSICIST, U. S. NAVAL RESEARCH LABORATORY
- MR. GEORGE CHATHAM — AERONAUTICS AND SPACE SPECIALIST, LEGISLATIVE REFERENCE  
 SERVICE, LIBRARY OF CONGRESS
- DR. HARALD ROSSI — PROFESSOR OF RADIOLOGY PHYSICS, COLUMBIA UNIVERSITY AND CHAIRMAN,  
 FAA COMMITTEE ON RADIO BIOLOGY ASPECTS OF THE SST
- DR. PAUL TOMPKIN — CHAIRMAN, FEDERAL RADIATION COUNCIL
- DR. ROBERT M. WHITE — ACTING ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC  
 ADMINISTRATION
- DR. S. I. GENAINE WOHL — CHIEF, RESEARCH PLANNING BRANCH, OFFICE OF AVIATION MEDICINE,  
 FAA
- DR. ARTHUR H. WOLFF — DEPUTY ASSISTANT ADMINISTRATOR FOR RESEARCH AND DEVELOPMENT,  
 ENVIRONMENTAL HEALTH SERVICE, HEW
- CHAIRMAN WILL DESIGNATE ADDITIONAL MEMBERS AS REQUIRED

Fig. 25

ENVIRONMENT — CTAB SST ENVIRONMENTAL RESEARCH PANEL

- DR. S. FRED STONE — CHAIRMAN, BOARD OF TECHNICAL OPERATIONS, INTERNATIONAL  
 CHAIRMAN
- DR. MYRON STREIB — SENIOR VICE PRESIDENT FOR RESEARCH AND DEVELOPMENT,  
 FORD CORPORATION
- DR. WILLIAM W. KELLOGG — ASSOCIATE DIRECTOR, NATIONAL CENTER FOR ATMOSPHERIC  
 RESEARCH
- DR. LESTER MACHTA — DIRECTOR, AIR RESOURCES LABORATORY, NATIONAL OCEANIC AND  
 ATMOSPHERIC ADMINISTRATION
- MR. H. J. MASTENBROOK — ATMOSPHERIC PHYSICIST, U. S. NAVAL RESEARCH LABORATORY
- MR. GEORGE CHATHAM — AERONAUTICS AND SPACE SPECIALIST, LEGISLATIVE REFERENCE  
 SERVICE, LIBRARY OF CONGRESS
- DR. HARALD ROSSI — PROFESSOR OF RADIOLOGY PHYSICS, COLUMBIA UNIVERSITY AND CHAIRMAN,  
 FAA COMMITTEE ON RADIO BIOLOGY ASPECTS OF THE SST
- DR. PAUL TOMPKIN — CHAIRMAN, FEDERAL RADIATION COUNCIL
- DR. ROBERT M. WHITE — ACTING ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC  
 ADMINISTRATION
- DR. S. I. GENAINE WOHL — CHIEF, RESEARCH PLANNING BRANCH, OFFICE OF AVIATION MEDICINE,  
 FAA
- DR. ARTHUR H. WOLFF — DEPUTY ASSISTANT ADMINISTRATOR FOR RESEARCH AND DEVELOPMENT,  
 ENVIRONMENTAL HEALTH SERVICE, HEW
- CHAIRMAN WILL DESIGNATE ADDITIONAL MEMBERS AS REQUIRED

Fig. 26

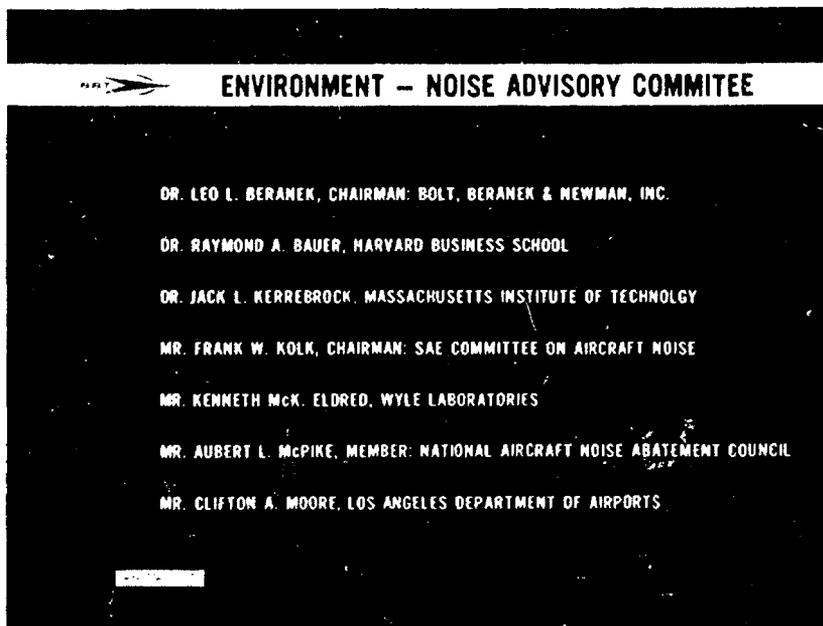
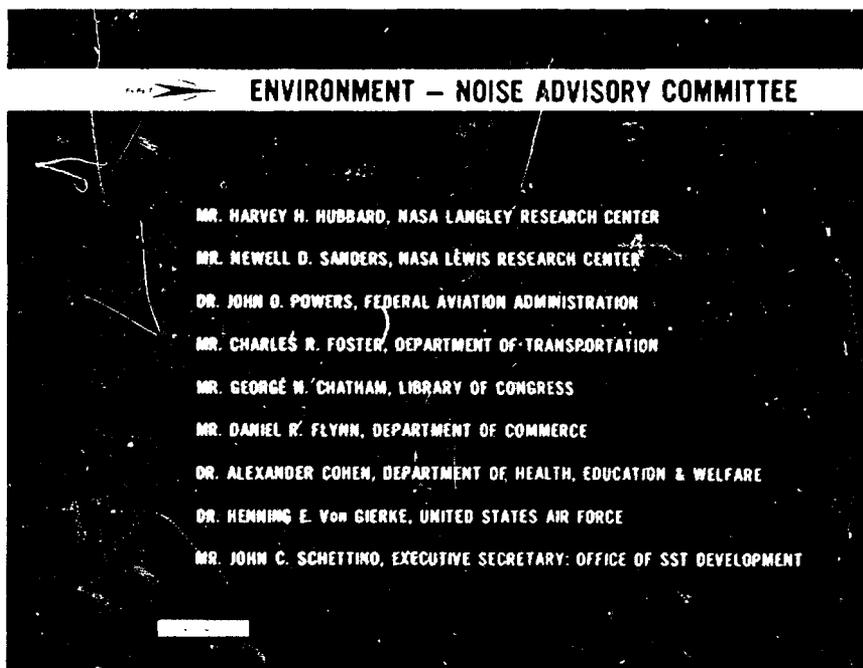


Fig. 27



ENVIRONMENT - PRODUCTION SST NOISE OBJECTIVES

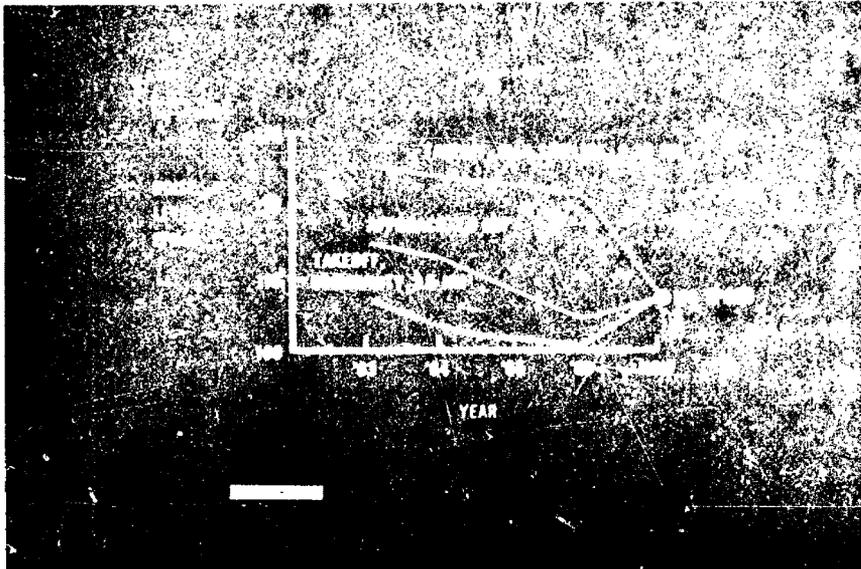


Fig. 41

ENVIRONMENT - NOISE

**CONCERN**

- ARE PRODUCTION SST NOISE OBJECTIVES ACHIEVABLE

**FACTS**

- PRIOR TO PRODUCTION COMMITMENT, THE CAPABILITY OF THE COMMERCIAL SST TO ACHIEVE NOISE LEVELS CONSISTENT WITH THOSE REQUIRED FOR CERTIFICATION OF NEW FOUR-ENGINE, INTERCONTINENTAL, SUBSONIC TRANSPORT AIRCRAFT, WILL BE DEMONSTRATED
- PROGRAM PHILOSOPHY -- MAXIMUM EFFORT TO BE MADE IN REDUCING AIRCRAFT NOISE
- ADVANCED RESEARCH AIMED AT REDUCING SIDELINE NOISE LEVEL WITHOUT ADVERSE EFFECT ON COMMUNITY NOISE
- SST CONTRACTORS CONFIDENT THAT OBJECTIVES CAN BE ACHIEVED FOR PRODUCTION SST
- SST NOISE ADVISORY COMMITTEE AGREE THAT OBJECTIVES ARE TECHNICALLY FEASIBLE

**RESEARCH (FY 71 \$6.15 MILLION)**

- SIGNIFICANTLY REDUCE SIDELINE NOISE LEVEL WITHOUT UNACCEPTABLE AIRCRAFT PERFORMANCE PENALTY
- FURTHER EXAMINE HUMAN FACTORS
- CONTINUE FUNDAMENTAL RESEARCH

Fig. 42

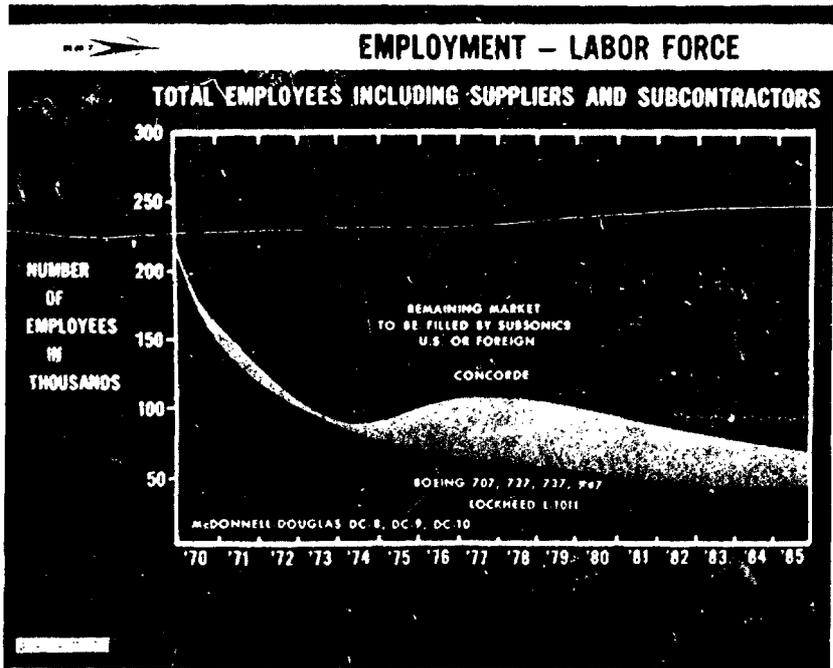


Figure 1

### EMPLOYMENT - SUMMARY

#### AEROSPACE EMPLOYMENT TREND 18 MONTHS ENDING MARCH 1971 (000s OF EMPLOYEES)

	TECHNICIANS (ENGINEERS)	SCIENTISTS (ENGINEERS)	PRODUCTION EMPLOYEES	ALL OTHERS	TOTAL
SEPTEMBER 1969	71	201	804	378	1,340
JUNE 1970	65	190	575	222	1,130
DECEMBER 1970	61	179	518	212	1,007
MARCH 1971	58	175	503	200	1,044
MARCH 1971 (% OF EMPLOYMENT)	6%	17%	48%	29%	100%

#### CUMULATIVE PERCENTAGE DECLINES FROM SEPTEMBER 1969

	TECHNICIANS (ENGINEERS)	SCIENTISTS (ENGINEERS)	PRODUCTION EMPLOYEES	ALL OTHERS	TOTAL
SEPTEMBER 1969					
JUNE 1970	11.3	1.5	20.7	15.0	13.9
DECEMBER 1970	14.1	12.3	25.8	17.7	20.7
MARCH 1971	18.3	12.9	27.5	18.7	22.4

Source: AIA News 6/24 & 11/10/70

B2707-300

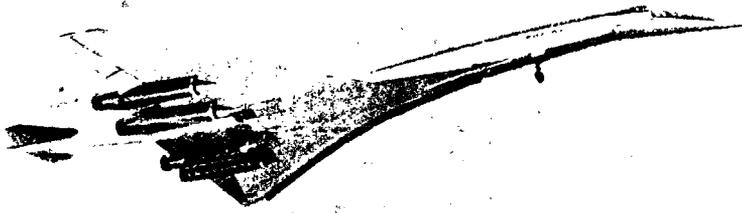


Fig. 33

### SST PROGRAM

- BUILD AND TEST TWO PROTOTYPES
- VALIDATE ECONOMIC VIABILITY
- ACQUIRE TECHNOLOGICAL/ENGINEERING SKILLS
- DEMONSTRATE PRODUCT TO AIRLINES
- DEMONSTRATE PRODUCT TO FINANCIAL COMMUNITY
- COST SHARE WITH INDUSTRY

PROGRAM FINANCIAL STATUS DOLLARS IN MILLIONS

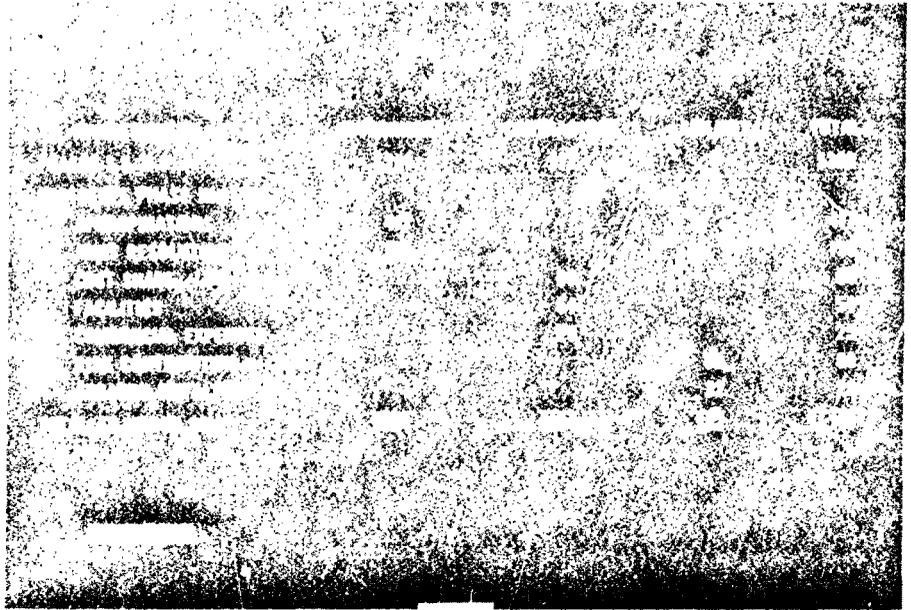


Figure 1

SST PROTOTYPE DESIGN

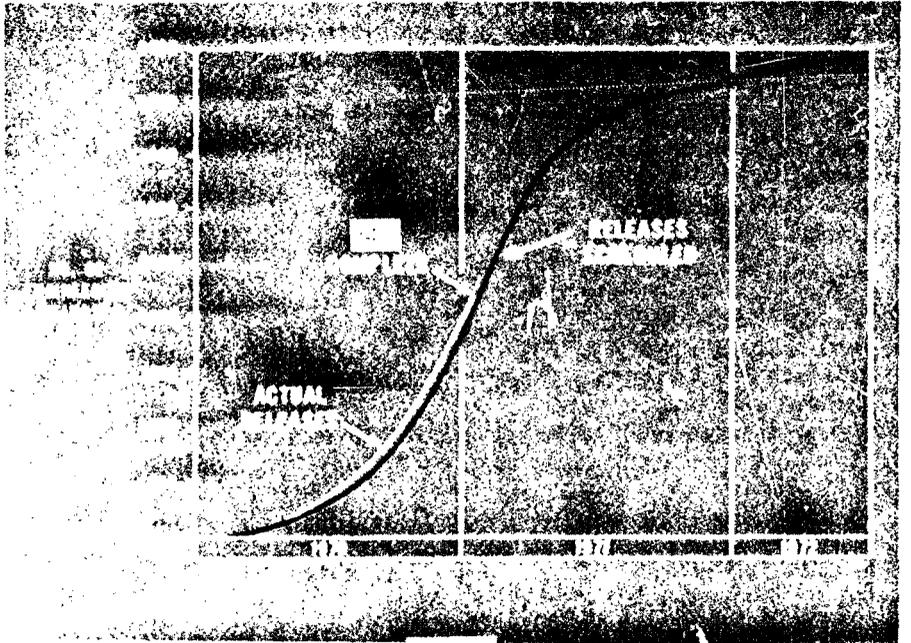


Figure 2

CUMULATIVE ENGINE TEST HOURS

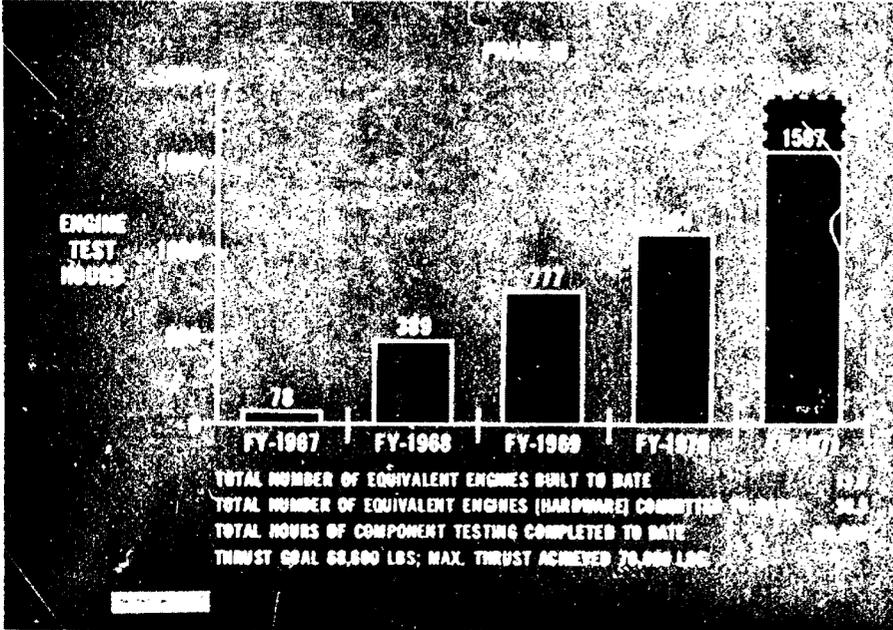


Fig. 37

EMPLOYMENT - TOTAL PHASE III

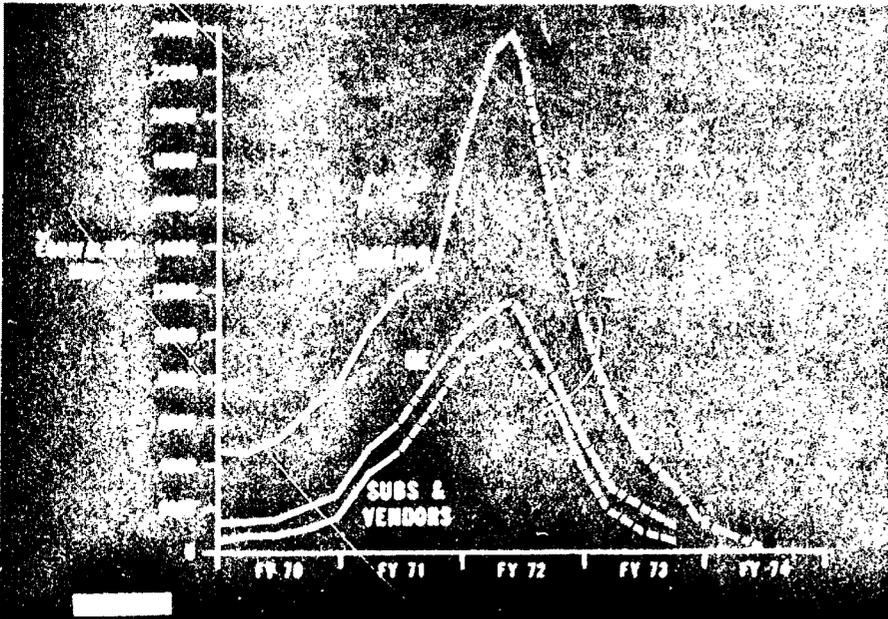


Fig. 38

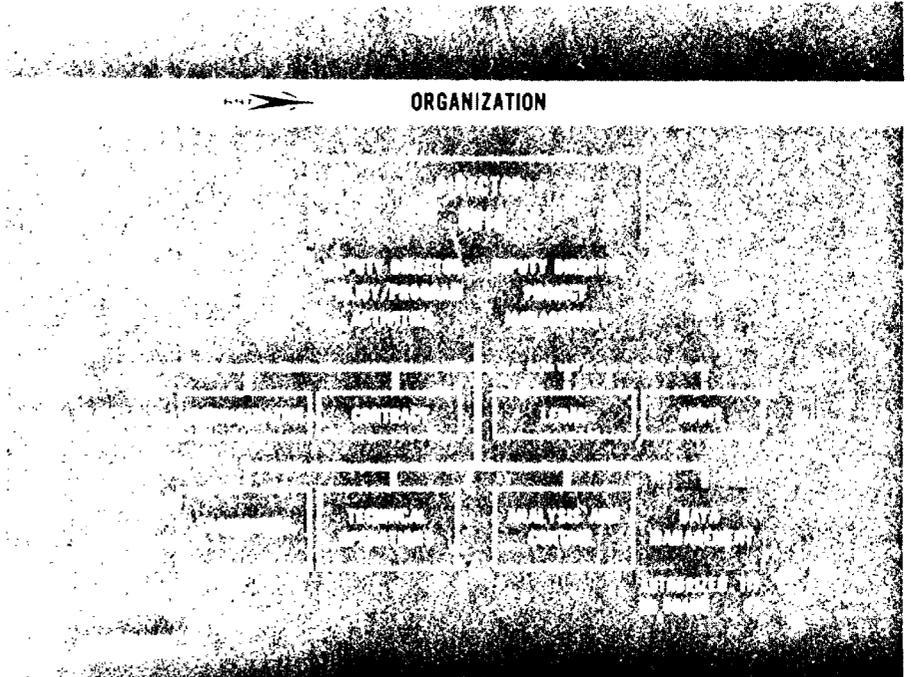


Fig. 39

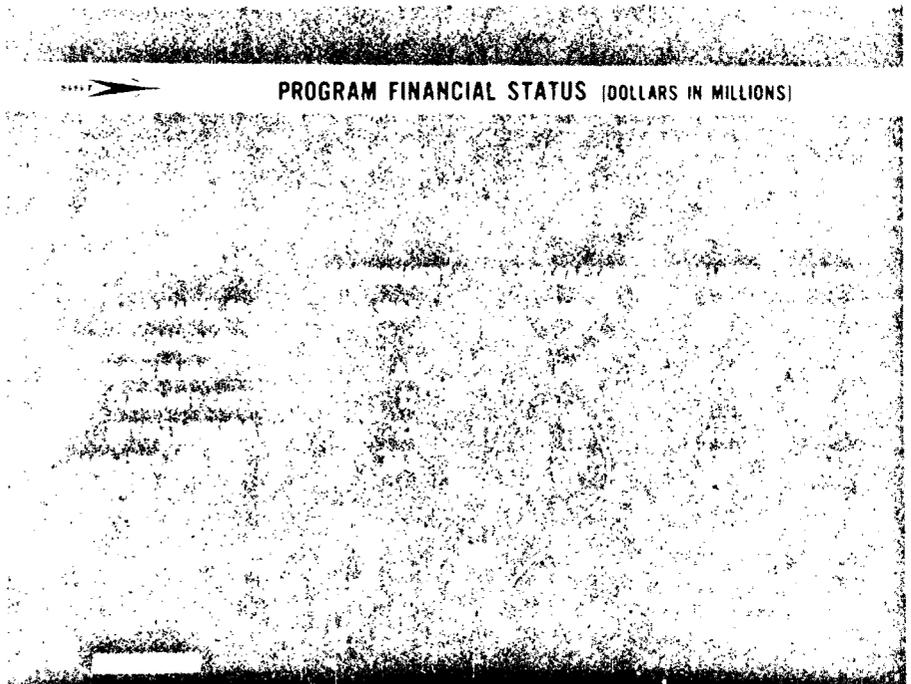


Fig. 40

**BALANCE OF TRADE— WHO SHOULD HAVE FAVORABLE BALANCE?**

● **THE UNITED STATES HAS MADE THE UNSELFISH AND MORAL COMMITMENT TO:**

- **HELP THE UNDERDEVELOPED NATIONS TO HELP THEMSELVES**
- **PROVIDE SOME OF OUR REAL RESOURCES TO THE LESS FORTUNATE NATIONS OF THE WORLD**

Fig. 41

**BALANCE OF TRADE — STATEMENTS**

**TREASURY -**  
**COMMERCE -**

**WORLD BANK -**  
**FEDERAL RESERVE BOARD -**

**EXPORT-IMPORT BANK -**

**EUGENE BLACK -**

**BUDGET BUREAU -**

**STANLEY de J. OSBORNE -**

**COUNCIL OF ECONOMIC ADVISERS -**

Fig. 42

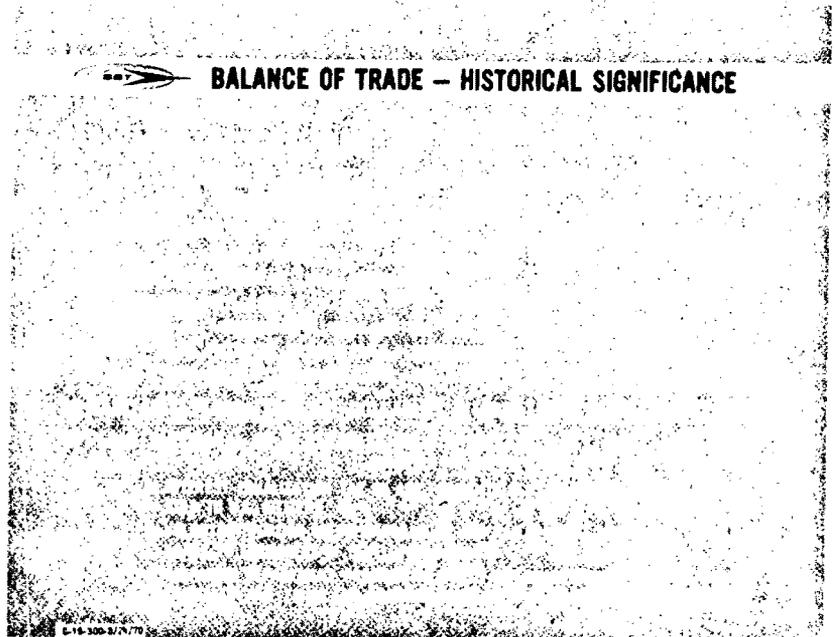


Fig. 43

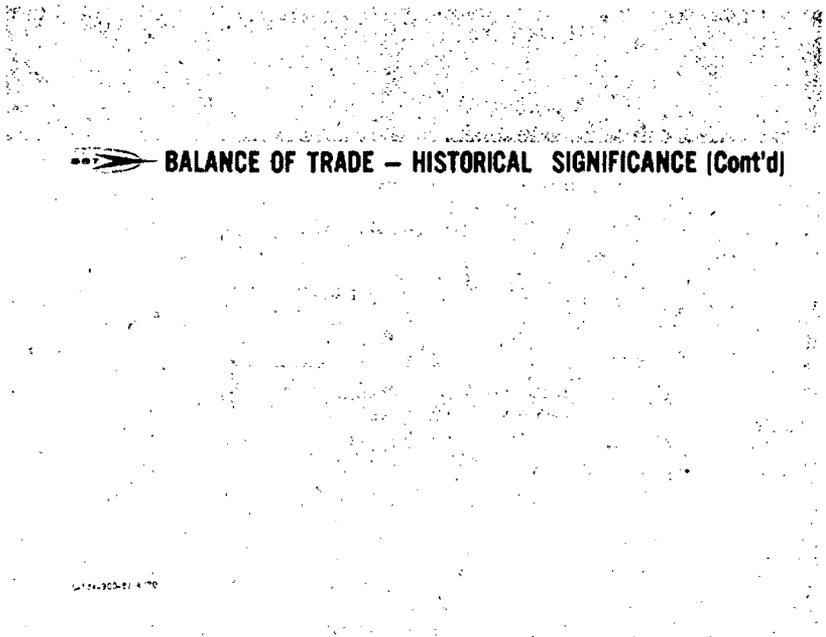


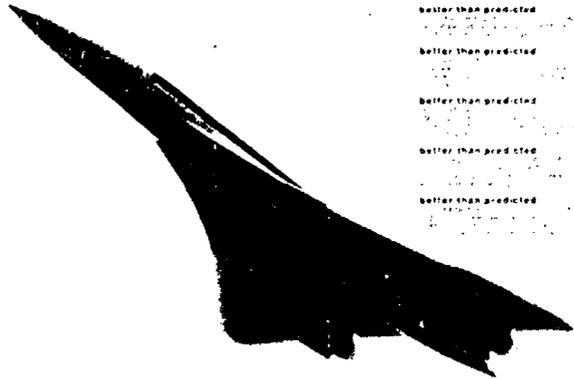
Fig. 44

 **BALANCE OF TRADE - GOVERNMENT METHODS TO IMPROVE**

- TIGHTEN CREDIT, REDUCE MONEY SUPPLY, BUDGET SURPLUS  
BUT: [REDACTED]
- REDUCE VALUE OF DOLLAR IN RELATION TO GOLD  
BUT: [REDACTED]
- INCREASE TRAFFIC OR IMPOSE QUOTAS  
BUT: [REDACTED]
- PROVIDE SUBSIDIES OR EXPORT CREDITS  
BUT: [REDACTED]
- RESTRICT BANK LOANS AND INVESTMENTS ABROAD  
BUT: [REDACTED]
- PUT CEILINGS ON DOLLARS SPENT ABROAD  
BUT: [REDACTED]

 **BALANCE OF TRADE - STUDY PREMISES**

- 1969 ●
- 
- 
  
- 1970 ●
- 
- 
- 
-



better than predicted  
better than predicted  
better than predicted  
better than predicted  
better than predicted

**better than  
predicted**



Fig. 47



# BALANCE OF TRADE - SUMMARY

G-13-200-7/10/70

Fig. 48

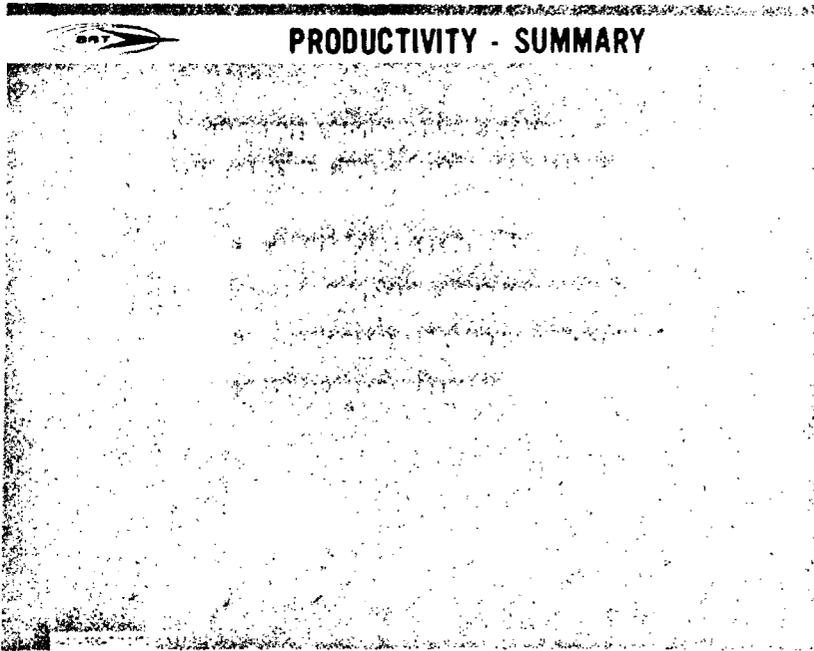
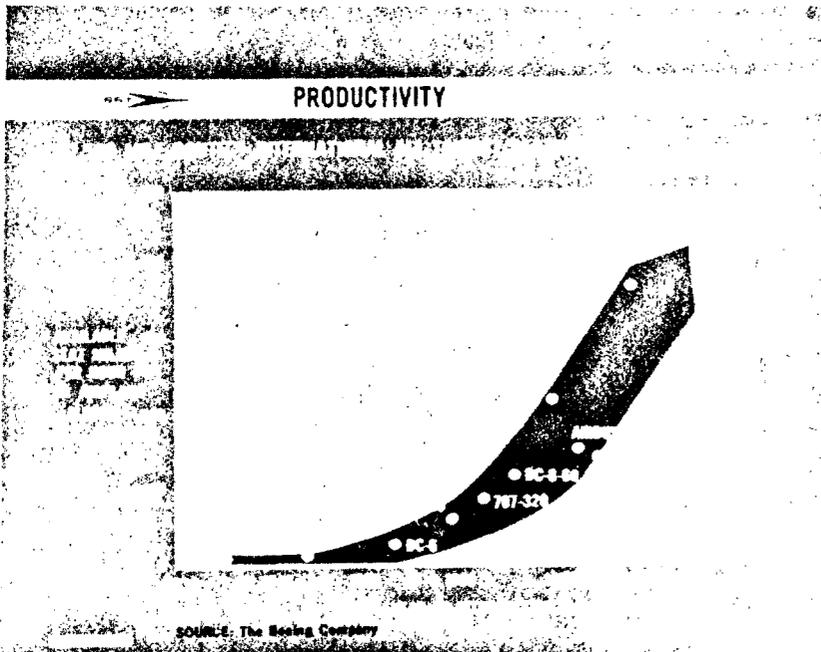


Fig. 49



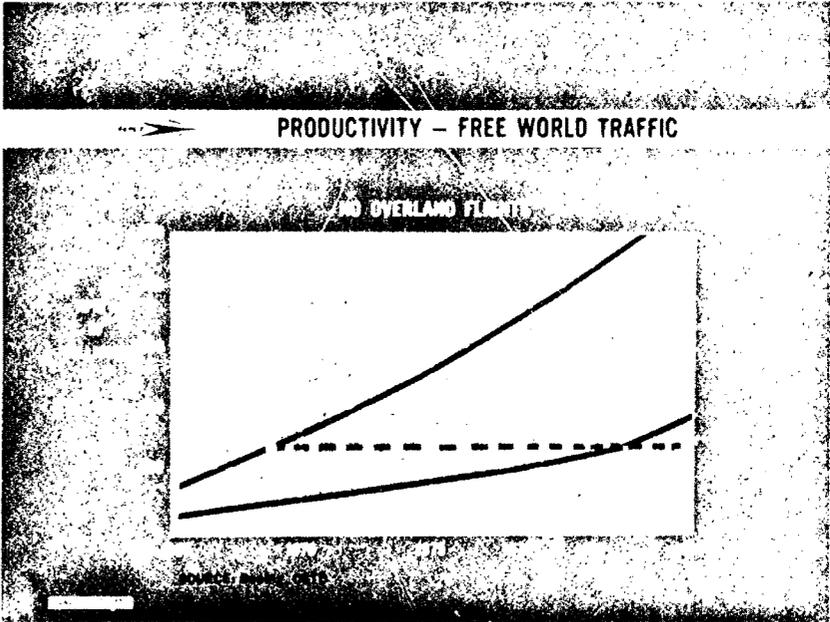
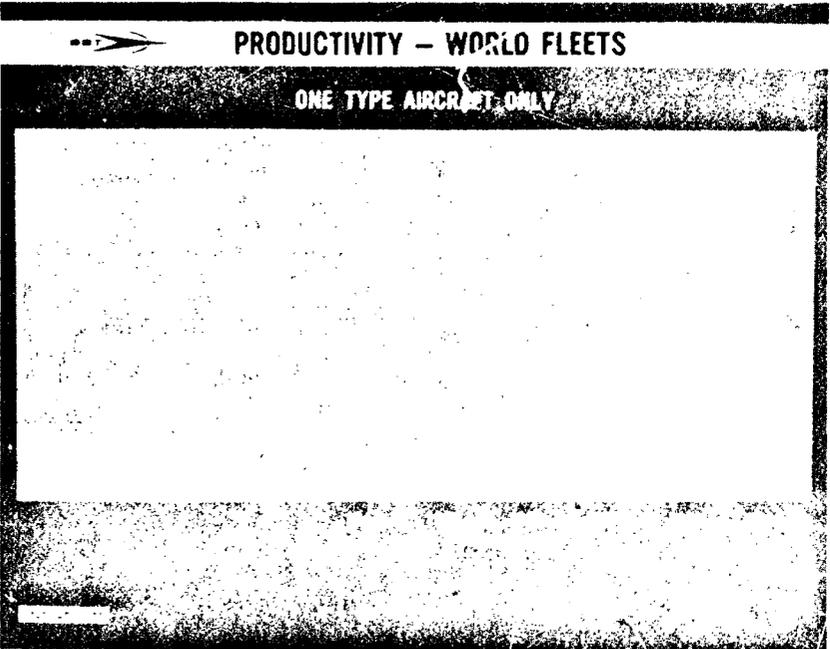


Fig. 51



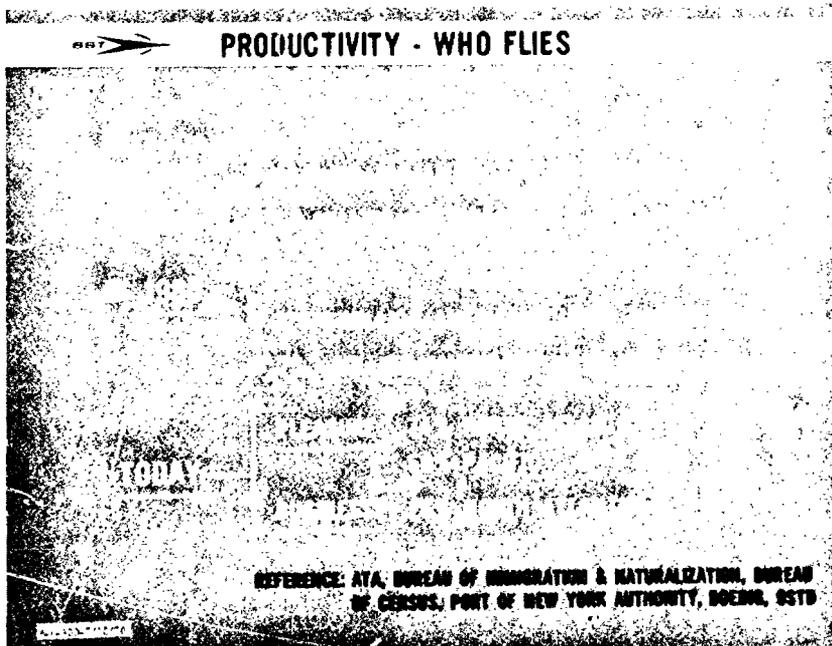


Fig. 53

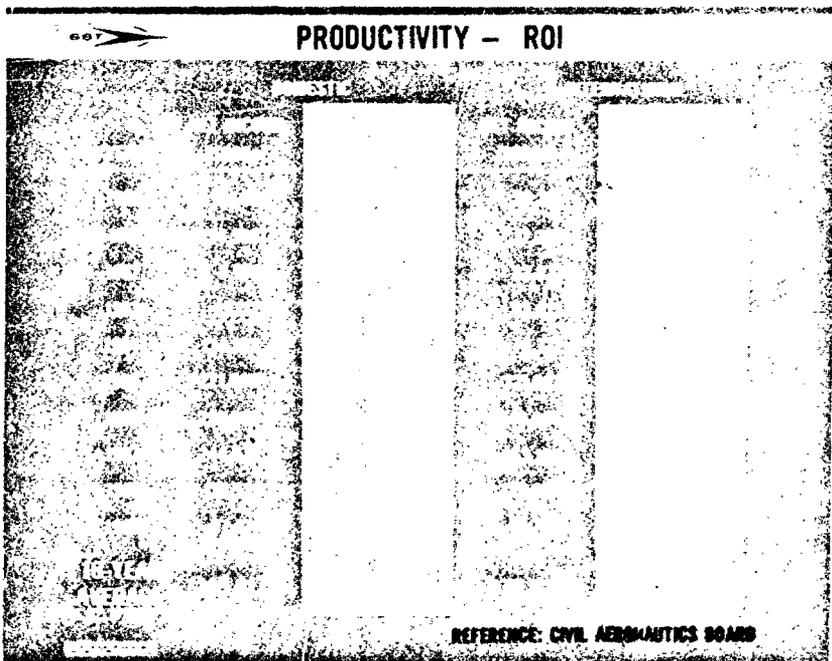


Fig. 54

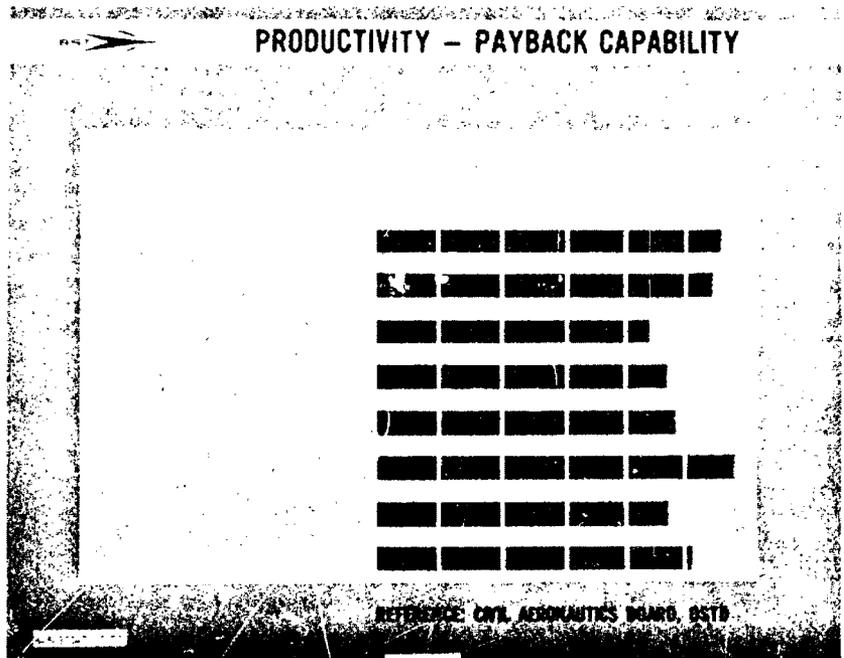


Fig. 53

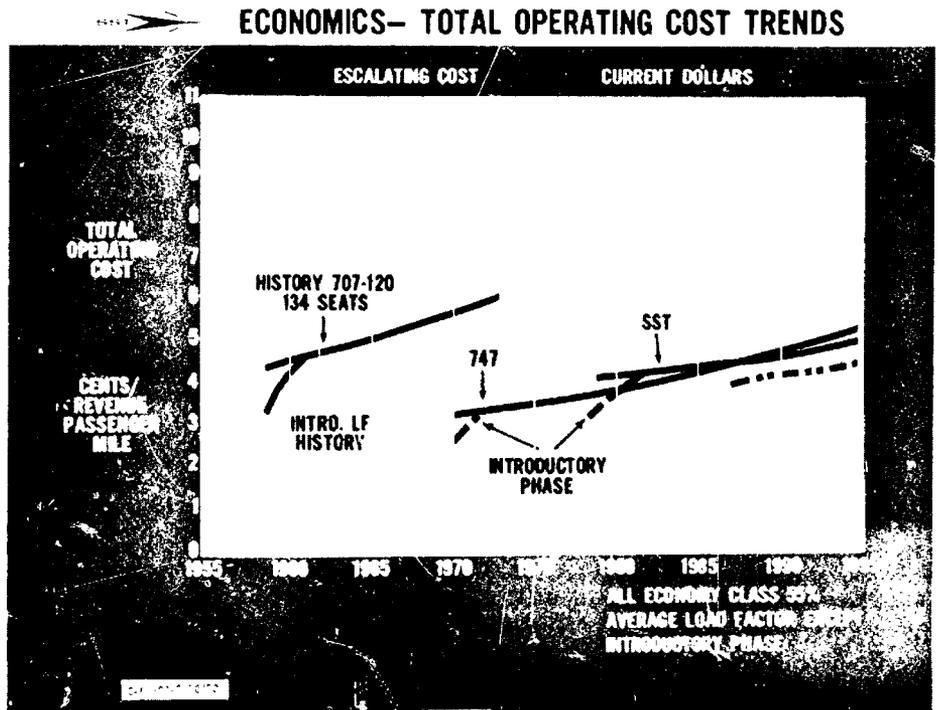


Fig. 56

SST FUNDING  
(DOLLARS IN MILLIONS)

	FY 1971		FY 1972		1st FLIGHT DATE	TOTAL PHASE III COST
	NOA	100%	NOA	100%		
BASE CASE	\$290	\$259 TBC 80 GE 9 ADM	\$235	\$220 TBC 65 GE 9 ADM	MAR. 1973	\$1.283
OPTION 1	\$210	\$184 TBC 67 GE 8 ADM	\$275	\$255 TBC 66 GE 9 ADM	AUG 1973  PRELIMINARY	\$1.377
OPTION 2	\$210	\$184 TBC 67 GE 8 ADM	\$235	\$220 TBC 65 GE 9 ADM	MAR 1974  PRELIMINARY	\$1.510

SST PROGRAM SUMMARY

**LOOKS AHEAD**

10 YEARS IN RESEARCH AND DEVELOPMENT.  
PART OF OVERALL U.S. TRANSPORTATION SYSTEM IN THE 1980's.  
MEETS AIRLINE PRODUCTIVITY NEEDS OF 1980's.

**ADD TO TOTAL U.S. ECONOMICS**

SIGNIFICANT BALANCE OF PAYMENTS IMPACT.  
MAINTAINS DOLLAR VALUE AND STABILITY.  
HELPS MAKE POSSIBLE EDUCATION, TRANSPORTATION, LAW ENFORCEMENT,  
AND ENVIRONMENTAL IMPROVEMENT PROGRAMS.

**NET FEDERAL SUBSIDY**

GOVERNMENT INVESTMENT FOR PROTOTYPE RETURNED PLUS \$1 BILLION  
BY 500th AIRCRAFT SOLD.  
TOTAL GOVERNMENT RETURN CAN BE 17% ON INVESTMENT IF PRODUCTION  
PROJECT SUCCESSFUL.

**PROTOTYPE PROGRAM ONLY; FOREIGN SST ALREADY FLYING**

U.S. DESIGN BEST WAY TO CONTROL SUPERSONIC AIRPLANE EROSION OF  
ENVIRONMENT AND IMPROVE AIR TRAVEL.

**EMPLOYMENT SUBSTANTIAL**

50,000 DIRECT JOBS AND 150,000 INDIRECT JOBS.

Mr. McFALL. Thank you, Mr. Magruder. I want to say that is some of the finest testimony that I have ever heard. You make an exceptionally fine witness.

In the interest of time, I am not now going to ask you any questions of my own.

Do I have any questions on this side?

#### BIOGRAPHY OF MR. MAGRUDER

Mr. BOLAND. Mr. Chairman, because I have an appointment at 11:45 I have no questions for Mr. Magruder. I would suggest that this committee place in the record prior to his testimony, or you may have done it, his background. I know that we have had it in prior hearings, and I would like the record to show the magnificent background that Mr. Magruder has.

Mr. McFALL. I think we might put it in at this time, Mr. Boland, since you suggested it.

(The background information follows:)

#### BIOGRAPHY OF WILLIAM M. MAGRUDER, DIRECTOR, SST DEVELOPMENT, DEPARTMENT OF TRANSPORTATION

William M. Magruder, 46, has 21 years of aeronautical engineering, design and flight test experience, including professional and consultant experience in supersonic transport design concepts dating back to 1961.

A native of Evanston, Illinois, Mr. Magruder was Deputy Director of Commercial Engineering for the Lockheed California Company when he accepted appointment April 1, 1970 as Director of the SST Development program for the U.S. Department of Transportation.

In his position with Lockheed, Mr. Magruder supervised the design and development of the L-1011 commercial jet transport and all the company's commercial advanced design concepts. Earlier he served as Chief Advanced Design Engineer for the L-1011 development and was responsible for technical development and integration, including safety, flight test and advanced design programs.

From August 1963 to January 1967, he held key roles in the design and engineering of Lockheed's entry in the U.S. SST competition.

A graduate of Santa Monica, California, High School, Mr. Magruder attended Santa Monica City College before entering military service. He completed Air Force flight training in 1944 and served as B-17 and B-29 instrument flying instructor until the war ended a year later.

He graduated from the University of California in 1949 with a bachelor's degree in aeronautical engineering and he has since majored in advanced mathematics at Ohio State Graduate School.

From 1949 to 1954, Mr. Magruder served at the U.S. Air Force Flight Test Division at Wright-Patterson AF Base, Ohio, and at the Flight Test Center, Edwards AF Base, California. As both pilot and engineer, he supervised the engineering and evaluated the performance of many aircraft, including the B-57, XB-52, C-124, F-86, C-133, and H-19. From 1954 to 1956, he was B-52 Test Task Force Commander at the Air Force Flight Test Center.

Mr. Magruder joined Douglas Aircraft Company (now McDonnell-Douglas) in 1956 and in 1960 was named Chief Engineering Test Pilot for the company. In this position he was pilot and flight test engineer for the DC-8, and was responsible for developments which reduced landing field length requirements for the DC-8F by 1000 feet.

He was Director of Market Development for Advanced Systems and Research Programs at Douglas when he left the company in August 1963 to join the Lockheed California Company. At Lockheed he was assigned as Chief Research and Test Engineer and Project Pilot for the SST. He was SST Assistant General Manager in January 1967 when the Government contract for the development of an SST prototype was awarded to Boeing.

Mr. Magruder is a graduate of the U.S. Air Force Experimental Test Pilot School; he holds the FAA airline transport pilot rating; and is an FAA flight test pilot representative. He has more than 6,000 flying hours to his credit,

including 4,000 jet hours. He has piloted 144 different kinds of aircraft, including 62 transports ranging from the DC-3 to twelve versions of the DC-8, and 10 types of helicopters.

Mr. Magruder is a Fellow in, and a past president of, the Society of Experimental Test Pilots. He is an Associate Fellow of the American Institute of Aeronautics and Astronautics; and a member of the Society of Automotive Engineers. He was awarded the Iven C. Kincheloe Award by the Society of Experimental Test Pilots for his work on the DC-8 flight test program, and the Arch T. Golwell Award by the Society of Automotive Engineers for his work on the Lockheed SST program; and the R. H. Burroughs Award by the Flight Safety Foundation.

He is married to the former Barbara Nethercutt and they have two children—William M. Magruder, Jr., 22; and Nancy Magruder, 19.

Mr. BOLAND. And I do that because of the great experience he has had in this industry, in business, his very deep concern about the direction in which this Nation is headed in this area, his very deep concern about what the SST will do the environment, and the arguments that he and Dr. Kellogg and Dr. Singer and Dr. Beranek will address themselves to with respect to the environment. This has been, up to the present of course, perhaps the greatest problem the SST has had.

I don't think anybody can dispute the fact that the attack on the SST or the opposition to the SST and the fact that the SST has had some problems being funded in the last Congress and perhaps being funded in this Congress comes about as a result of a combination of those who are interested in protecting the environment—no one quarrels with this. The quarrel comes with the arguments that they use and whether or not those who use those arguments actually state the facts or fiction.

From my point of view, I just want to indicate to you, Mr. Magruder, that I agree with what the chairman, Mr. McFall, has said. It has been one of the best presentations I have ever heard. I am delighted that the press is here and all of the communication media to understand and see you in action and to judge for themselves, not as a result of what this committee says, but to judge clearly and simply for themselves the competence that the Department of Transportation has in the Office of Supersonic Transport. Because of a previous commitment, I must defer my questions. I do want to commend you for your complete, fair, extremely knowledgeable presentation.

Mr. MAGRUDER. Thank you, Mr. Boland.

Mr. McFALL. Thank you, Mr. Boland. Questions on this side?

Mr. Bow. I have no questions at this time.

Mr. MINSHALL. I have one.

Mr. McFALL. Mr. Minshall.

#### PROGRAM DELAY FOR ENVIRONMENTAL RESEARCH

Mr. MINSHALL. Mr. Magruder, I would like to commend you on the excellence of your testimony. As I said yesterday, I have been following the SST program with intense interest now since the early sixties. We have heard all kinds of claims of one kind or another, but I think you have summarized it very well. I would especially like to commend you on coming here yesterday and today, because I know you are suffering from a gall bladder problem, and I can certainly sympathize with you, because I went through that exercise just 3 years ago. I think you should get double stars for even coming here.

I have one question, though, with respect to what you and Dr. Greenfield brought out yesterday, as to the research and development that will take place on the pollution of our upper atmosphere. You said that those tests would not be completed until 1973. I presume that means the latter part of 1973. However, coming back to the testimony yesterday, and some of the things that you and Mr. Volpe have said, when you boil this all down, you agree this is a gamble that you thought we should take, not knowing yet the likely result of those tests.

If they turned out negatively, you said you would not go ahead with the program.

That brings me to my question, then: Why would it not be advisable to hedge your bet, so to speak? When you hedge your bet, you do not come out as well, but you do not lose as much, either. Hedge your bet and go to one of those options, either option 1 or option 2. Would you care to discuss that?

Mr. MAGRUDER. Yes. The first thing I would like to say—

Mr. MINSHALL. The reason I ask is that your chart shows your option 2, for example, going into 1974, and option 1 I think going into mid-1973.

Mr. MAGRUDER. That is right.

First, I certainly do not want to leave you with the impression that I feel the word "gamble" is the proper word on this environmental research. I think Mr. Boland was speaking to the heart of the environmental problem. Those scientists that have advised me have indicated very clearly that they have not one single fact that SST's will harm the environment. I think Mr. Greenfield said this yesterday, and Mr. Ruckelshaus said it very clearly. I think tomorrow Dr. Kellogg, Dr. Singer, and Dr. Beranek will say the same thing. There are no facts today that say that two SST's or a fleet of SST's will harm the environment. There is the very big question of looking at the whole global impact of man's impact on weather and the environment.

If we went on the basis of the facts that we have today, we would simply say there are no facts and there is no problem. We are acting responsibly, and should do so. We have laid on some research, not because we expect to confine the problem, but to increase our confidence in the statement that there is not a problem.

If we had to make a statement today in the Government and the scientific community, we would say the facts indicate there is no problem but there are concerns, and we want to increase our confidence.

#### PROGRAM DELAY IMPACT

If we were so concerned about this, which we are not, that we should delay while the rest of the world goes ahead—they are already 4 or 5 years ahead of us—and goes after this market which has all the economic benefits, then I think that would be the gamble. You would be gambling that you would never get any of that market while you took on a \$27 million research program and slowed the program down and put all those things on the shelf. The teams would have to disband. They would not be in place any more. Then you would have to reassemble those people later at great cost. You would be years late and the marketplace would have gone away.

This would be in spite of the fact that many of the scientists today say if they had to predict now, they could see no problem.

If the scientists turned around and were to say that on the basis of all the data available we predict a very serious problem, that might be a different situation, but that is not the case. Scientists say the available evidence indicates there is no problem, but we have to be honest and candid and say we have not been studying man's impact on weather for very long, and we want to improve our confidence.

I think the intelligent thing to do is to take the program in parallel. Study the environment and go with all due deliberate haste to capture the marketplace. Truly, this is an economic argument for trying to stay in the commercial aviation and supersonic and transportation race because of the economic benefits that will come back to this Nation and, at the same time, protect ourselves from taking an irreversible step.

What Mr. Ruckelshaus and Secretary Volpe have both said is that this is not an irreversible project. If any adverse evidence shows up, Mr. Ruckelshaus will recommend the program stop and come to you, the Congress, and I am sure you will give him authority. Secretary Volpe will also go to the President and ask to stop the program.

I think all the necessary checks and balances are in place. I think the wise course is the \$290 million program. The options increase the cost to the taxpayer and the cost to the subcontractors and contractors. It keeps the schedule and hedges the bet on the marketplace. We are fighting to keep our place in the marketplace and the economic benefits.

Mr. MINSHALL. Are you saying if you went to option 1 or option 2 you would lose your position in the marketplace so substantially that it would not be worthwhile to go ahead with this program?

Mr. MAGRUDER. If you went to option 1 or option 2 you would seriously erode the marketplace, you would seriously erode the contracts with the major contractors, and it would result not only in a schedule slip and a market loss, but an increase in cost.

I am not sure, if we went to option 1 or option 2, that as program manager I could keep this team together. I am honest with you in saying if we go to \$210 million fiscal year 1971 funding program, I have serious doubts that I can keep this contract or team intact.

I have shown you the minimum impact estimated by my office. It in no way shows an evaluation by Boeing and GE and the major subcontractors. It could be quite a bit worse than that. It is just my estimate. That is why the word "preliminary" is up there. It certainly will be no better than I have shown up there.

Mr. MINSHALL. Thank you, Mr. Chairman.

#### PROGRAM COSTS—PHASE 3

Mr. McFALL. Mr. Yates.

Mr. YATES. Mr. Magruder, before the hearings began I told you I was going to turn my back on you during your presentation because I just cannot stand these television lights. Frankly I have been in favor of televising hearings, but I must say that I am inclined now to change my mind, because I think it has become an almost unbearable experience to look into the lights. I have been driven in self-defense to face

this wall. My colleagues, of course, are smarter than I am, having taken unto themselves some smoked glasses.

At any rate, I am glad we have this open hearing. I offered the amendment in committee to open our hearings and this proves the validity of my amendment.

I thought it was a most impressive presentation. I thought so when you presented it to the Senate last year. It was as thorough, as comprehensive, and I think as favorable a presentation as you could have made on behalf of the SST.

I think you are as able a person as could be obtained for the job that you have. I think you are an outstanding public servant who comes to the program with excellent credentials. I think what you have told us deserves our very serious consideration.

I must say in all frankness that I am still not persuaded. I would like to ask you some questions.

You indicated that the total cost for the program was going to be \$1.283 billion in the event that you were not faced with the reductions that the conference came up with last year. Is that correct?

Mr. MAGRUDER. That is the phase 3 cost. You said total cost.

Mr. YATES. I mean the total cost to phase 3.

Mr. MAGRUDER. That is right. That is the total cost of phase 3.

Mr. YATES. What portion of that represents the cost of the engine and what portion the frame?

Mr. MAGRUDER. For the engine, \$376 million, and \$861 million for the airframe.

The difference between those two numbers and the \$1.283 billion is added research and development and administration costs.

Mr. YATES. In the event you were required to resort to either option 1 or option 2, which of the programs, the engine or the airframe, will be required to be increased?

Mr. MAGRUDER. Both will be required to be increased.

Mr. YATES. One more than the other, or both proportionately to the amount that you have allocated for them?

Mr. MAGRUDER. I think the airframe will probably be slightly more than the engine. The reason for that is that always, in these kinds of programs, the engine development precedes the airframe. So, a great deal more of that is done.

#### PROGRAM COSTS—TOTAL

Mr. YATES. In the Department of Transportation hearings for 1968, your predecessor, General McKee, Administrator of the FAA, testified in response to my question. I asked the question:

Let me direct your attention to this article that appears in Fortune for February 1967. I am sure you have read it. I read from page 113.

The Federal Aviation Agency estimates that the program will require an investment of some \$4 billion to \$4.5 billion before the first SST can be delivered to an airline.

The Federal Aviation estimates that?

General MCKEE. We gave this figure a while ago.

Mr. YATES. This is the total investment?

General MAXWELL. That is right.

Do you agree with your predecessor?

Mr. MAGRUDER. Yes, I do, but it is a ball park figure. I would like to make sure the record shows that most of that money is done by private sector financing. That would not in any way imply that that is Government money.

Mr. YATES. The difference between the \$1.283 billion and \$4 billion or \$4.5 billion is what you estimate the cost of production will be at the present time, is that correct?

Mr. MAGRUDER. I want to make sure another thing is in the record, that that number \$1.283 billion is the cost of phase 3. Phase 3 is the building of the 2 prototypes and flight testing to 100 hours. We testified yesterday that the Government's share of the entire program, which was the original question, was \$1.342 billion because there was a phase 1 and phase 2 that preceded phase 3.

Mr. YATES. I see. Only phase 3 costs are \$1.283 billion. You have phases 1 and 2, which cost how much?

Mr. MAGRUDER. The Government's share was \$291 million.

Mr. YATES. How much was the contractors' share?

Mr. MAGRUDER. The contractors' share of a total of \$308 million was \$9 million for Boeing and \$8 million for General Electric respectively.

Mr. YATES. I misunderstood. You said the Government's share was \$291 million. How much was the contractors' share?

Mr. MAGRUDER. Add \$17 million to the \$291 million. So, the total was \$308 million for phases 1 and 2.

Mr. YATES. Is that the cost to the Government, \$1.283 billion?

Mr. MAGRUDER. That is the total phase 3 cost.

Mr. YATES. Including both the Government and the contractors?

Mr. MAGRUDER. That is correct.

Mr. YATES. If you add that \$1.283 billion to the \$308 million, you get the total cost through phase 3. Is that correct?

Mr. MAGRUDER. That number is \$1.591 billion.

Mr. YATES. Roughly \$1.6 billion.

Mr. MAGRUDER. Yes. That you get by adding \$1.342 billion, the Government's share, to the manufacturers' share, which is \$190 million plus \$59 million that came from the airlines.

#### FACILITIES AND COMMERCIAL COSTS

I want to make sure this goes in the record. This \$1.591 billion does not include \$132 million in new facilities and commercial costs that are borne by the manufacturers.

Mr. YATES. Those are in addition?

Mr. MAGRUDER. Those are in addition.

Mr. YATES. And are considered to be a contribution toward payment of the manufacturers' share of the contract, is that correct?

Mr. MAGRUDER. It is in addition to their share.

Mr. YATES. This is a gratuity on their part?

Mr. MAGRUDER. I would not call it a gratuity, but I would say it is a price of admission.

Mr. YATES. What do you mean by "price of admission"?

Mr. MAGRUDER. Part of the contract with the contractors said they would take on the new facilities. They would take the responsibility for all the commercial costs, negotiating with the airlines, putting on specification reviews, and the sales effort.

That is not a small number. Those two numbers added together for the total program add up, as I said, to another \$132 million of real money that they will have to put into the program over and above \$190 million which was the contractors' cost of phases 1, 2, and 3 in direct cost-sharing.

#### COSTS TO CERTIFICATION

Mr. YATES. Do I understand you correctly that the total cost through phase 3, including that amount, will be \$1.732 billion, roughly?

Mr. MAGRUDER. I will add it up.

Mr. YATES. All right.

Mr. MAGRUDER. \$1.723 billion.

Mr. YATES. Through phase 3?

Mr. MAGRUDER. That is correct.

Mr. YATES. Do you estimate the difference between \$1.723 billion and the \$4 billion or \$4.5 billion figure that was given, that I just read from the testimony of General McKee, will be the most of the production version of the plane?

Mr. MAGRUDER. That is correct, for the program up to the time of certification.

Mr. YATES. Maybe we had better ask you, Mr. Magruder, whether you would tell the committee what the cost will be to the time that the first plane is turned out, the first commercial aircraft.

Mr. MAGRUDER. That is another way of saying the same thing, the program through certification of the first passenger-carrying plane.

Mr. YATES. What is that figure?

Mr. MAGRUDER. That is around \$4 billion or \$4.5 billion.

Mr. YATES. Is it closer to \$4 billion or \$4.5 billion, in your opinion?

Mr. MAGRUDER. I do not know the exact figure. These are estimates.

Mr. YATES. It is a question of half a billion dollars.

Mr. MAGRUDER. That is correct.

Mr. YATES. Is there a chance it will be higher than that?

Mr. MAGRUDER. These are in 1967 dollars, so I think, depending on abnormal inflation or escalation, the answer could be yes or no. It could be either way.

#### PRICE PER AIRPLANE

Mr. YATES. You did give us an answer as to what the price of the plane would be at the time it was turned out in inflated dollars. You thought the price would be, as of the present time, approximately \$37 million, and you said you thought—not you, but whoever testified on behalf of DOT said he thought the price of the plane, because of inflation, would be \$51 million. Is that correct?

Mr. MAGRUDER. I do not remember that number.

Mr. YATES. I will find it in the hearings and show it to you later.

Mr. PARSONS. I remember that, sir. It was on the assumption that the economy continued to inflate from now until 1980.

Mr. YATES. You made that assumption?

Mr. PARSONS. That may or may not be the case. It could go either way in the future.

Mr. YATES. You mean the economy could deflate?

Mr. PARSONS. It could.

Mr. YATES. That would be a welcome prospect, certainly, in the face of what is happening presently. I do not think it is very realistic, however.

Mr. McFALL. I hope it does not deflate.

Mr. MAGRUDER. We are talking about 7 or 8 years from now.

Mr. YATES. That is right. The figure that was given to this committee by Mr. Beggs or by Mr. Parsons or Mr. Vierling was \$51 million is the figure in the event inflation takes place, and I think you did it on a 3 percent per year basis, Mr. Vierling, is that correct?

Mr. VIERLING. That is correct.

Mr. YATES. If this be true, if the price of the plane, inflated, will be \$51 million when the first plane is turned out, what will the cost of the program be, inflated, using the same formula?

Mr. PARSONS. I estimate up to certification, the time the first airplane is delivered, and using your reference in the ball park of \$4 billion, it would be—

Mr. YATES. I did not hear the first part of that.

Mr. PARSONS. The \$4 billion that we are talking about, total cost up to the time the first airplane is delivered, could be approximately between \$5.2 billion and \$5.5 billion if one assumed escalation continues at recent rates.

Mr. YATES. Assuming escalation of inflationary trends on the same basis as you assumed for your per-plane price of \$51 million?

Mr. PARSONS. Yes, sir.

Mr. MAGRUDER. May I make a point?

Mr. YATES. Surely.

#### PRIVATE FINANCING FOR PRODUCTION

Mr. MAGRUDER. I would like to make sure it is clear to the committee that the number we just calculated of \$1.723 billion for the total industry and Government and airline program, including 100 hours' flight test, is the same number as existed last year. That has not changed.

I also would like to make sure as we get off this excursion of total program costs getting up into the \$4 billion area, we are not talking about the Government's program but that program that we are aiming at being done by the private finance sector. We are now trying to estimate what will happen between lending institutions and manufacturers and airlines 8 years from now.

Mr. YATES. May I go back again to those hearings and refer your attention to what your predecessor testified to in connection with the appropriation for 1968. At page 309, Mr. Boland asked the question:

General Maxwell, is it your opinion that the Government will end its investment in the SST program at the end of the prototype development effort?

General MAXWELL. Mr. Chairman, let me be perfectly candid on what we now foresee the situation to be. We have conducted some preliminary studies of the possible means of financing future phases as a basis for planning. Based on your current projections of the ability and projected financial position of the manufacturers and the airlines in, say, 1971—

4 years ago—

in that time period what we think they could be expected to invest in this program, using the 747 program as sort of a base line, it would appear that between what the Boeing Company and General Electric can raise and what the airlines would be able to advance, there is a gap of about \$1 billion. Whether they can solve that problem on their own, I do not know. Certainly there may be ways to solve this problem without the use of appropriated funds. That is our objective.

Mr. BOLAND. After the prototype is constructed, they are in a sense flying on their own.

General MAXWELL. Yes, sir.

Mr. BOLAND. They have to scrape up the necessary capital to continue.

General MCKEE. I stated, sir, as a matter of policy, that it is the objective of the Administration to turn this program over to the normal operation at the earliest practical date, and we would hope at the end of the prototype phase. I think I should also add that in discussion with the presidents of the two companies involved, Mr. Allen of Boeing and the vice president of General Electric in charge of this particular division, Mr. Jack Parker, that they have expressed their desire to get to the normal commercial relationship at the earliest practical time. I would like personally to see the Government get out of this program as soon as it could and maintain the contractual provision of getting our money back.

Mr. BOLAND. That is a nice statement. Is it practical?

General MAXWELL. I think it is.

General MCKEE. I think it is.

General MAXWELL. If the manufacturers are unable to swing it, as I pointed out a moment ago, one of the alternatives is to go to some plan such as a production corporation. So, there are alternative means to get it out of the private sector.

Do you agree with the statements of your predecessors?

Mr. MAGRUDER. What I would like to do is make my own statement, rather than give carte blanche to all those words.

Mr. YATES. All right. I would like to hear your statement.

Mr. MAGRUDER. I believe the objectives of the program are clear. We only want the Government to be involved in proving the two prototypes are economically acceptable to the airlines, acceptable from an environmental, noise and pollution standpoint, and demonstrate the airplane is compatible with the Air Traffic Control System, airports, and those planned for the future. That is our objective.

As I mentioned, a major part of my job and that of the staff of the Secretary's office, as a matter of fact, is to develop a comprehensive finance plan to show how the private sector will take on the production phase of this program. We would hope at the termination of the 100 hours of flight tests of the two prototypes that the Government will move out of the program except to the extent of monitoring the recoupment of its royalties. We should be there to make sure we get the money back as negotiated in the contract.

I think the Administration—is dedicated to the principle that all Government agencies, industry and labor, because all these people have a hand in this, do everything possible in the United States to give this country the healthiest, most efficient, least eroding to our society, forms of transportation that are available to man.

The SST is just a part of that.

I would like to leave my statement just that way, that we are going to do everything possible in the Government to make sure that not only the SST but air transportation, rail transportation, subways and seaways, provide the maximum benefit to the maximum number of people in the United States. The SST financing plan is a part of that

program. It is our objective to get out of the program and get the program into the private sector at the end of 100 hours of flight testing.

Mr. YATES. Are you aware of what Mr. Withington said last year in response to a question from the press? I asked whether Boeing would be able to take up the production version of the plane. As I remember Mr. Withington's response, he pointed out Boeing had a net worth of approximately only \$800 million at that time, and he did not see how they could finance it.

Mr. MAGRUDER. I do understand what Mr. Withington was saying. In most of the dealings I had with Boeing and the GE people as program manager, I have always had to keep in mind that almost all the things one says are said in the spirit of negotiation.

I anticipated your question, so I went to the Chase Manhattan Bank and the First City National Bank and they said, "Just send Mr. Yates to us and we will show him how we are presently financing an airplane that costs about \$25 million."

Mr. YATES. If you will give me the names of those people at those banks, I will be very glad to go up there and try to find out how they propose to finance the production version of the SST.

Mr. McFALL. When you go, will you take me along?

Mr. YATES. I will, indeed.

Mr. McFALL. I think we had better quit now. We will come back at 1:30, and I would like to start with someone on this side.

Mr. YATES. I have not finished.

Mr. McFALL. We will come back to you.

#### AFTERNOON SESSION

Mr. McFALL. The committee will come to order. We have as our first witness, Dr. James E. McDonald of the Institute of Atmospheric Physics, University of Arizona. We welcome you before the committee, Dr. McDonald, we will be pleased to have your testimony at this time.

Dr. McDONALD. Thank you, Mr. McFall. I am very pleased to have a chance to be here, and tell about some of the work that I have been doing in connection with the SST problem, and to try to point out to you some viewpoints and problems that I believe are being underestimated, and to some extent almost overlooked.

Mr. McFALL. Excuse me, Dr. McDonald. Do you have any more copies of your statement?

Dr. McDONALD. I have just one or two.

Mr. YATES. How many were prepared?

Dr. McDONALD. I think there were many dozens. I want to refer to certain specific points in the prepared statement as we go along.

Mr. McFALL. I think perhaps you had better go ahead. We have copies, and we will make sure the press gets what we have.

Mr. YATES. Where did you leave them, Dr. McDonald?

Dr. McDONALD. I think there are a fair number in your office.

Mr. YATES. For the benefit of the members of my committee who are laughing at this, let me say Dr. McDonald's testimony was prepared in my office. I offered him the assistance of my office because he needed help, and I was glad to do it.

Dr. McDONALD. I just checked and they said they had a number for the press. If they are delayed for a few minutes it won't interfere.

Mr. McFALL. All right, go ahead, Dr. McDonald.

## ORIGIN OF DR. McDONALD'S STUDY

Dr. McDONALD. Let me just first point out that the reason I happen to have been looking at SST environmental effects at all is because I am a member of the National Academy of Science Panel on Weather and Climate Modification. Inadvertent modifications of a variety of types are going to be discussed at some length in our upcoming report.

I have been concerned by some of the statements that have been getting into both scientific and general literature by midsummer concerning our last academy report, 1966, mentioned yesterday, I think, by Mr. Magruder in testimony. This report is being cited as a comprehensive analysis of environmental side effects of the SST, and this startled us who prepared the report, because we had never considered that rather brief examination of a couple of problems as being anything like a comprehensive report. The chairman of our panel asked me to update some of the parts that I had worked on 5 years ago on the SST ice crystal problems. That is how I got to looking at it. The more I looked, the more concerned I became, particularly after the August briefings that our panel received from the SCEP, the MIT summer study program.

The SCEP people, as pointed out, dug into new phases of the problem. This in turn made us realize we had to look farther. Briefly that is how I am involved in this, but let me follow those comments with a very clear statement, stressing that I do not speak for the Academy of Sciences nor do I speak for the Panel. I speak today as an individual scientist who has had this occasion to devote a fair share of time, for the past 4 or 5 months, to SST problems.

## RELATION TO OTHER ENVIRONMENTAL PROBLEMS

I want to point out that the problem of environmental hazards, interactions with the atmosphere—I am not going to talk about sonic boom or sideline noise, regarding them as environmental problems outside of my immediate concern—but the atmospheric effects, the responses thereto, the possible subtle consequences are things I am going to talk about. I shall try to get across to you that this is an extremely complex matter, that though it may put a part of the problem before you to stress how many things we don't know, as Mr. Magruder did briefly this morning, it only comes out in its full implications for possible unanticipated and adverse effects when you start looking, as I have been doing, into detailed physical processes.

## STRATOSPHERIC FLIGHT

The part of the problem that I will be talking about almost entirely deals with the cruise-mode side effects. The SST will cross, as you know, at 65,000 feet, and that is well within the part of the atmosphere identified as the stratosphere. Just to take about 30 seconds to identify terms here, the upper panel on the figure might be of help to you to give you a notion of the heights involved. The stratosphere begins around 40 to 45 thousand feet. That wavy black line is the base of the stratosphere separating the troposphere below, where we fly around in most of our present day jets, from the stratosphere above around

45 thousand feet into which we are now moving for the first time with a major transport technology, as distinguished from occasional military activities in that upper level.

We know a great deal about the stratosphere that we didn't know 50 years ago, no doubt about it, but we know very little compared to what we must know if—and this is a major point that I want to get across—if we are going to safely open the stratosphere now to a heavy commercial transport technology.

It has been cited in testimony here and in a number of DOT and Boeing statements that military flight experience in the stratosphere amounts to—the figures vary—around 200,000, sometimes it is less, sometimes more, 200,000 hours logged in the stratosphere by all military jets in the last 20 years, and that sounds impressive to you or me. We have never been in the stratosphere, but it is a very, very minor exposure of the stratosphere to aircraft technology.

For instance, that figure—if we take 200,000 hours in 20 years—averages about 40 hours a day. But even the projected Boeing fleet of 500 SST's, not counting Russian and British, if they log about 6 hours in cruise mode per aircraft per day which is the Boeing figure—

Mr. YATES. Will you defer a minute, Doctor. Peter, will you take those over to the press.

Dr. McDONALD. Did you finally locate them?

Mr. YATES. Yes.

Dr. McDONALD. The 200,000 figure boils down to only about one-seventy-fifth the rate of flight time in the stratosphere that will be logged by just the American SST program, if it comes to full tilt, and even that is underestimated, because Boeing will have four very powerful GE-4 engines, and many of the aircraft that have gotten up there are far smaller fuel consumers.

The fuel consumption that has been going on, and the exhaust emissions that have been going on in the stratosphere, because of our SR-71's, U-2's and occasionally interceptors getting up there and counter parts abroad are a trivial burden that has been placed on the stratosphere in the past, and any claims that you may have heard that that of itself shows that there are no hazards, because we haven't detected any untoward events, is completely beside the point for sheer reasons of numbers. The projected commercial SST technology is completely out of range of that problem, so the major point here is we are talking about a new technology in a region of our total environment which though it is a long way up, 60,000 feet, well above the tropopause which separates stratosphere from troposphere, nevertheless has very definite effects on us, and we know much less about it than we should.

This is very unfortunate because we have had time to do it, but it hasn't been done, and now we are confronted with all these questions, and hastily trying to nail things down in a big hurry, and that just doesn't work, as we know from lots of past experience. It takes time and committed efforts over an extensive period of time.

Moving to the next point, I want to draw attention to three generalizations. If you have the submitted statement, I would like to have it inserted in the record.

## PREPARED STATEMENT OF DR. McDONALD

Mr. McFALL. We shall include it at this point in the record.  
(The statement follows:)

## BIOGRAPHICAL SUMMARY OF DR. JAMES E. McDONALD

Present position: Senior Physicist, Institute of Atmospheric Physics, and Professor, Department of Atmospheric Sciences, University of Arizona, Tucson, 85721.

Area of principal research interest: Atmospheric physics.

Educational background: B.A. (chemistry), University of Omaha, 1942; M.S. (meteorology), Massachusetts Institute of Technology, 1945; Ph. D. (physics), Iowa State University, 1951.

Miscellaneous: Joined University of Arizona staff in 1954; Research Physicist, Cloud Physics Project, University of Chicago, 1953 to 1954; Assistant Professor of Physics, Iowa State University, 1950 to 1953; Naval Intelligence World War II, 1942 to 1945. Married, six children. Born Duluth, Minn., 1920.

Professional affiliations: American Meteorological Society; American Geophysical Union; Royal Meteorological Society; American Association for the Advancement of Science; Committee for Environmental Information; Society for Social Responsibility in Science; American Association of University Professors; Sigma Xi.

Current professional activities:

Member National Academy of Sciences' Panel on Weather and Climate Modification.

Member Advisory Panel for U.S. Navy—ESSA Project Stormfury.

Member, Evaluation and Goals Committee, University Committee on Atmospheric Research.

## 1. INTRODUCTION

Deliberations on the national decision as to whether to proceed now with an SST program have brought into public debate important questions concerning possible environmental effects of major SST fleet operations. I wish to summarize here some points which I think have been overlooked or underemphasized in recent discussions of the pros and cons of initiating a major air transport technology in the stratosphere.

During the past several months, a substantial share of my time has been spent in assessing certain specific questions as to how SST fleet operations might affect the earth's atmosphere and thereby modify either climate, weather, or human activities contingent upon important atmospheric processes. Although my work was undertaken in connection with current studies of the National Academy of Sciences' Panel on Weather and Climate Modification, I wish to make clear that I do not speak here for our panel, but rather as an individual scientist. However, I wish at the same time to express my indebtedness to many other scientific colleagues in various parts of the country who have offered advice and critique in various phases of these analyses. Although some of my viewpoints and findings are still tentative, all have been laid before a substantial total number of workers in a variety of different fields in an effort to detect and eliminate gross errors, so I acknowledge the help and criticism reflected in what I shall say here.

Before examining in some detail one specific SST atmospheric effect and its consequences (ozone reduction and its effect on skin cancer incidence), I want to emphasize three principal generalizations that strike me as having strong bearing not only on the present SST decision but also on the feasibility of moving on even farther toward a still higher-altitude mode of air transport now under engineering study, namely the HST (hypersonic transport) technology (1, 2).

To make clear certain points that will come up repeatedly below it needs to be noted first that the present generation of subsonic jets such as the 707, DC-8, 747, etc., which cruise at altitudes near 35,000 feet, are still operating within the troposphere, the lowest major subdivision of the atmosphere, separated by the thin tropopause layer from the next higher and quite different region, the stratosphere. For present purposes we may take the mean altitude

of the tropopause as about 40-45,000 feet over middle latitudes. SST's and HST's would, by contrast, operate well within the stratosphere. The proposed Boeing SST would cruise near 65,000 feet, while the HST's still only on drawing boards would cruise at altitudes that might begin near 80,000 feet, working upward as technology advanced to ultimate HST cruise levels perhaps near 150,000 feet (1, 3).

Although there are military jets, such as our U-2 or our SR-71, which can cruise at stratospheric altitudes, and although a number of interceptors have short duration altitude capabilities of well over 50,000 feet, the total number of flight-hours per year (or better, total tons of fuel burnt per year) logged by present and past military aircraft flying in the stratosphere are small (order of a few per cent as large) compared with the projected operational levels envisaged for United States and foreign commercial SST's by the 1980-85 period. Hence we do not yet have experience with the environmental effects of flying large numbers of very high powered aircraft in the stratosphere, a point sometimes forgotten or even misrepresented in arguments over potential seriousness of SST atmospheric modification effects.

## 2. THREE IMPORTANT GENERALIZATIONS ON POTENTIAL ENVIRONMENTAL SIDE EFFECTS OF HIGH ALTITUDE AIR TRANSPORT TECHNOLOGIES

I suggest that very careful attention should be paid to the following three points as we weigh the pros and cons of the present SST decision:

(1) The stratosphere is effectively about 100 times more sensitive to technologic contamination than is the troposphere because its turnover time averages about 100 times longer than that of the troposphere.

(2) The stratosphere is a region of high chemical reactivity, unlike the troposphere in which our current air transport technology now operates.

(3) If we now start an SST transport technology and then later attempt to improve range efficiencies by modifying engine or airframe designs to permit flying at still higher altitudes (or if we move on to an advanced HST technology) then we shall find that both of the preceding difficulties grow even more serious the higher we try to fly in the stratosphere.

The first of those three generalizations hinges on the important quantity known as the mean turnover time (also called the residence time, exchange time, or holdup time). In the troposphere, into which we emit essentially all of our present industrial and technologic pollution, the effective turnover time for the major pollutants averages only about a week, possibly rather less than that (4). Precipitation processes rapidly scavenge particulates and many gaseous pollutants from the troposphere, so that contaminants (even those from present-day jets flying in the upper troposphere) are fairly quickly washed out by rain. But the stratosphere enjoys no such efficient scavenging action; it has no cloud-and-rain washout mechanisms comparable to those that are effective in our troposphere. Instead, gases or particulates emitted into the stratosphere find themselves in an extremely stable region in which removal hinges upon slow transport and downward mixing to the tropopause, followed by "tropopause folding" or other leakout mechanisms that carry the pollutant down into the troposphere where rain scavenging can complete the removal process (5).

For the lower stratosphere, where the proposed SST's would fly, the average turnover time is now regarded as averaging about 2 years (5, 6, 7, 8) in contrast to the troposphere's 5-8 days. Hence for any given pollution rate, steady state accumulations will run about 100 times greater in the stratosphere because contaminants take 100 times longer to be flushed out if inserted into the lower stratosphere. Actually that ratio of 100-fold should be set at an even higher figure since the great stability of the stratosphere prevents the kind of deep mixing characteristic of the far more unstable troposphere, with the result that the mass thickness of stratospheric air effectively available to dilute contaminants run about 5 times smaller than for the troposphere. Without pursuing these matters into further detail, we may say that we shall probably be underestimating the seriousness of this point by here adopting the figure of 100-fold greater turnover time in the stratosphere where the SST's would be emitting various exhaust products.

The second point, concerning the far greater degree of chemical reactivity of the stratosphere, results from the presence there of the ozone layer (5), from the presence of small but chemically quite significant concentrations of reactive free radicals like hydroxyls and peroxy, and from the presence of an intense

flux of solar ultraviolet radiation, whose quanta have energy sufficiently high to drive many reactions that cannot occur in our lower atmosphere (because such energetic quanta are filtered out before they can get down into the troposphere, chiefly by the ozone layer itself).

The third generalization calls attention to the fact that if future aeronautical improvements in the SST should permit it to fly at higher altitudes (attractive for reasons of both fuel economics and sonic boom mitigation) this would only tend to exacerbate the foregoing two difficulties. Average turnover times increase as one goes to higher altitudes in the stratosphere (a trend well documented from nuclear bomb-test debris tracer studies), probably attaining values of the order of 10 years near 100,000 ft. (4, 5). This implies a tendency to build up still higher steady state concentrations for any fixed rate of injection of aircraft contaminants as we raise the injection level from the currently projected 65,000 ft. cruise level of the first SST's now under consideration. This difficulty is further aggravated by the fact that the main peak of the ozone layer lies above the 65,000 ft. level (ozone concentrations attain a broad maximum centered in about the 75,000-100,000 ft. interval, the exact value depending somewhat on latitude and season).

Relative concentrations of free radicals and also intensities of reaction-energizing solar ultraviolet quanta not only increase upwards through the latter altitude zone, but go right on increasing to still greater heights such as those now being talked about for HST operations. If there are (as I believe to be the case) some serious environmental consequences of starting an SST technology at 65,000-ft. cruise-levels, those difficulties will get worse as efforts are made to push SST cruise-levels still higher. And, without going into the point in full detail, there will certainly be pressures to push for those higher altitudes, since considerations such as those underlying the Breguet range-efficiency formula show that one will be able to fly with steadily lower specific fuel consumption by going higher and faster. That will tend to put pressure on to push SST cruise altitudes upward and later to follow them with even higher flying HST's. Then longer holdup times at these higher levels will tend towards higher and higher steady-state contaminant concentrations, and at the same time greater local abundances of reactive molecules and energetic quanta of solar ultraviolet radiation will tend to pose steadily more serious problems of environmental side effects. This point is not, I believe, widely appreciated in the aeronautical engineering world.

These three rather broad generalizations, I submit, need to be weighed very carefully in any major national decision to undertake an SST technology. Those three points have been ignored in a number of recent defenses of the SST program, with the result that SST exhaust contaminations have sometimes been made out as of quite minor concern, whereas the full implications of the long holdup time and high reactivity of the part of the atmosphere in which SST's would operate have only begun to be explored. Some of the past casual playing-down of potential hazards that I have encountered reflects little appreciation of these complexities.

Furthermore, there is a fourth generalization one might well append to the above three: Increases in the concentrations of stratospheric particulate concentrations that will result from SST exhaust emissions and their reaction-products (sulfates, nitrates, soots, hydrocarbon products) will be introduced into a part of the atmosphere where it is quite possible that they can exert more climatically adverse effects than similar particulates would have in the lower atmosphere. This is a subtle point (and one entailing some still poorly known optical properties of possible particulates resulting from SST stratospheric operations as well as some complex interactions with other atmospheric processes), so I shall only mention it in passing—but at the same time it is necessary to warn that long-term operation of new types of high-altitude air transport technologies might make this still poorly understood form of environmental disturbance as serious as or even more serious than any others now suspected.

### 3. SOME FALLACIES AND MISUNDERSTANDINGS ABOUT POTENTIAL SST ATMOSPHERIC EFFECTS

(1) SST's will cause persistent ice-crystal veils which will alter the earth's climate: Fears that the extremely large volumes of water vapor emitted from SST fuel combustion will lead to contrail-formation and hence to development of long-persisting hazy stratospheric veils of slow-falling ice crystals do not appear to be well-founded. I have reviewed again the arguments that led me

and others who prepared the 1966 NAS report on weather and climate modification (9) to discount this problem and have found no reason to alter our 1966 conclusions to the effect that this will not be a source of any significant climatic disturbance. SST's will not only fly at altitudes too high to lead even to formation of contrails most of the time, but, still more to the point, they will be flying in a region where mean relative humidities due to naturally-occurring water vapor average only about 5% so that persistence of any contrails that do occasionally form is ruled out by such dryness. Only rarely, at high altitudes in the winter, or possibly occasionally at low altitudes is it at all probable that contrails would form and persist. Serious climatic disturbance from those comparatively rare occasions does not appear likely.

(2) Water vapor additions to the stratosphere will produce such tiny reductions of ozone that no biologically serious consequences will ensue: This conclusion was reached in the SCEP Report (10), and it was also my own initial conclusion. However, a previously overlooked line of evidence now appears to lead to quite opposite conclusions. The possibility that ozone-reduction resulting from chemical interactions with SST-exhaust water vapor will be large enough to yield serious increases in incidence of skin cancer over the estimated operating period of an SST technology is a good example of a subtle and initially unrecognized environmental hazard now calling for the most searching scrutiny. I shall take this example of a "hidden SST problem" below and use it to show how there may well be difficulties in high-altitude transport technologies that we have only barely begun to understand. Briefly, it is my present estimate that operation of SST's at the now-estimated fleet levels predicted for 1980-85 could so increase transmission of solar ultraviolet radiation as to cause something of the order of 5-10,000 additional skin cancer cases per year in just the United States alone. I return to this point below.

(3) Water vapor added to the stratosphere by SST's is of only trivial significance since thunderstorms put far more water into the stratosphere by entirely natural processes: This argument has appeared in several places (12, 13). In one widely repeated form it suggests that a single tropical thunderstorm can inject as much water vapor into the stratosphere as would the entire SST fleet in a single day. The argument then usually continues with the remark that for the world as a whole there may be something like 4,000 thunderstorms per day, hence why worry about SST water vapor additions. The primary fallacy here is that any and all natural processes (including thunderstorms) accounting for the naturally occurring water vapor in the stratosphere are already fully allowed for as soon as one introduces into an analysis the present estimate of the average natural water vapor content of the stratosphere, now put at about 5 p.p.m. by volume as a result of the work of many investigators, especially Mastenbrook. To the extent that tropical thunderstorms are a factor in natural vapor injections into the stratosphere, that effect is taken into account as soon as one uses the average figure of about 5 p.p.m. by volume. I know of no analyses of potential SST environmental effects related to SST exhaust vapor contamination of the stratosphere that have not proceeded from just this basis; hence I can only regard the "thunderstorm argument" as inherently misleading because it, of course, makes the uninitiated think that SST vapor additions are somehow trivial when measured against wholly natural effects and has often been made in a context vaguely suggesting that critics of SST environmental hazards are ignoring such thunderstorm effects. That is unfair and misleading argumentation on the part of SST proponents.

Furthermore, the SST proponents who use the thunderstorm argument have, to my knowledge, never backed up their basic claims with good observational data as to (a) what fraction of the several thousand thunderstorms per day actually penetrate the tropopause and succeed in delivering any vapor to the dry stratosphere, and as to (b) just how much vapor is actually exchanged with the stratosphere even in those cases where a thunderstorm does penetrate the lower stratosphere. I would suggest that only an extremely small percentage of all thunderheads (i.e., cumulonimbus clouds) build up into the stratosphere (in either middle or low altitudes) and that the thunderstorms of the world are actually a minor component of the overall meteorological machinery by which vapor moves up to the tropical stratosphere—most of it ascending slowly over an enormous area in the rising branch of the Hadley-cell circulation near the Equator. But, in any event, the all-important point that the nonmeteorologist should realize in connection with this is that we are already taking into account

any and all such effects when we start hazard-analyses (as in the skin cancer question below), with the observed average stratospheric water vapor content of about 5 p.p.m. by volume. The "thunderstorm vapor injection" argument is about as misleading to public and to Congress as is the "ice crystal veil" argument, as I now see it.

(4) SST pollution effects are unimportant since they will constitute only about 1 percent of the pollution from other technologies. This argument (13) has several fallacies in it. First, it takes as "SST pollution" only the kind of particulate and gaseous pollutions that tend to cause pollution difficulties in the lower atmosphere (sulfur dioxide, hydrocarbons, soots) and it quite casually ignores the point that, in the stratosphere where these emissions have to be worried about, even such a seemingly harmless exhaust product as water vapor can lead to serious disturbances, yet, is emitted in amounts about a thousand times greater. Second, it casually ignores the point stressed above that the roughly hundredfold greater holdup time (turnover time) of the stratosphere as contrasted with that of the troposphere where other present forms of atmospheric pollution are occurring, implies that if SST's put out only about 1 percent as much pollution as all other polluting technologies, then the hundredfold greater holdup time characteristic of the part of our atmosphere in which SST's will cruise will just about cancel out that advantage. That is, storing up for a hundred times as long the emissions of an SST technology emitting only 1 percent as much pollution would just bring the SST pollution levels up to about par with those of all other technologies. I would not wish to press that argument too far; but it serves to show how incomplete some of the existing argumentation is. Such incomplete argumentation can be a source of confusion, as exemplified in one recent statement made within the Senate where it came out that three automobiles going down the highway at 60 miles per hour would emit more water vapor than the entire fleet of SST's, a multiply-garbled version in which several misunderstandings and errors became confounded.

(5) If SST's are going to pollute our atmosphere, it's better to have it polluted by U.S. SST's than by the same number of foreign-produced SST's.

Sometimes it is suggested that it is pointless to debate the present SST decision because if we don't build those SST's, somebody else will. I believe a sounder viewpoint is this: Whether we build and fly many hundreds of stratospheric commercial transports or whether some other country does, exactly the same careful scientific assessment of potential global (or hemispheric) environmental hazards has to be conducted. Entirely independent of who builds high-powered SST's that will contaminate the sensitive and reactive stratosphere, the hazard-burdens will be much the same, since stratospheric winds will spread the effects over most of the (Northern) Hemisphere.

The real question at stake is thus the question of whether it is acceptable to any and all nations to have operating in the stratosphere a heavy air transport technology which might impose any globally unacceptable environmental burdens affecting any or all national interests. The inherently international characteristic of the problem, when properly appreciated, requires that the United States or Russia view the Concorde program just as critically as the British or Russians must view the American program, et cetera. The basic question is whether the stratosphere is going to be just too sensitive to the kinds of transport technology now envisaged by aeronautical engineers who have made their impressive advances without fully examining environmental implications of the powerful and fast vehicles they have been designing with such skill.

(6) The sensible and conclusive way to sort out all of these questions about SST environmental effects is to build several prototypes, fly them in the stratosphere, and make direct measurements to settle all of the uncertainties. Although such a suggestion has a rather plausible ring to it, careful examination of where the really crucial environmental questions now lie shows rather conclusively that availability of a few flying SST prototypes will do almost nothing to settle these scientific controversies. There are far more scientific uncertainties than I shall be able to pinpoint here; but with only few exceptions, the kinds of research now needed to clarify these problems involves laboratory or computer work, or biological studies having no relation at all to the availability of prototype SST's. Our difficulty is that we lack basic scientific understanding of a number of key questions raised by proposals to initiate high altitude transport technology. As with all too many past examples, we have failed to conduct a broad and vigorous program of basic research so that we just don't have all the answers at hand when technological change suddenly calls for assessing hazards. Flying models

of the SST may be useful in checking engineering-feasibility questions but they will, unfortunately, be essentially useless in providing answers to most questions on environmental side effects that have emerged from recent inquiries.

#### 4. AN EXAMPLE OF AN OVERLOOKED SST ENVIRONMENTAL HAZARD: INCREASED INCIDENCE OF SKIN CANCER FROM ENHANCEMENT OF SOLAR ULTRAVIOLET EXPOSURE ACCOMPANYING DIMINUTION OF STRATOSPHERIC OZONE

Past experience with new technologies offers a number of historical examples of the general principle that entirely unanticipated environmental difficulties, often of a rather subtle nature, may ultimately come to light after years of operation with that new technology (pesticide technologies, release of mercury from seemingly harmless industrial processes, radiation hazards, lead tetraethyl gasoline additives, etc.). Certainly it must be agreed that in trying to avoid many more such experiences, we need to find ways of assessing new technologies far more carefully than we have done in the past. A recent National Academy of Science report on technology assessment (14) has provided a penetrating analysis of these challenges, and has drawn particular attention to the need for detecting those potential side-effects of new technologies before the latter attain so advanced a state of development that too large an economic and social investment has been made to stop the new technology prior to its getting beyond a point-of-no-return. Surely all such considerations ought now to be brought to bear on the present national decision to initiate an entirely new form of high-altitude commercial transport technology that raises complex environmental questions of an unprecedented nature.

It was very much in that spirit that I have reexamined recently certain earlier conclusions that ozone-reductions due to water vapor added to the stratospheric ozone layer would be too small to have discernible biological importance. Although the full argument that has led me to the view that SST's might cause adverse effects large enough to be of public-health concern is too lengthy to be completely detailed here. I wish to outline its main features, since I believe the argument is strong enough that it must now be carefully weighed into the present decisions on the SST program.

(1) Carcinogenic effects of solar ultraviolet radiation. That skin cancer, especially of the basal cell and squamous cell types, is caused chiefly by prolonged exposure to solar ultraviolet radiations has now been attested in so many ways as to be essentially beyond dispute (15, 16, 17). Among the items of evidence supporting this conclusion, those of particular concern relative to SST effects include the following:

(a) In all parts of the world there is a systematic tendency for higher skin cancer incidence in regions characterized by low average ozone amounts overhead, by high percentage of clear skies, and by short airpath for incident solar rays. Briefly, all of these factors tend to imply higher UV (ultraviolet) dosage rates at low than at high latitudes, and skin cancer incidence is found to increase correspondingly as one moves from high to lower latitudes (18, 19). (b) In any given area, skin cancer incidence is known to run much higher among persons who spend a great deal of time out-of-doors (farmers, ranchers, construction workers, sportsmen, seamen, etc.). (c) Long-standing clinical experience shows that skin cancer lesions appear predominantly on exposed portions of the body; about 85-90 percent of all lesions, in fact, occur on head and neck areas which are least covered by clothing. (d) For the same reason, average incidence for males exceeds that of females in essentially all parts of the world. (e) Light-complexioned persons exhibit markedly higher skin cancer incidence than do dark-skinned persons; persons of Celtic derivation seem particularly vulnerable according to many studies (15, 20), while Negroes exhibit much lower incidence than do Caucasians. (f) Albinos or persons homozygous relative to the autosomal recessive genetic disease xeroderma pigmentosum provide particularly dramatic evidence (albeit of very distinctly different nature in those two categories) of vulnerability to solar induction of skin cancer (21, 22, 23). (g) Laboratory irradiation experiments demonstrate induction of skin cancer at wavelengths near 3,000 angstroms. (h) Increasing incidence of skin cancer in recent years appears explainable in terms of changing recreational habits leading to greater average solar exposure and in terms of changing clothing habits, especially among women.

(2) Critical role of the ozone layer in filtering solar UV (ultraviolet). Despite the seemingly small total amount of ozone in the stratosphere (equivalent in mass to a layer of sea level air only about 3 millimeters thick), the strong absorptivity

of ozone for wavelengths near 3,000 angstroms and below, serves to filter out much of the solar UV; so that for most purposes it is accurate enough to say that the ozone produces a cutoff near 2,900 angstroms (24). It has long been known that this filtration effect is of critical biological importance to all forms of life, especially animal life; but in just the past few years there has emerged a still more impressive and still more fascinating series of indications that stratospheric ozone has, in fact, been a crucial limiting factor throughout most of the evolutionary history of terrestrial life. The evidence is now mounting very rapidly that various life-forms (ranging from microorganisms to humans) now survive in the face of existing solar UV exposures only because of having evolved astonishing and fascinating protective mechanisms or UV damage-repair mechanisms (at the cell-biological level).

I cannot here do justice to this impressive body of biological evidence; suffice it to say that DNA damage (chiefly thymine dimerization that amounts to somatic mutation) results from UV irradiation, and the more so the shorter the active UV wavelengths, since DNA absorption peaks near 2,600 angstroms. Furthermore, mounting evidence implicates thymine dimerization in DNA as either a controlling or a contributing factor in UV induction of skin cancer, some of the most cogent evidence thereof having been turned up very recently in special studies dealing with xeroderma pigmentosum skin tissues (21, 22, 23).

(3) Implications of the north-south gradient in skin cancer incidence. Various epidemiological studies (18, 19, 25) have revealed a north-to-south increase in average skin cancer incidence in the United States that amounts to about an eight to tenfold higher incidence (measured in numbers of new cases detected per year per 100,000 total population, and ranging from around 25 per 100,000 per year averaged across the northern tier of states to around 200 to 250 per 100,000 for the southern tier of states). Strong corroboration of this kind of systematic latitudinal gradient of skin cancer comes from all parts of the world (e.g., 26, 27), and the gradient is marked enough that one can even detect it in data from within a single large State like Texas, or within rather small countries like England or Japan.

This north-south gradient of incidence results from the interaction of a number of factors including average annular-number of hours of outdoor exposure, cloudiness, solar elevation angles, and total overhead concentrations of stratospheric ozone. For fairly obvious reasons, annual dosages are dominated by summertime exposure; and when one examines data on cloudiness and effects of sun angle, he finds that these produce fairly small latitudinal effects in the United States. A larger gradient effect is brought in by length of time per year in which temperatures are warm enough to permit appreciable amounts of out-of-doors work and recreation. Without reviewing all details, let me say that considering all of these factors has led me to assign no more than half the total dosage gradient to factors other than ozone differences. (I suspect this may be underestimating the relative importance of the ozone gradients.) Taking that value along with reported medical data on cancer incidence yields a rough, but I believe meaningful, calibration figure of a variation of about 6 percent of skin cancer incidence for every 1 percent of variation of columnar total ozone overhead. Unfortunately, laboratory studies using experimental animals have never been carried out in a way permitting direct cross-check on this "amplification factor" of around 6; but such data as are in the literature (17) are at least not incompatible with such a factor. There is urgent need (on grounds broader than mere SST concerns) to secure far more such data in the near future.

(4) Reductions of stratospheric ozone by chemical interaction with SST water vapor: Beginning about 5 years ago a series of investigations (28, 29, 30) have revealed that naturally occurring stratospheric water vapor interacts with ozone to reduce its average concentrations by a substantial amount. Still more recently the theory of these photochemical interactions have been employed (31, 32) to estimate the percentage reduction of average stratospheric ozone that one might expect to result from SST operations. These predictions depend, of course, on the assumed numbers of SST's, and on certain atmospheric parameters such as turnover time, mixing effects, etc. Current estimates range from about 2 percent (31) to about 4 percent ozone reduction (32).

Assuming an ultimate global SST fleet totaling the equivalent of 800 American SST's (500 American SST's plus the fuel equivalent of 300 more operated by foreign countries), using a figure of 6 hours per day in cruise-mode at or near 65,000 feet, assuming a turnover time of 1.5 years and a vertical mixing depth of 150 millibars, and assuming uniform mixing over the entire Northern Hemis-

phere, my own present estimates yield an incremental water vapor concentration of about 0.6 p.p.m.v. (parts per million by volume). This SST increment would be superimposed upon the present natural background concentration of about 5 p.p.m.v., a boost by about 12 percent, say.

Using the Leovy model (30) one then obtains a predicted decrease in columnar total ozone of about 4 percent from such a rise of water vapor, a figure similar to that obtained by Harrison of the Boeing Research (32). However, again in the interests of conservatism (and adding to what I believe to be several other conservative biases built into other parts of my overall estimates) I have taken only a 1-percent reduction for purposes of the rest of the argument.

(5) Estimated increase of skin cancer incidence resulting from SST operations: Considering just the United States, where the present annual skin cancer incidence now runs about 120,000 new cases per year, the foregoing figure of a 1-percent ozone decrease together with the previously discussed sixfold amplification factor inferred from epidemiological data, would imply an SST effect on national skin cancer incidence amounting to perhaps 7,000 new cases per year. If one used Harrison's 4 percent ozone reduction estimate the corresponding rise of skin cancer incidence would be estimated at about 30,000 new cases per year. If other conservative factors that I have used elsewhere in the argument were dropped, this figure might be doubled again. Here I prefer a round-number estimate near 10,000 new cases per year.

(6) The amplification factor: Because the literature on UV carcinogenesis was found to contain nothing like a well-established mathematical model of skin cancer induction, and because the roughly sixfold amplification factor which I obtained from considering epidemiology and related factors is rather crucial to these estimates, I have devoted a good deal of effort to finding a physical and biological basis for understanding whether such an amplification effect can be understood. Without here elaborating the point in detail, let me merely remark that there does appear to be an entirely plausible chain of reasoning, tied up with the marked nonlinearity of absorption of the carcinogenic wavelengths, combined with the absorption properties of DNA. Briefly, I find that a sixfold amplification is just about what one should expect if the peak of the UV carcinogenesis were narrow and fell near 2,950 angstroms. In reality, UV carcinogenesis almost certainly results from an appreciable range of wavelengths, but nothing in the biomedical literature is at all incompatible with an effective peak near the cited wavelength. This tends to give significant support to the overall argument, I believe.

(7) Present conclusions on the SST skin cancer hazard. I can fully understand why some persons might, on hearing that there was fear being expressed that increases of skin cancer could result from operating SST's in the stratosphere, think that such a suggestion sounded ridiculous. But though there may well be errors in my analyses of the various parts of this problem, the prediction is far from being unsupported. The evidence is now quite strong that modest variations of stratospheric water vapor concentrations could lead to just such modest ozone changes. And the evidence also is rather strong that modest reductions of stratospheric ozone would be reflected in increased average incidence-rates for skin cancer. Finally, the purely biological and evolutionary evidence that we, as well as all other life forms, have evolved in ways leaving us only marginally protected from highly adverse effects of ultraviolet radiation is essentially incontrovertible.

One needs, perhaps, to reflect on other examples of inadvertent modifications of our natural environment as a result of new technologies, to be reminded that adverse effects have repeatedly unfolded as a consequence of causal chains that connect *seemingly* very distantly related events. In my own opinion, the present evidence points rather strongly to the conclusion that operating a major SST technology of the magnitude now under consideration here and abroad would, via the ozone-ultra-violet-carcinogenesis chain, lead to increased incidence of skin cancer of the order of 104 new cases per year within the United States alone. The world total would be somewhat greater, of course, but not greater by a large factor since skin cancer is above all an affliction of Caucasians (rather than Negroes, Asiatics, or other pigmented ethnic stocks), so considerations of world geography and world climatology seem to imply that the brunt of the skin cancer burden, regardless of who builds and flies them in the Northern Hemisphere, would necessarily be borne by the Caucasian population of this country, with Europe bearing most of the remainder of the total burden.

My suggestion, based on analysis of just this one SST environmental hazard, is that this single side-effect poses by itself a difficulty of sufficient magnitude to postpone any immediate commitments which might tend toward subsequently irreversible pursuit of SST/HST of high-altitude transport technologies. Until reliable answers can be obtained through appropriate research, I would have to suggest that these present estimates, albeit tentative, are much too disturbing to warrant further immediate moves toward SST/HST technologies. If careful research into all of the many factors underlying the above estimates should disclose that an estimate of some 104 new skin cancer cases per year is a gross overestimate, then this one of the several grounds for caution in the present SST decisions will disappear. My present surmise, however, is that it will probably be found to be on the low side.

## REFERENCES

1. Ferri, A., *Astro. and Aeronautics*, October 1966.
2. Goethert, B. H., *Astro. and Aeronautics*, October 1966.
3. Simpson, R. W., and J. W. Hursh, *Astro. and Aeronautics*, October 1966.
4. Martell, E. A., in *Advances in Chemistry Series No. 93*, Am. Chem. Soc., Washington, 1970.
5. Junge, C. E., *Air Chemistry and Radioactivity*, N.Y., Academic Press, 1963.
6. Feely, H. W., and J. Spar, *Defense Atomic Sup. Agency Rept. DASA 1222*, 1960.
7. Martell, E. A., *J. Atmos. Sci.*, 25, 113, 1968.
8. List, R. J., and K. Telegadas, *J. Atmos. Sci.*, 26, 1128, 1969.
9. National Academy of Sciences, *Rept. 1350*, 1966.
10. SCEP (Study of Critical Environmental Problems, Man's Impact on the Global Environment) Cambridge, MIT Press, 1970.
11. Chatham, G. N., *Astro. and Aeronautics*, January 1970.
12. Boeing Aircraft Co., *Air Quality as Affected by Air Transportation Including the Supersonic Transport*, Rev. B, 1970.
13. Boeing Aircraft Co., *The Supersonic Transport and the Environment* (brochure), August 1970.
14. National Academy of Sciences, *Technology: processes of Assessment and Choice*, 1969.
15. Urbach, F., ed., *The Biologic Effects of Ultraviolet Radiation*, Pergamon Press, N.Y., 1969.
16. Blum, H. F., in *Radiation Biology*, Vol. 2, A. Hollaender, ed., N.Y., McGraw-Hill, 1955.
17. Blum, H. F., *Carcinogenesis by Ultraviolet Light*, Princeton, Princeton University Press, 1959.
18. Auerbach, H., *Public Health Reports*, 76, 345, 1961.
19. Dorn, H. F., *Public Health Reports*, 59, 33, 65, 97, 1944.
20. Carmichael, G. G., and H. Silverstone, *Brit. J. Cancer*, 15, 409, 1961.
21. Cleaver, J. E., *Nature*, 218, 652, 1968.
22. Epstein, J. H., K. Fukuyama, W. B. Reed, and W. L. Epstein, *Science*, 168, 1477, 1970.
23. Trosko, J. E., D. Krause, and M. Isoun, *Nature*, 228, 358, 1970.
24. London, J., in *Biologic Effects of Ultraviolet Radiation*, F. Urbach, ed., Pergamon 1969.
25. Lynch, F. W., C. F. Lehman, and J. L. Pipkin, *Arch. Dermat.*, 79, 275, 1959.
26. Segl, M., *Conf. on Biology of Cutaneous Cancer*, Natl. Cancer Inst. Monogr. 10, 1967.
27. Belisario, J. C., *Dermatologica Tropica*, 1, 127, 1962.
28. Hampson, J., *Tech. Note 1627/64*, CARDE, Valcartier, Quebec, 1964.
29. Hunt, B. G., *J. Geophys. Res.*, 71, 1385, 1966.
30. Levy, C. B., *J. Geophys. Res.*, 74, 417, 1969.
31. London, Jr., and J. Park, in *SCEP Report*, see 10 above.
32. Harrison, H., *Science*, 170, 734, 1970.

## CHARACTERISTICS OF THE STRATOSPHERE

Dr. McDONALD. Start at page 4. The three important generalizations are on potential environmental side effects of high altitude air transport technology. That is what I wish to remark on next.

First of all, you should at all times be well aware that the stratosphere is effectively about 100 times more sensitive than the troposphere to contamination. Our Con-Edisons, and Phelps-Dodge in Arizona are polluters and automobiles and all the rest we are thinking about as a pollution problem, are found at the base of the troposphere. The troposphere is rapidly cleaned out by rain and cloud processes which are simply not found in the troposphere. It is really more than a one hundredfold difference, the net effect of this, in the following sense. It takes about 5 or 6 days, something like a week on the average—it is an average over a broad range—an average of a week to scavenge out particulates that get into our atmosphere.

Dusts, gases—not all but most gases—have been washed out by that cleansing action which we fortunately enjoy in the rain process, in a time of 5, 6 or 7 days, something like that. The recent estimates have been pulled down from 20 days to something like 5 days. A very important point in contrast to that: with the SST when we start operating heavy technology—500 and 600 SST's represent by these standards a heavy technology—in this uninhabited region we find that all of the emissions that are going to be put out stay about 100 times longer. The holdup time, transfer, exchange time, residence time—using all the terms employed for the same one idea—the clean out time of the stratosphere at SST levels, 60,000 feet, average around 1 to 3 years.

The estimates are based on bomb test tracer studies. That is how we happen to know anything about this complex point. That averages 1 to 3 years and most people making calculations such as I am going to be summarizing here use a figure of 1½ or 2 years for these altitudes. It is shorter time if you go lower in the stratosphere. It is quite a bit longer time if you go up, but that difference between a year and a half, which is 500 days—just to round it off in numbers to see where this comes out—that 500 day, a year and a half, residence time in the stratosphere has to be contrasted with about 5 days in the troposphere which means the concentration tends to build up at a lower rate as contrasted with the troposphere. That means it is that much more sensitive by more than a factor of 500 and it is more than that because the mixing depths are smaller, the total mass diluent, the diluting mass in the stratosphere is less, so I am being a bit conservative—underestimating the seriousness of this problem—if I use a figure of 100. That gives you pause in looking at a lot of numbers that are bandied about all to glibly in this problem. Let me just point out one example.

One of the rarer, the less important emissions of the SST in any high temperature combustion process is nitric oxide. If you flew a Volkswagen at 60,000 feet you would get nitric oxide out just as you will from the SST or any other aircraft that operates at combustion temperatures like this, and it is not a very important figure when you look at the total numbers. Nevertheless, the annual average output of nitric oxide from the full complement of SST's by the 1980-90 period is of the order of half a megaton, half a million tons per year, and it will accumulate then—you will get a year and a half's worth—and that means there will always be something around a half to one million tons of nitric oxide over and above the natural amounts.

Well, that may form particulates and also many of the sulfur dioxides. That looks small at first glance when you compare it with the present figure of about 25 million tons of industrial particulates that we inject into the lower troposphere. But to cite the point that I want you to try to get clear here, to cite the main point, those 25 or so million tons a year of industrial particulates, soots and all the rest, only stay 5 or 6 days. You get 5 or 6 day's worth on the average of that, whereas you are accumulating a year and a half's worth of the SST materials that may be in the range of 1 million tons even for the rarer material, and that means that the steady state amounts at present in the stratosphere from some of the emissions actually are very much greater than the steady state amounts down where we usually think about pollution, due to this 1-hundredfold greater holdup time. That is a first generalization which all of us have to worry about a bit as we think about this fascinating prospect of getting high efficiency transport at high altitudes.

The second point about the stratosphere, and particularly the regions near the SST altitudes and a little bit above is this: It is a region of very high chemical reactivity, whereas the troposphere where we pollute now with various technologies is a chemically very inert region. Why is the stratosphere in these altitudes chemically reactive? Primarily because the ozone layer is up there, and it is an extremely oxidizing substance. That is the chief reason. The  $\text{So}^0$  which comes out of the SST will be oxidized to  $\text{SO}^3$  very rapidly and so on. We make half the copper in Arizona for the whole country but it is hard to convince yourself if you look carefully at the kinetics that  $\text{So}^0$  from Tucson has oxidized to  $\text{So}^3$  in roughly the day it takes to get there but it is about 1/100th of a second in the presence of that ozone to oxidize  $\text{So}^0$  to  $\text{So}^3$ . That is an example of the effects of the reactivity that have to be brought into the picture in thinking about pollution.

Another reason for this high reactivity is the presence of radicals. It gets involved in important water vapor reactions. A third major reason, really the prime reason, is that there are short-wave-length ultra-violet solar high energy quanta present in abundance when you get up into these altitudes which can drive photo-chemical reactions at rates not to be found in the lower atmosphere. That is the second point. It stays there a hundred times longer and it is subjected to relatively high chemical reactivity.

The third of the three generations that I have pointed out on page 4 is this. You want to look, and DOT should look and FAA and the entire air transport field needs to look at what may be happening here in terms of environmental effects. We are doing something really new, if we go up to 60,000 feet. Why are we going up there to these altitudes we haven't been before, with air transport as distinguished from military planes? It is cheap and economical to fly at high altitudes.

The Breguet range efficiency consideration, well known to aeronautical engineers 30 years ago, shows quite clearly that it is cheaper to fly higher and faster, and this will always stand as a pressure to get people like Mr. Magruder and his colleagues to thinking up these fascinating methods of solving those challenging problems, because it is better to fly up there. It is better to fly to Calcutta or Tehran there, than down below, for reasons tied up with air drag and the like. The

point is that already before you have decided about the SST technology, they are rather well beyond drawing board stage plans for the HST. The HST, the hypersonic transport, which would go at mach 5 to 10, will begin at maybe 80,000 feet and cruise ultimately, when everything is tuned up, to something like 150,000 feet. I want you to try to, we all need to try to think of the SST as just the first step. It is sort of either/or. We either really can't get up in there or if we do we are going the rest of the way to HST.

If you look at the diagram of the ozone layer which is the blue curve in that upper panel, you will notice that it increases up to about 100,000 feet. The maximum of ozone concentration, the source of much of the mischief here and the pollution problems, is getting steadily higher as you fly anything above SST altitudes. The economic range efficiency pressures will make us want to go up there. The HST is already being touted as just the ticket to get up there. Indeed it is very interesting.

As we go up, all these things get worse. The exchange time which is a year and a half or 2 years at SST altitudes is known from bomb debris studies to get up to around 10 years at something like 100,000 feet, and the concentrations of ozone that drive these complex and uncommon reactions is greater, and the opportunity to interfere with the ozone layer is automatically greater. All of those things, I stress in this third point, will get worse before they get better, and these have to be lumped together—SST, HST type technologies—when we think of not flying just a few SR-71's or U-2's but hundreds of heavy transports. Then we have to know much more about this rather unfamiliar environment than we now do.

There may be a fourth generalization made here, but it is so fraught with scientific uncertainties that where I cite it on page 8, I put it in only in passing because I can't do justice to the complexities. I only point out that a fair share of the time I spent 3 or 4 months ago on the first parts of this problem were concerned with the particulate question, the radiative interaction of particulates, the question of just what will happen to the nitrates, sulfates and so on that will form because of ozone interactions with the emissions of the SST, and you run into just basic question after question which we can't predict reliably. You can put crude bounds on it, but you need to know more about optical properties, about really quite complex dynamic interactions. Dr. Greenfield, yesterday, stressed this to you. I heard just a bit of his testimony. You can't, in a matter of a few months, or even in a year or so, sort out all of the complexities that we really need to know in settling those kinds of problems, and you will have to make decisions, I understand, as to what the implications of that are. The fact, and I say it is a fact, and I am prepared to defend that viewpoint much more vigorously than I am here, that there are so many unknowns in this problem, which might lead to adverse effects, that it means a good many years of research.

We haven't done our work. The suggestion that our NAS Panel Report of 1966 was anything like a comprehensive report on the SST is a standing joke within our panel, and it is very disappointing that in the intervening 5 years the people who, speaking very frankly, should have been doing this really haven't pursued this. I am most unimpressed, very disturbed by the superficiality of a great deal of what has passed in recent months as findings on SST hazards, that are much more subtle than that.

## FALLACIES, MISUNDERSTANDINGS, AND THE SST

Let's look at a few fallacies and misunderstandings starting on page 8 that are in my general area of atmospheric physics which are fallacies on both sides of the uncertainties here, some of which can be squared away and some of which are still just big question marks.

## CONTRAILS

Take the first one, the suggestion that persistent ice crystal veils, which form up in the stratosphere at cruise altitudes, will shield the earth, cut down radiation, and cause disturbed climatic effects. That we talked about. The main reason I was asked to update these parts of the NAS report we are working on was that that is a portion of the work I had done in 1966, and conclusions that we published in that report, 1350, were that there is no evidence or reason to think that persistent ice crystal veils will form and cause trouble. I will say that again. At least speaking for my inputs—which is the main part of the input to the next panel report on the subject—nothing I have examined in the recent months alters that conclusion at all.

There are two simple reasons without giving you the full physics. In the stratosphere, the natural amounts of water vapor are too small, the relative humidity is too low and it is too warm. Temperatures are too warm though relatively cold, minus 50 degrees, to form contrails at these altitudes. The contrails even if they form—they won't even form most of the time, if you find an SST overhead you will see no contrail—if they just form briefly, they will just not persist, and there is an example of a misunderstanding, a fallacy that has been given a good deal of currency in the last year or so, where you can be essentially unequivocal. That is a problem we do understand. It is nice to understand something of this problem. That is one we do understand and the answer is negative.

## SKIN CANCER

The second one I want to briefly comment on, and then come back to in a moment, is this kind of an assertion: Water vapor additions to the stratosphere will produce such tiny reductions of ozone that no biologically serious consequence will ensue. You have heard that. You have heard, for instance, Senator Jackson, I think, identify as some kind of ecology extremism this ridiculous notion that SST's would cause skin cancer.

Well, I want to tell you why it is not ridiculous, and that this is an example of a fallacy on the other side, the suggestion that there is no evidence that there might be biologically adverse consequences from increased ultraviolet, from decreased ozone, from increased water vapor—I will go over that chain after a bit—is a fallacy. The evidence, as I will try to point out, is disturbingly strong if not conclusive. I say no more about that second point because I want to come back to that in just a minute.

## THUNDERSTORMS

Here is another one that you have heard. I was talking to a Midwestern Congressman yesterday. He wanted to talk to someone who had a look at these problems and was kind of on the outside. He told me that in his home area some of the workers who have kind of a stake in some of the SST decisions were badgering him and bringing up the "thunderstorm argument" as an example of why he really shouldn't be telling them about environmental hazards.

Well, the thunderstorm argument, which I can read from this brochure that I have—he had been given this—published by the Aerospace Industries Association, February 1971, I saw this version for the first time yesterday, but I have seen the same argument in many publications, including Boeing publications and I think DOT publications. Here it is in this form.

"Contribution of Water to the Stratosphere"—that is from SST's—"would be insignificant. A world total of 1,600 transocean SST flights per day would put about as much water into the stratosphere as a single large thunderstorm, and there are 3,000 to 6,000 such storms around the world every day."

Now that is so strange an argument, viewed from the point of view of somebody in atmospheric physics, that I hadn't realized the importance of thinking out all the foolishness about that, and my statement isn't really a full summary of some of the curious errors in that point. But having been told several times that a lot of Congressmen are being given this one as a good example of why environmental concerns are negligible, I at least said something in here on pages 9 and 10, and here is the point.

First of all, when any of the people like the SCEP, MIT group, or the things I have done or Boeing or what have you—when any of these people start talking about water vapor effects on something like ozone, they take observed measurements of the existing amount of water vapor that is up there in the stratosphere, and that counts every process, including whatever little bit thunderstorms contribute to that. You have already factored into the problem anything like this that is the basis of this misleading argument, when you take 3 parts per million by mass or 5 parts per million by volume, as your reference, and start saying how much will we add on to that. That is all in the picture. That is the first and really a sufficient point to make.

More than that it illustrates a kind of misleading, casuistic treatment to those of us who look at this from the outside and are bothered by so much of this. Here is the point.

We don't follow every thunderstorm with radar, but there has to be a lot of data. Some of the data was gathered by SST people for very obvious reasons, and it is a fairly rare thunderstorm that even gets to the tropopause at around 45,000 feet. They get there but they are rare. A Kansas squall line will very often put a tower above 45,000 feet but not by very much. Even in the equatorial region where thunderstorms build higher the stratosphere builds higher, too—around 48,000 feet. The first point is that it is maybe less than 1 percent of all thunderstorms that get up that high. When they get up that high, they en-

counter a region of such stability that they push through and sag back. It is a question Boeing, DOT and the Aerospace Industry Association don't even confront to try to decide what tiny fraction of the top of the thunderstorm gets turbulently mixed into that stratosphere. All of those important details are just ignored.

The suggestion then that these three thousand or so thunderstorms that are found around the world per day should be multiplied by this other figure is just all wrong. Less than 1 percent of those would get into the bottom of the stratosphere. The bottom of the stratosphere doesn't count because that has a turnover time that is very much less than what it is at 60,000 feet. And in any event, if those thunderstorms were poking up with such vigor and frequency to anything like SST altitudes, so that they fit this apparently widely used fallacious argument, Boeing had better not bother to build the SST because they will never be able to fly through those skies if there are that many thunderstorms. Hail storms that got up to 60,000 feet would be a very, very serious operational and navigation problem. This has been checked and it is quite clear that they will not have to worry many times out of a year about encountering a thunderstorm anywhere near cruise altitudes.

Well, it obviously takes a few moments to make some sense of the counterarguments, but there are lots more, and this problem just hasn't received that kind of critique from the other side. If I seem a bit exercised about it, it is because I keep going over these, not this one particularly—it was so farfetched I am not paying much attention to it—but I am exercised because of the Congress and the public unfortunately haven't gotten a clear picture of many of these complexities.

#### AMOUNT OF POLLUTION

No. 4, SST pollution effects are unimportant since they will constitute only about 1 percent of the pollution from other technologies. That is almost a direct quote from a Boeing brochure widely distributed. The figure shows some cars down below, an SST above and the caption talks about this figure of 1 percent. Well, it is an example of the kind of reasoning that puts two entirely different things together, almost an apples and oranges comparison. They are really talking first of all, about hydrocarbons and carbon monoxides and things like that that don't come out of the SST in huge amounts, and so the actual facts are properly stated as put there, but I didn't ever realize anybody was very much worried about the SST as a low altitude polluter. There may be some people, but the present jets, of course, are already a bit of a problem there and this wouldn't change that part of the problem.

Furthermore, the heart of the problem is that if you concede, as Boeing does in this—just to make a little play with the Boeing argument here—that the SST's are going to contribute 1 percent as much pollution as all other transport technologies. Then you multiply that figure by this one-hundredfold greater sensitivity that I called your attention to—keeping in mind that the bulk of that emission is up in the stratosphere—it just comes out the same total figure, 100 times 1 percent being 1. You have the net effect—though I don't push the

argument too far, I just want to point out how incomplete their argument is—you end up with the conclusion that the total pollution emissions are about the same when measured in terms of holdup times and how it pollutes the atmosphere. You have got to look farther than many of these arguments and that is an example of that particular one.

I haven't had a chance to talk with Senator Goldwater from my State, but on the Senate floor, I guess it was a month and a half ago, maybe a little more than that, Senator Goldwater had gotten this idea garbled. I mentioned this as the sort of thing that can happen when you put out this kind of superficial misinformation. It came out in the Congressional Record in the following form: that three automobiles going down the highway at 60 miles an hour would emit more water vapor than the entire fleet of SST's.

Well, that came from that little Boeing brochure, and it changed from pollutants, which Boeing meant as things like carbon monoxide and hydrocarbons, to water vapor, which is not true at all. There is about a millionfold difference there, much more than a thousandfold, and it was changed to the whole fleet, so this sort of thing is an example of how one thing leads to another. It has not been a good critique of these problems. I tried to get in touch with Mr. Goldwater's office just the other day to clarify it, but I haven't been able to yet.

I think the moral there is you have to watch these oversimplified arguments because people will get oversimplified and garbled conclusions.

#### UNITED STATES AND FOREIGN SST'S

Here is another statement that I think is a fallacy of a different sort. If SST's are going to pollute our atmosphere it is better to have it polluted by U.S. SST's than by the same number of foreign-produced SST's. There is an understandable idea behind this. What I want to point out is it doesn't matter at all if there are hazards. For instance, when I get to this skin cancer hazard that as I will point out, if it is a real hazard it will be primarily our concern regardless of whether they are all Russian TU-144's, Boeing SST's, or not. Anybody flying a major fleet of SST's in our Northern Hemisphere is going to lay down by the time the mixing process occurs in a year and a half—it has got plenty of time, in fact it mixes in a few weeks, a month or two, the mixing smears out the stuff all in the middle Northern Hemisphere.

If it is our water vapor interacting with the ozone, our sulfates and so on, it is no different to us or the native of Azerbaijan if it is a British Concorde or a TU-144. Here we have a pollution problem if we have one at all. It is either/or. They have to worry about the Concorde, we have to worry about the SST. It is really interjecting a purely irrelevant point though one that sounds OK at first blush, saying let's build them. If they are going to pollute we might get the revenue out. That is backward. Let's look to see where the problems are and then go at this in a very general way. You could fly all these 500, 600, depending on the figure you use, SST's in a very tight circle in the Atlantic Ocean, the Pacific, anywhere in the Northern Hemisphere effectively, not in the Southern, and that would change things meteorologically, all in the middle of the ocean, north and south, it doesn't matter, the smearing action of dispersion mechanism, cyclones, and all the rest spreading

in the year and a half holdup time will get it all over the Northern Hemisphere and you have got to look at it that way.

#### ENGINE EXHAUST

The sixth point here, I wasn't quite so keenly aware of this until I was again queried by a Congressman who seemed to be very eager to talk to somebody who has looked at these problems and isn't working for Boeing or DOT, as nearly as I can tell. There seems to me a very urgent appreciation of the need to at least hear somebody who has a different slant on the whole problem. It is suggested in this sixth point, which I think is fallacious, that the sensible and conclusive way to sort out all these questions about SST and environmental effects is to build prototypes, fly them in the stratosphere, and make direct measurements to settle these uncertainties. I can think of one problem which worried me a great deal in November and October which I now back away from because the unknowns are too extensive.

The nitrous oxide is really the one emission of the SST's at cruise levels whose amounts are somewhat uncertain because the GE tests at Ohio, static tests on the ground, can't readily be extrapolated to full mach 3 flight levels at altitude. They have made the extrapolation for us. I have talked this over with the GE people at length. We have the best figures. I am mixing my viewpoints here. When I say "we" I am talking frequently about the panel but I am pointing out here that we had to go to GE and Boeing for a lot of data, and GE figures have been qualified as somewhat uncertain on nitrous oxide because it is difficult to extrapolate up to cruise levels.

If you could fly, not an SR-71, which we already have, but a real GE-4 at mach 2.7 at 60,000 feet and follow it with a chase plane—it would probably take a year and a half or so to work out the hardware—but if you did this then you would get direct measurements of the nitrous oxide emissions that are not laboratory extrapolations from the static tests.

I have now told you the uncertainty which could be really usefully illuminated, but I am afraid it is not crucial because I think from conferring with a lot of engineers in various universities around the country that the GE figures are reliable or believable. I don't even think that is crucial but that is the one thing that might be illuminating.

The sulfur dioxide—if you want to worry about the sulfates coming from ozone interaction—is strictly an economic factor. It has nothing to do in this case with any uncertainties at all. The question of whether the airlines will be able to purchase fuel that has a low enough sulfur content at the price they are willing to pay, and get it down to five-tenths, two-tenths, one-tenth percent is a question of economics, the economics of desulfurization of fuel. We haven't gotten very good answers but that is something that flying an SST around will just not illuminate at all. You don't need an SST. You need to nail down Esso, Texaco, and a few other people and get firm estimates of what fuel you can buy and then you tell me the sulfur content. It is something completely known. It oxidizes to ozone 2 and 3 in milliseconds.

The problem of the water vapor emissions which is very much of a concern to many of us to me is strictly a matter of how much fuel you burn. The oxidation of  $C_{10}H_{22}$ , or any type of fuel, gives a very accurately predicted amount of water vapor, roughly 1.4 pounds of water vapor for every pound of fuel you put through every one of those engines. You don't need to fly any of those planes to improve on that figure. The uncertainty is over an entirely different area where the existence of prototypes contributes nothing. It doesn't illuminate the problem. You need to get better reaction cross sections for the certain key chemical reactions in this photo-chemical active layer. You need to do a lot of work on cancer research as I will turn to very quickly. You need to look very carefully at a lot of optical phenomena and thermal reactions from particulates that might be absorbing from these altitudes. All of these are in the area of computer laboratory theoretical studies and so on. To state it again—really only one question of now probably secondary importance would be illuminated by having prototypes. Again I think that has been misunderstood.

#### THE SKIN CANCER ARGUMENT IN DETAIL

Now let me take one example to look here at what we have to worry about in the way of hidden problems. Let's take one of these fallacies and examine it more carefully and I will show you that when Senator Jackson said it is ridiculous, or when other people say skin cancer in SST, what kind of a "kooky" idea is that, they just haven't heard this disturbing argument.

Unfortunately, though we briefed DOT on this 3 months ago—everything I am going to say to you now was said really in more detail to DOT and many of the people who were in the group that heard me are right behind me—I haven't heard anything from them since that time. There hasn't been anything that came out from them that got over to this side. I made a strong plea on November 30. Why don't we now go tell Congress where we are? It was felt that well, we had better go a little further along, and check some of these things, and this and that, and I again made further pleas. That is why I do not speak for the Academy or for a panel.

I was invited here by Congressman Yates to talk about these things. I feel no compunction in telling you what I have done. But you haven't heard and Senator Jackson hasn't heard about skin cancer and I am afraid it is the largest single hazard that may lie ahead. Not 100 percent certain, but when Mr. Magruder said this morning he hasn't heard a scientist who laid before DOT—I forget how his wording was—any serious environmental problems—it is true he wasn't able to be there that day but 8 or 10 of his staff spent 3 hours when I went over this with them. They have heard about this.

Let's look at skin cancer and see what the problem is here, and why it is not "kooky," it is not nutty, it is not ecological extremism. It is physics and chemistry, photochemistry, cell biochemistry, atmospheric physics.

There have been other examples of unanticipated environmental problems. Who thought DDT would do some of the things that it does, when we first started applying it? Who would have thought that vari-

ous technologies would put mercury out in codfish and tunafish in the way those technologies did? Who would have thought that antiknock, which was such a boon to driving cars from 1920 onward, in fact put lead in our environment to an extent that may already have gone beyond the safe point, and so on? There are many examples of this.

When you have a technology like this, and first examinations of the problem have overlooked, failed to find, a problem, there is nothing new in that. It happens all the time. That is the difficulty. The little amount of work that has been done by Boeing and GE and DOT and others, and this very little attention we gave in our report in 1966, would inevitably miss all kinds of points.

#### OZONE CALCULATIONS

How I got on to this one is as follows: The MIT SCEP group used the ozone calculations of Dr. Julius London at the University of Colorado, London and Park, published in the SCEP report, which some of you undoubtedly have read, a figure of about 2-percent reduction in ozone from interaction, chemical interaction with water vapor from SST's, over and above the natural interaction effects that are influenced by all of the processes that get water vapor—including the roughly 1 percent due to thunderstorms, to make that point again—over and above all of those interactions, the SST's will add maybe 10 percent more water vapor in the steady state. We are always talking about the steady state differences here, and that was the kind of figure that the MIT study group, the SCEP group, came up with, and Dr. London's figure was about 2-percent reduction in ozone.

Subsequently one of the few things that Boeing has done that really represents any kind of a detailed analysis of environmental hazards is Halstead Harrison's publication in *Science*, November 13, 1970, of a short note on ozone reduction by water vapor. His figure is twice as large, 4 percent. When I come back to get my numbers, mind you, I am going to use one-fourth of the Boeing figure. I am only going to talk about a 1-percent reduction, what a 1-percent change in ozone would do. That is a fourth of the Boeing figure, a half of what is published in this figure; and I will tell you that already there are difficulties ahead if the argument unfolds in the way that it seems to me that it will.

Well, these difficulties I have talked about with MD's; I have talked to groups in the cancer hospital at the University of Texas, Temple University, Baylor; and this has been talked about. Again there is a difficulty here in pointing out just how it was reviewed within the Academy, but all that I am about to point out is not something that hasn't been laid before many scientists in many parts of the country, and it comes about as follows.

#### WATER VAPOR AND OZONE

Water vapor gets involved in these complex interactions with ultra-violet quanta, and water vapor is broken up into hydroxyl radicals, to run through it quickly to give you some idea of the lingo here. The hydroxyl radicals will interact with the ozone that uses up the ozone, decreases the ozone. The ozone in the stratosphere, as portrayed in that diagram, is the only difference between being exposed to all of the

solar ultraviolet, which would do us in in a very short time, and being protected quite extensively in the shortwave lengths where DNA and various cell biological entities are extremely vulnerable to ultraviolet quanta.

Two thousand nine hundred angstroms is the cutoff from the ozone layer. If we didn't have that cutoff we wouldn't be here. The water layer will reduce the ozone by what seems a small amount—and I will tell you why it seems so small—but you put that through an argument and you get skin cancer incidence figures that are not, I submit—it is just my opinion; you have to evaluate all parts of this, too—it is not negligible, because my estimates are five to ten thousand new cancer cases per year resulting from a 1-percent reduction in ozone. That is as I say, one-fourth of what the Boeing figures themselves would give.

The burden would be borne on the ground. It has nothing to do with the people who fly in the jets. It is the people on the ground, primarily farmers, ranchers, people outdoors who over the years have always been the people vulnerable to skin cancer, and not the pilot or anything else. It is down on the ground, and it is just as bad for you and me if it is a TU-144 that is laying this down. Whether it is American water vapor or Russian water vapor, it is all water vapor, and it is the sort of thing which, if we go to a big technology and maintain this for 10 or 15 years, we will have some serious trouble.

Well, here to run through the arguments very quickly, but I am running over my time here, and I can't give you a full summary of what is in the submitted statement here, but it goes as follows.

#### NORTH-SOUTH GRADIENT

There is a marked north-south gradient in skin cancer and the bottom panel over here displays a figure that is based on public health data, cancer surveys of 1947. Across the bottom of that is latitude and vertically is incidence of skin cancer, new cases per hundred thousand population per year. If you are from Chicago, the figures are over on the far right at latitude 42 for both male and female squares and circles—there were around 25 new cases per hundred thousand per year lesions of skin cancer—but if you were a male, an average male in New Orleans, it was something like 125 per 100,000 per year. The latest data from my part of the country, where we get so much sunlight, and we have less ozone than most parts of the country, is 500 new cases per year, 20 times the Chicago incidence, because of the solar ultraviolet that is so intense and because of the exposures.

The main message of that diagram is the slope, high amounts at low latitudes, lots of skin cancer, about 10 times more than in the northern territory of States. Part of that is due to difference in sun climate, cloud cover, and so on. A little bit of it is due to sun angles. Some of it is due to the amount of time that people spend outdoors, and a fair share of it, as I will point out now, is due to a gradient in ozone, and I don't have figures to show that, but this is very familiar to people in atmospheric physics—ozone average amounts decrease from high latitudes to low latitudes. That difference in the amount of the filter is what lets more ozone through on the Texas rancher than on the Montana rancher, and so on, and it is the Arizona rancher,

the Floridian who shows up with skin cancer earlier and with more lesions than the Canadian or what have you.

That figure is basic to the argument here. It is documented by many other data from other parts of the world. The gradients are strong enough that recently in England, the difference between north-south England has been identified in this sense. Just across Japan you can see differences in incidence of cancer, and within Texas alone there are discernible increases southward from this.

Well, that is the first point, ozone differences. I will not take time to go through all the arguments, but mainly growing season differences between high and low latitudes put northern farmers out in the open about half as much, let's say, as southern farmers, and all of these things are together with a factor of about two. Let's tentatively talk in terms of half of that gradient being due to factors other than ozone.

Well, the relation of the solar ultraviolet, which is what we are talking about in this SST problem to skin cancer shows up in a lot of ways. On pages 15 and 17 and 18 I run through a lot of examples. It is the outdoor people that present symptoms of skin cancer. All of this is well documented in the dermatological literature. About 90 percent of the lesions are head and neck. That means clothing differences are unimportant. The face is the main target, and it is the part of the body that is exposed. Basal, squamous cell, carcinomas are rare in the back and common on the face, males more than females by a factor of 15 or 20 percent, and greater than that in some parts of the country. Men are outdoors more.

Light complexioned persons show with many more skin cancers than dark. It is curious that in Arizona the Indians, who spend a great deal of time outdoors in the Navajo Reservation average one-fiftieth of the skin cancer incidence of caucasians like myself in Tucson, a factor of 50 from the difference in melanization of the skin. Biological protection mechanisms differ.

The blue-eyed, fair-haired sunburner is the guy who gets skin cancer. This is well established, particularly if it is an Irishman for reasons that I can't go into.

One of the most recent scientific arguments about this has more clearly implicated DNA as the target, UV as the missile. Is a very rare disease called xeroderma pigmentosa which I paid no attention to until talking to biological people around the country, at Stanford, and so on, who told me that the best evidence is the literature on pigmentosa. I have read it. It is fascinating. It is a rare genetic disease. If you are born with this disease, you are dead from cancer by the time you are 8 or 10, because you lack, it is now quite clear, a genetically, evolutionary contrived and genetically maintained enzyme system, which moves up to a damaged DNA molecule after an ultraviolet quanta damages it, thymine dimerization, some of these terms are discussed in here.

I won't explain them here, but it cuts out the thymidine, dimerized thymine and fits in a new one like putting a new generator off the shelf in your Ford. This enzyme system is controlled by enzymes and the xeroderma pigmentosum individuals don't have those genes. Kids 5 years old are covered by lesions and are dead by 10. The evidence

biological and otherwise that ties that to this whole argument is extremely closely related to SST problems. There are lab experiments on animals that established this, not nearly as many as you would like. That is one of the sadly needed areas of research. I can say a lot more about that, but the main point is it is known that ultraviolet quanta 3,000 angstroms give or take 100, are the ones that do the mischief.

#### HIGH RISING INCIDENCE OF SKIN CANCER

The last point is that in many parts of the country there is disturbing high and rising incidence of skin cancer. I have learned a great deal about a subject I didn't know anything about. I lived in Arizona 15 years, had no idea that this was one of the worst places—there are no Arizona Congressmen here—I didn't realize that for many of the Irishmen that is one of the poorest places to go. The place in El Paso, the epidemiological data shows a threefold rise in skin cancer incidence among women, tied up, it is believed by the Texas people, with changing sports, recreation, clothing habits, and here then we have one more indication of the problem.

You think you are going to be able to persuade the people to put on hats, wear long sleeved shirts, not play golf and go swimming, in order to take a differential ozone ultraviolet effects from SST's? Maybe you can. I doubt it from looking at the cigarette experience.

Mr. YATES. Doctor, would you please explain a little more slowly and clearly how the SST relates to this?

Dr. McDONALD. I went through it very quickly so I will now do it again.

Mr. YATES. No; it is very important.

Dr. McDONALD. I realize that I am speaking very rapidly.

Mr. YATES. You are.

Dr. McDONALD. And I am sure that the gentleman transcribing over here is strapped, but the difficulty is there is a lot to be said here. It hasn't been said to any congressional audience, let alone the public, and this is the first time these months of research have had any airing, and about that I am happy. I am trying to give it to you too fast.

Mr. McFALL. Doctor, do you give your lectures this fast?

Dr. McDONALD. As a matter of fact, I do. The students can look over the text and some of the notes afterwards. I would be happy to tone down but I want to get through with this and I am taking too long.

#### RELATIONSHIP TO THE SST

Mr. YATES. The reason I asked my question was because the committee is directly interested in this relationship with the SST and I would like to express again my interest to find out why the SST may be a dangerous instrumentality.

Dr. McDONALD. You have asked the question just at the right time because I was about to go into a little more detail. Water vapor comes out in huge quantities from the SST because it is a product of the combustion of the fuel. It is a very large amount in tonnage but it is not a very large measure against the natural amount. It will produce about a

10 percent increase, by my figures—and other figures are in fair agreement with this—in the average water vapor content of that naturally dry stratosphere. That increased water vapor will interact with the ozone, the source of so much of the chemical reactivity, and it will use it up to some extent. The water vapor eats up the ozone.

Now, the ozone is the filter that traps the ultraviolet from the sun in the shorter wavelengths which are biologically just intolerable and it lets very little radiation through, shorter than 2,900 angstroms, but as we change the ozone content by a little bit—1 percent is the figure I am using for design calculation purposes—1 percent reduction of the ozone actually that would occur from a mere 3 or 4 percent change in water vapor. My figures say 10 percent. So I am staying on the conservative side, or trying to. I may not have been. I am trying to, and DOT didn't have any argument with my figures and we went all over these parts. I am not saying they okayed the biology because they did not know about it at that juncture, but no argument with these kinds of numbers.

The ozone decrease lets more ultraviolet through. Ultraviolet is now, from the biomedical research of 30 years, and particularly a lot of work in the last few years, almost incontrovertibly implicated as the cause of skin cancer.

So I walk around or a Bedouin—let's take a Caucasian because we have to worry about them, an Englishman, let's take a Caucasian who is lower middle altitude. In Sweden it won't be so bad. Or in Canada, but you or I walk around and we get more quantum per year or per lifetime of the high energy condition that you can call DNA damage.

The full mechanism of carcinogenesis is not fully understood but will lead to increased skin cancer. The question is the numbers in that. What if it produces one skin cancer case per year? That wouldn't be serious. But if my numbers, and I think I am conservative, are close to being correct at 5,000 or 10,000 cases a year I think the public when it understands that this is not ecology extremism, is not a nutty guy off some deep end, will have a second thought about whether we do dare get high altitude major transport technologies that burn any kind of hydrogenic fuel. You can't combine methane or hydrogen because it will be worse. You are going to get water vapor out of any hydrogenic fuels. It will get worse the higher we go. The question is, okay, so what? How many numbers? And I would like to have plenty of time to tell you all the rest of the details.

The point is I first went at the scope of this experience with the skin cancer and allowed a factor of half right away for nonozone effects and then calculating from that and the known sun angles and the known absorptivity of ozone—all these parts of the data are fairly good—I got a conversion factor for what 1 percent change in ozone will do in terms of chances of skin cancer. At that time that is fairly empirical and it is a means of leaping across the unknowns, and then I came back and went at it after getting my answer. The answer was that there appeared to be an amplification factor between fivefold and tenfold from some source, and I didn't find it in the literature of carcinogenesis but I will tell you what I think it is, and a lot of MD's have had a chance to cross-check me on this. The figure I got was fivefold to tenfold. Six was the number I used in these notes. So that a

1-percent change in ozone will give a 6-percent increase in skin cancer over the whole population.

Now, the American experience with skin cancer in the last American Cancer Society report was 120,000 cases per year. This is morbidity, not fatalities. Six percent of 120,000 is about 7,000 cases, so staying on what I regard as the low side I come out with like 7,000 cases and what it was based on was that sixfold amplification factor which I derived from those kinds of data.

Now, one doesn't like to deal with such arguments. You want to have mechanisms. You want to understand why. That is a number, but why? I talked to cancer people and it was really quite surprising the cancer people who were mostly unaware that there was an ozone difference in high and low altitudes.

There has been very little thinking about the mechanisms at this level, at this intermediate process, the mechanisms in relation to the atmospheric effects, so I was on my own and puzzled over this for some time. The real clue to it was some of this recent work that so clearly involves DNA; the absorption spectrum of the DNA in the skin is believed to be the target molecule. It peaks up at around 2600 angstroms, so just in this indicated band of wavelengths of the solar ultraviolet and right in that same region the absorptivity—I hope I am not giving you so much detail I am snowing you here, but the point is there is this last argument. Ozone activity changes very rapidly, and it is from the exponential absorption law basically that you got this non-linear amplification that can account for this empirically derived six-fold factor.

Now I have said it but I am sure you didn't follow it. However, I won't say it again unless you ask me a question about it. But the point is, that supports the argument disturbingly, in my opinion.

Mr. YATES. How do we test it?

Dr. McDONALD. You have to do a lot of things, unfortunately.

Mr. YATES. Is it going to be covered by what Mr. Greenfield proposes to do?

Dr. McDONALD. Not to my knowledge. This whole problem has not been laid out before anybody, really, and I haven't heard that DOT has initiated any action on it. They haven't even come back to me in 3 months with any queries. But if your question is, what can we do, there are some things I can talk about.

Mr. YATES. The chairman admonished me that I should let you finish.

Dr. McDONALD. That is very good of him in view of the long-winded approach I am using here, but the answer is that there are some very definite things but they are not going to be done in 3, 4, or 5 months. It is again work we should have been doing years ago, but I can tell you about that if you ask me later.

OK, that concludes it, and I am through, then. The conclusions are summarized back near the end. I will say no more about the detailed physics, the cell biology.

The most fascinating thing is the evolutionary aspects of that. We just can't stand that ultraviolet and the whole history of the evolution, it has been becoming clearer and clearer, has been a battle with ultraviolet. We always just barely won, and that is very interesting from a

scientific point of view and I greatly enjoyed learning about that in the course of this study.

My conclusion is that I think I stayed on the conservative side with my SST assumptions, my tonnages, my turnover times, my mixing process, and so on, all of those things. Then I believe I am on the conservative side by attributing half of this gradient to factors other than ozone. I am taking only 1 percent ozone change, whereas both my figures and all the other figures are two to four times bigger. That would mean something like 40,000 skin cancer cases per year if this argument holds up and yet I come out with a number which I—as just a citizen now—can't regard as trivial. I don't think that 5,000 to 10,000 new cases of skin cancer per year are a burden which can be written off lightly and be regarded as something that we dare just wave off and regard as ridiculous.

The burden would be chiefly borne by Caucasian Americans. The Bedouins of Africa, the Asiatic, the yellow-skin races of the world, the Indians, the blacks, the Mediterranean types, are biologically protected for, again, reasons that that stock evolved down here, but many of us came from up here, particularly Irishmen like me, and they have been transported to low altitudes like Queensland, and Arizona and Texas, and they don't belong there and those Caucasians which are mainly found now in middle or low levels in America—but not in north Africa, not in India, not in China—are the ones that are going to bear the bulk of the burden. Hence I have not extrapolated up from the 10,000 or 10 that I stated here to a much bigger total because I don't think it will be more than a factor of 2 or 3 for reasons of ethnic incidence of ultraviolet skin cancer. And whether the TU-144, or Concorde, or ours, it is a problem that will come back to us, if it is a real problem, and I believe it is, one way or another.

I believe I have identified here a problem that was overlooked. Problems like DDT showing up in the penguins or something aren't anticipated but there are these things that happen, and I think this is a problem that got overlooked.

Dr. London ignored it because he thought: what could a 1 percent difference or so mean when there may be a 10 percent difference between north and south latitudes and when day-to-day changes in weather can also produce a change in ozone. But that was too quick because the person who gets skin cancer has been UV-irritated for 10, 15 years, the lifetime of the SST technology, and it is the average over not 1 day that is important but the average over 10 or 15 years. To be sure there is a tenfold larger difference north to south in the naturally occurring radiation and some SST proponents have come up with an AEC-type argument that, "Well, that is only the difference of moving everybody 50 miles or so north." That is true, but nobody is going to move the population of the United States 50 miles north. You are going to take the same population, shift all those cases of skin cancer and you get the 10,000 cases I am talking about, so you have to be ready to wear shoes and long-sleeve shirts or to wear cosmetic preparations.

One of the things I learned was, that there is suspicion that benzophenol in a suntan lotion is a carcinogenic so you won't solve this problem with cosmetics.

One widely known scientist is very concerned about the benzophenol, about skin cancer, because it triggers UV action on DNA, he thinks. The point is you aren't going to get people to solve this problem by wearing Stetson hats any more than the health people got everybody to stop smoking cigarettes.

The problem is whether we can really afford to jump into this kind of a technology when there is in fact, to correct Mr. Magruder, a scientist who spent a good deal of time and who has talked to his people about a population health problem which seems to bear rather direct but surprising relation to the SST.

I submit to you the warning that we had better check this very carefully. Thank you.

#### MCDONALD'S COMMENTS ON SCEP STUDY

Mr. McFALL. Dr. McDonald, we thank you for your interesting testimony. I would like to ask you a question or two. I am sure the other members of the committee will have a few questions to ask you also. We will have, as you know, other scientists coming who will probably be commenting on your testimony from their own point of view, and I would like to ask you a question which might give you an opportunity to reply in advance to what they might say about your testimony.

Were you a member of the SCEP study panel?

Dr. McDONALD. No; I wasn't on the SCEP group; no.

Mr. McFALL. Well, the chairman of the working group, Dr. William Kellogg, made a statement after the month-long seminar held at Williams College last summer, and when Mr. Ruckelshaus was here I asked him about his opinion of this statement, which Mr. Magruder had in his presentation this morning. I would like to read it to you and solicit your comments on it. Dr. Kellogg said in part:

I am very much disturbed over recent gross exaggerations and scientific misstatements regarding the SST's potentially harmful effects upon the atmosphere and man's environment. Last August a group of scientists at the MIT summer study stated that there are indeed environmental uncertainties, caused in no little part by gaps in available information, which require additional research in order that they may be resolved. I pointed out at that time and want to strongly reaffirm that there is no environmental reason to delay construction of the two prototype SST's.

What would your comment be on that paragraph?

Dr. McDONALD. Of course, Will Kellogg is out of date and that quote from Kellogg is out of date in the sense that he hadn't heard about the skin cancer question at that juncture. As a matter of fact, Dr. Kellogg has never been in a group that I have briefed on this to date. Don't make any mistake about the prototype. Flying two prototypes will be no skin cancer hazard. It is when you are flying a total of 500 or 600, 700 SST's that you get emission levels that pose these problems. So that proviso in the statement makes it I think unobjectionable within that narrow sense, but it was made before there was any skin cancer question raised. The skin cancer question hadn't even been raised at this point.

Mr. McFALL. That leads me to another question. Was your 6 percent increase in skin cancer based upon 500 SST's?

## BRIEFING SUMMARY OF DR. McDONALD

Dr. McDONALD. I have copies, if the committee would like, of the briefing summary that I used in DOT which has all those numbers and it might be well—

Mr. McFALL. We can place it in the record.  
(The information follows:)

## TENTATIVE ESTIMATE OF SST EMISSIONS—WORKING ASSUMPTIONS (1985-1990+)

- (1) Equivalent number of U.S. SST's,  $N_e$ .  
Estimates for U.S. fleet now range from 540 to 900+ (C.R.A. est.). Use 500 here.  
Concorde production by ca. 1978  $\approx$  280 (DOT/FAA/UK).  
TU-144 production estimated at 120 (DOT/FAA).  
Concorde/TU-144 fuel consumption est. 17,000/23,000  $\approx$  0.75 times that of U.S. SST, so  $0.75(280+120) = 300$ .  
 $\therefore$  use  $N_e \approx 500 + 300 = 800$ .
- (2) Utilization factor,  $U$ .  
Present estimates run about  $U \approx 0.30 - 0.33$ .  
Cruise-mode utilization factor is smaller (6 hr./day), so here use  $U = 0.25$ .
- (3) GE4/J5, in cruise-mode uses  $F \approx 23,000$  lb./hr.  
(Begins cruise at 26,000 lb./hr., ends at 20,000 lb./hr. Information confused re augmentation).  
Use  $F = 23,000$  lb./hr.
- (4) Stratospheric residence time,  $\tau$ .  
Estimates from weapons-debris studies, etc., range from about 1 year to 3 years+.  
Effective  $\tau$  increases upwards. Slightly less for larger aerosols than for gases.  
Here use 1.5 years.
- (5) Area of dispersion,  $A$ .  
Past estimates have ranged from global to 0.1 global.  
Here use 0.5 global (No. Hem.), considering projected traffic geography, stratospheric transport, and seasonality factors.  
 $\therefore$  use  $A \approx 2.5 \times 10^{18}$  cm.<sup>2</sup>.
- (6) Average depth of mixing,  $\Delta p$  (mb).  
Depends on effective value of vertical diffusivity,  $K_z$ , near SST cruise level (20 km.).  
Past estimates for lower stratosphere run  $10^3 - 10^4$  cm.<sup>2</sup>/sec.  
Accepting larger value and using  $d^2 \approx 2K_z \tau$  suggests  $\Delta p \approx 150$  mb ( $\approx 150$  grams/cm.<sup>2</sup>).
- (7) Diluent mass,  $M$ .  
 $M \approx A \cdot \Delta p = 2.5 \times 10^{18}$  cm.<sup>2</sup>  $\times$  150 g./cm.<sup>2</sup> =  $3.8 \times 10^{20}$  g.
- (8) Stratospheric inventory of  $i^{\text{th}}$  emission,  $m_i$ .  
If  $e_i$  is called the emission coefficient for the  $i^{\text{th}}$  combustion-product (units, lb./1000 lb. fuel), then the average steady-state inventory (mass-increment in stratosphere due to SST operations) is  $m_i = N_e \cdot F \cdot U \cdot \tau \cdot e_i$ .  
And the incremental mass-mixing ratio for that emission is  $r_m = m_i / M$ .

Values of  $e_i$  in table below taken from GE memo of 10/6/70 to NAS/POWACM, except  $SO_2$  doubled tentatively

	A	B	C	D	E	F
	$e_i$ (lb/1000 lb fuel)	$e_i \cdot F$ (lb/hr)	Inventory (lb)	Inventory $m_i$ (grams)	Mass- mixing ratio, $r_m$	Volume- mixing ratio, $r_v$
CO <sub>2</sub> .....	3100	71,000	$7.1 \times 10^{11}$	$3.2 \times 10^{14}$	0.84 ppm	0.55 ppmv
H <sub>2</sub> O.....	1380	32,000	$3.2 \times 10^{11}$	$1.4 \times 10^{14}$	0.37 ppm	0.59 ppmv
NO.....	5.8	131	$1.3 \times 10^9$	$5.9 \times 10^{11}$	1.3 ppb	1.5 ppbv
CO.....	1.3	30	$3.0 \times 10^8$	$1.4 \times 10^{11}$	0.37 ppb	0.36 ppbv
SO <sub>2</sub> .....	0.4	9	$9.0 \times 10^7$	$4.1 \times 10^{10}$	0.11 ppb	0.04 ppbv
HCs.....	0.3	7	$7.1 \times 10^7$	$3.2 \times 10^{10}$	0.08 ppb	~
500c.....	0.04	0.9	$9.1 \times 10^6$	$4.1 \times 10^9$	0.01 ppb	~

PRINCIPAL REACTIONS IN OZONE-H<sub>2</sub>O SYSTEM (z < 50km)

[See Work of Hampson, Hunt, Leovy, Shimazaki &amp; Laird, London &amp; Park, etc.]

Reaction	Rate Constant (CM-Molecule-2d System)
1 O <sub>3</sub> + $\gamma$ → 2O	} Basic Ozone Photochemical for Dry Stratosphere. { $\lambda < 2420 \text{ \AA}$ , O = O (4F) $k_2 = 7 \times 10^{-11} \exp(890/RT)$ $\lambda < 11,400 \text{ \AA}$ $k_4 = 6 \times 10^{-11} \exp(-5700/RT)$
2 O+O <sub>3</sub> +M → O <sub>3</sub> +M	
3 O <sub>3</sub> + $\gamma$ → O+O <sub>2</sub>	
4 O+O <sub>3</sub> → 2O <sub>2</sub>	
5 O <sub>3</sub> + $\gamma$ → O*+O <sub>2</sub>	} Source of Hydroxyls in "Wet" Strato- sphere. { $\lambda < 3100 \text{ \AA}$ , O* = O (1D) $k_6 = 5 \times 10^{-11}$
6 O*+H <sub>2</sub> O → 2OH	
7 OH+O <sub>3</sub> → HO <sub>2</sub> +O <sub>2</sub>	} Self-Regenerative Chain Consuming O <sub>3</sub> in Wet Atmosphere. { $k_7 = 5 \times 10^{-12}$ , HO <sub>2</sub> = Peroxy $k_8 = 10^{-14}$
8 HO <sub>2</sub> +O <sub>3</sub> → OH+2O <sub>2</sub>	
9 O*+M → O+M	} (Fast-Quenching Reaction.) { $k_9 = 7 \times 10^{-11}$
10 OH+HO <sub>2</sub> → H <sub>2</sub> O+O <sub>2</sub>	
11 OH+OH → H <sub>2</sub> O+O	} Principal Terminators for OH and HO <sub>2</sub> Radicals. { $k_{10} = 10^{-11}$ $k_{11} = 3 \times 10^{-11}$
12 OH+O → O <sub>2</sub> +H	
13 HO <sub>2</sub> +O → OH+O <sub>2</sub>	} Terminate "Odd Oxygen" Molecules (O, O <sub>3</sub> ) But Not "Odd Hydrogen." { $k_{12} = 5 \times 10^{-11}$ $k_{13} = 10^{-11}$
14 H+O <sub>3</sub> → OH+O <sub>2</sub>	
	(Imp. in Mesosphere, Not in Strato- sphere.) { $k_{14} = 3 \times 10^{-11}$

## SOME OTHER REACTIONS RELEVANT TO SST PROBLEM

A N <sub>2</sub> +O <sub>2</sub> → NO+N	} Zeldovich Chain Forms NO in Engine (Consumes O <sub>2</sub> ) { $k_A = 10^{-10} \exp(-75,500/RT)$ $k_B = 5 \times 10^{-11} \exp(-8000/RT)$ $k_C = 1 \times 10^{-12} \exp(-2500/RT)$
B O <sub>2</sub> +N → NO+O	
C NO+O <sub>2</sub> → NO <sub>2</sub> +O	

## NOTES

- a. Improved values of  $k_4$  and  $k_7$  disclosed (ca 1965) defects of "dry model."  
 b. In dry atmosphere only R-4 terminates odd oxygen; R-3 merely cycles with R-2.  
 c. R-9 competes with R-6 for (O<sup>≡</sup>O<sup>•</sup>D) atoms, consuming majority.  
 d. Shuttle-chain R-7 and R-8-a would consume all O<sub>3</sub>, except R-10, R-11 compete.

Mr. McFALL. Where did the 500 figure come from?

Dr. McDONALD. I took it from congressional testimony. I have it in my briefcase but it is congressional testimony, testimony from DOT and FAA, the estimated 500, 500 or so Boeing and 280 Concorde, and 120 TU-144's projected to, I guess it is 1985, allowing then for the lower engine output, fuel consumption rate of those two foreign engines, and corrected back to the equivalent of 800 SST's. So my numbers are based on 800 SST's. If only a total of 400 go through, cut those numbers in half. Actually, some estimates for the U.S. fleet have gone to 900 and all these things we all realize are all highly, highly tied up with economic factors, but that is the answer to that.

## COMMENTS ON DR. KELLOGG'S STATEMENT

Mr. McFALL. Now I would like to read the other paragraph in Dr. Kellogg's statement:

It is my profound hope that the U.S. Congress will not be misled by these exaggerations or by scientific misstatements. Dr. Ed David's statement, which Dr. Walter Roberts and I strongly endorse, says it well: "Let's not suppress technological advances but through research, development, and experience make sure that those advances are obtained without undesirable side effects." I support a vigorous environmental research program in parallel with prototype SST construction. Don't downgrade the ability of American scientists and engineers to apply their genius to the successful resolution of uncertainty.

Dr. McDONALD. That is, of course, what we are all trying to do. Let me make this comment on that statement of Kellogg's. The National Academy of Sciences published a very important report related to technology assessment only about a year or two ago. One of the major points of this very cogent analysis of past instances where technologies led to unanticipated difficulties was this point: that we need to be on the alert and to develop better systematic means of detecting poten-

tially adverse side effects early enough that the technology doesn't get beyond the place where total investment, inertia, and total involvement makes it irreversible.

You are a better judge of where we are in the SST reversability arguments than I, clearly. I would have my opinion. It wouldn't be as good as yours. But I think that is a very important generalization that we all have to worry about and what I am submitting to you as a scientist talking before this congressional committee, is that a good many months of research on this problem imply a sufficiently serious problem with respect to the skin cancer question, that I would think it would be rather dangerous to risk going beyond the no-return point in going to prototypes. So I have answered the question, but that is as much of a citizen's comment as Dr. Kellogg's. Neither of us is really entitled to any unusual statement on that. The problem of assessing technological hazards early is a very crucial problem and we are right up against, I think, a question like that here, and it is a national and a public policy question of what do you do with SST technology like that, if these numbers stand as much scrutiny as I think they have already gotten from people around the country. What are you going to do? That is your problem. I will read in the newspapers how you collectively react to that kind of a problem.

Mr. McFALL. Well, thank you, Dr. McDonald. You gave a very fair answer. I would say to you, though, that there is no special expertise or mental alacrity that comes with being elected to Congress. We have to arrive at the conclusions in the same way that you do, and we are very appreciative for your very fine testimony.

Mr. YATES, do you have any more comments?

Mr. YATES. Yes, I would like to say that Dr. McDonald is testifying at my request. I must say, too, that I invited Dr. McDonald with some compunctions at the start. Somebody told me about Dr. McDonald's skin cancer theory and immediately I shrank because most people would think that this is one of those mad scientists.

Mr. McFALL. Obviously, you are not susceptible.

Mr. YATES. Well, I have been out playing golf in Florida for a few days. At any rate, I checked with the National Academy of Sciences scientists, a number of whom I know, and I checked with other scientists and I said "Who is this fellow McDonald and what are his credentials?" and without exception they all said he was a very fine scientist.

I think what he did today was give us a 3 months' seminar in roughly 1 hour as a result of talking as fast as he did, and I am not sure that the reporter was able to get everything that he said.

But getting back to the SST and the ozone, you were correct in pointing out that this is not a two-prototype program. While it is true that it has been represented to this committee that all the Government has committed itself to, is the development of two prototypes, I think all the testimony that we have here indicates fleets of SST's for the future, so that the contractor can make profits and can pay the royalties to the Government that it says it wants to pay and so 100,000 or 150,000 people can be employed, and all the other glorious visions that were developed in the Magruder testimony, so you have a horizon of approximately 500 SST's certainly that are going to be flown. Testimony to our committee earlier was to the fact, that, if we stop the

SST there may be as many as 900 Concorde that will be developed and flown as a result of the lack of competition by the SST. What do we do about the Concorde, Dr. McDonald? What do we do about the TU-144? You may have been here yesterday when I said I had suggested to the President in a letter that perhaps we ought to sit down with Russia, and with Britain, and with France, and try to work out some sort of a testing before any of the respective countries would go into a production phase with respect to their planes, and of course the reply I received from the Department of Transportation was, that there is such an economic race on now for prior position in this aircraft struggle, that they aren't even going to approach the Russians, or the British, or the French. They don't think it would serve any useful purpose.

Mr. Greenfield, who was here yesterday with Mr. Ruckelshaus, said that he thought that they could obtain all the information that they needed to test the dangers in the stratosphere through SST flight, without the necessity of constructing the prototype, that it was essentially an economic question that had to be decided. I don't believe Dr. Greenfield, or anybody for that matter, has raised the question of possible danger through skin cancer resulting from the water vapor eating up the ozone, if I understood your theory correctly. Nobody has raised that as a possibility. I am impressed to the point of where I want to ask Mr. Greenfield, why this isn't being included in the series of experiments that Mr. Ruckelshaus is supervising, and that Mr. Magruder has said is being undertaken by the Department of Transportation.

How much time would it take to test your theory and what would have to be done for it?

#### OZONE REDUCTION

Dr. McDonald. Well, you have asked a question or two there. On the first point of what we do, if there is as substantial a carcinogenic hazard here from ozone reduction as I am suggesting, then we face a problem comparable to that which has been a difficulty for more than a decade, the international aspects of bomb tests, radioactivity as a global health problem, and we have with difficulty and slowness managed to begin to take a somewhat international look at that problem. Technology in general is getting to be an international problem and this is only one more example of many such difficulties coming up.

The whole reason I am here, for example, in Washington and happen to be able to accept your invitation to testify and quickly write up some notes, is that I am on a panel that is looking at hurricane modification. There is now a glimmer of hope that you can seed hurricanes with silver iodide and do some decent things. The point is, if you do that, then you have all kinds of international problems, and more and more technology is forcing us to look at the disturbance of the environment that goes beyond national boundaries. I can only say that we need to develop better means of sitting down with the Russians and the British and trying to see what will happen from the TU-144's and the Concorde, and SST's.

The first problem is, of course, to get a better clarification of this whole skin cancer question. You wouldn't go and start an international tribunal at this stage. But clearly that is the sort of thing that one would have to do.

## TIME REQUIRED TO TEST

Your second question was, well, how long would it take if one began to go at that. It takes a long time. You know that. It is also more expensive. You know that. The kinds of things that we have to get are large sample mouse studies.

If you go up to Dr. Fred Urbach at Temple, one of the leading workers in this area, and start talking to him about how easy it is to get sufficient mice to get stable statistics on the action spectrum of ultraviolet carcinogenesis, you have an interesting hour's discussion on the difficulty. There have been no large mouse sample irradiation studies in the country since 1942, a measure of the difficulty of getting good statistical data on that one control. I am just citing an example of the problem. It won't be done in 2 or 3 months. If you want to find out, if you want to start getting optical indices of a fraction and absorption coefficients for the sulphate-coated volcanic and meteoric particles that may result from SST deposit, you have got yourself a problem. It is not going to be answered in a few weeks, so I would think the kind of remark that Dr. Greenfield made and the one that was made by the Director of ESSA in examining the DOT package of proposed research which is not underway but kind of proposed—there is always the unexpected. The problem invariably has to reveal dimensions that weren't anticipated; so I would say if we could get meaningful and decisive decision-type answers on these in 3 or 4 years, we probably would be lucky.

Mr. YATES. Could you get it before 3 or 4 years?

Dr. McDONALD. Actually, there has been a fair amount of review. I am sorry that it really isn't in order for me to outline to you all the Academy mechanism that has been quietly gone through in the way of review of the skin cancer problem because it is not my place to describe it, but much more of it needs to be aired openly, the usual give-and-take, and a great deal of sizeup of this problem may even emerge from the fact that here for the first time it is laid out on the top of the table openly. That is obvious.

## OTHER POSSIBLE DANGERS FROM THE LOSS OF OZONE

Mr. YATES. I have one more question, Mr. Chairman.

Doctor, you said that as a result of the possible loss of ozone through SST flights there is the possibility that these additional skin cancer cases will result. Are there other possible harmful consequences that you foresee that might arise through the loss of ozone?

Dr. McDONALD. That is far and away the most important. The human significance of the ozone layer is that, the filtering action.

Mr. YATES. What about the possible damage to crops and things of that sort?

Dr. McDONALD. Plants are susceptible to ozone damage. That is well tested in the literature, particularly older literature, but the sensitivity of plants and the like to these UV wavelengths is distinctly less important than humans. The difficulty is we last longer. The crop matures and dies, and it only gets 3 or 4 months of sunlight. You and I soak up the quanta for 20 years. And there is a further difficulty. You say, What about animals? It turns out that in Arizona and Texas

spotted Hereford is cancer sensitive. In spotted Herefords it is a real long-range problem, but for most wildlife animals problems are non-existent here because they have evolved in the given areas like the Irishman who should have stayed in Ireland or like the Hindu who still does stay in India; they have evolved there and can take the local UV.

Mr. YATES. What you are saying is, Let's go slow before we authorize the production of the plane?

Dr. McDONALD. I think so, because of the very point I stressed more than that, that it is awfully easy to get beyond the point of no return. That is my feeling, and that is the reason I am concerned.

Mr. McFALL. Mr. Conte.

Mr. CONTE. Mr. McDonald, I can appreciate your concern about those ozones and skin cancer. I wonder if you could give us a dissertation on the effect of these lights here.

Dr. McDONALD. Carcinogenic.

#### PRESENTATION TO DOT AND OTHERS

Mr. CONTE. I know what effect they have had on my eyes. You mentioned that you made a presentation to the DOT, in November I believe—

Dr. McDONALD. November 30, yes.

Mr. CONTE. 1970; and very briefly what was the reaction to the presentation? Has there been any followup by DOT?

Dr. McDONALD. None that I have heard of, and certainly none that came to me; and since this whole problem is one that is essentially—I mean, I would be the one that I would expect would hear about it since I dug the problem up and developed this argument, and the fact that I haven't heard from them in the succeeding 3 months would be my only clue to what they have done, which would presumably be not very much. They have some advisory panels which may have done something. I have been asked by CTAB—Commerce Technical Advisory Board—which is working with DOT, to brief them on this sometime in March, but that is the first I have heard of that, so I don't happen to know. You could ask one of the DOT people for a direct answer.

Mr. CONTE. I will direct that question tomorrow morning. When will the report of the National Academy of Sciences Panel on the Weather and Climate be completed?

Dr. McDONALD. I am called upon to write this material up and then get back to a writing commitment on that report on a large range of weather modification projects, and I am a good person to ask that question. It will probably be about 2 or 3 months, something in that ball park, before it is at the end stages.

Mr. CONTE. Have you discussed your tentative findings with any other member of the Panel, and have any of them reached the same conclusion?

Dr. McDONALD. Yes. The entire panel hasn't met since all this came up. The last fall meeting of our panel was at MIT where we were briefed on SCEP and it was right after that that I began to dig into these problems. But the chairman of this panel is well aware of this, Dr. Thomas Malone. He was the one who organized the DOT hearing,

and there are other groups within NAS, within the National Academy of Sciences, who have heard this, but it happens that our panel, in full, has not.

Mr. CONTE. I rode pretty hard on William Ruckelshaus yesterday, the Administrator of the Environmental Protection Agency, because he couldn't give me any timetable on when they would make some tests regarding ozone and other problems and I was admonished for that. I wasn't blaming him but with all the years that they have been kicking this SST around I felt that some studies should have been made.

Dr. McDONALD. I am afraid I have to agree very strongly.

#### UNIDENTIFIED FLYING OBJECTS

Mr. CONTE. On the other hand, though I rode hard on him and others, I have to ask this because no doubt this will be brought up in debate. I believe, and I may be wrong, but I have been told that you are an expert on unidentified flying objects, or flying saucers. Do you think that these flying objects are extraterrestrial probes, vehicles or products of some technology other than our own? I recall that you did testify before the Congress that you believe the power failures in New York in the mid-sixties were caused by these flying saucers and I also recall that the Federal Power Commission found that the cause was due to a relay being set too low for the load which the line was carrying. I think it is very, very important to this hearing to determine how you came to that conclusion.

Dr. McDONALD. I didn't come to that conclusion. Congressman Ryan asked me a question on that and he worded it in the following way: Did I think there was enough correlative evidence of UFO sitings at the same time as power failures to raise a major investigation? My answer was essentially negative but enough of a correlation to be a little bit disturbing. That was the answer I gave in the House committee.

Mr. CONTE. Why would you think it would be disturbing? I want this for my own edification because it is going to be bandied around and I think we ought to know.

Dr. McDONALD. Why would power failures be disturbing?

Mr. CONTE. Oh, not power failures; rather, UFO's causing power failures.

Dr. McDONALD. You asked a question which I am prepared to talk about in far more detail than I am prepared to talk about the things you have just heard me discuss, as a matter of fact, and the reason for that hearing was that the Committee on Science and Astronautics wanted to get an evaluation from some scientist who had seriously examined the problem, and scientists from Northwestern and various places discussed the problem. I am very seriously considering the UFO problem, above all, after 3 weeks of careful study of Maxwell Air Force Base archives in Montgomery, Ala., the content of which was to me simply astonishing.

The number of Air Force radar cases, some of which have been in conjunction with power failures, to come back to your point, is really disturbingly large and whereas I have the feeling you are asking the question in a somewhat different context, my answer is very forthright that this is a problem which has been scientifically ignored by persons

who know practically nothing about it, but a close examination of the Air Force files and the kinds of detailed investigation that I have done of the problem leads one to be quite scientifically concerned about it, and I am fully on record about that.

Mr. MAHON. Have your views in connection with unidentified flying objects tended to open up a credibility gap in the scientific community?

Dr. McDONALD. I don't think so, not that I am aware of. I have discussed that problem with a very large number of scientific groups around the country. I suppose I have had plenty of chance to encounter answers to that question and, no, I think not. I think I have looked at that problem with about the same attempt to keep an open mind and go at it diligently as I have on this one, and I have a feeling that scientists have in fact, many of them, become quite concerned about the problem as a result of my attacking it, but it is not entirely clear that there is a relationship between SST's and UFO's.

Mr. CONTE. I think there is a relationship. I wish Mr. Yates were here. I voted against the SST last year. I am not certain now how I am going to vote on it, but I am probing everyone who comes before us. Certainly if you come up with a theory, and assuming I oppose the SST and I use you as an expert, it would be thrown against me on the floor of the House, and I must know whether your theory on flying saucers has held up and whether it did have any connection with the power failure in New York.

Dr. McDONALD. I have answered that question, of course.

Mr. CONTE. Do you understand my point? That is the relationship.

Dr. McDONALD. To some extent, yes; but take a look at the total block of testimony in that hearing which was mine, about an 80-page inserted statement in the House document that grew out of that. You have an excellent opportunity to examine the scientific address that I tried to bring to bear on that, and you would have no difficulty finding a large number of scientists around the country who know a great deal about my examination of that problem, who could give you a good reading on how thoroughly I have dug into it and why in the end I am concerned about that as a scientific problem. Yes, there is a connection in that sense. Are we talking about a nut? You used the term "flying saucers." You used the term "believe." I don't use those terms.

Mr. CONTE. I used "unidentified flying objects" or "flying saucers."

Dr. McDONALD. What I am saying is, the problem of unidentified flying objects is, in my opinion, indeed a very significant and serious scientific problem, the nature of which is very different from what the public and the Congress have been given to believe. The best place to check that is to go down to Maxwell Air Force Base, examine the Air Force archives, look at 20 years of records of which most of us have never heard, and you will see why the few scientists that know about this have been concerned.

Mr. CONTE. I wish I had that time, but just one more question. I wonder if anyone in England and in France—I should know this. This is the first time this theory has come forth about skin cancer.

Dr. McDONALD. Right, as far as I know.

Mr. CONTE. As far as I am concerned. Have they gone into this and would you give me some names, because certainly they are just about in the production stage of the Concorde. They have had four prototypes flying. Assuming that we don't allow them to fly in the

United States and the Congress decides to pass a bill, they are going to be landing in Montreal and Ottawa, so what you say is very significant, if it is true; whether they land in the United States or not, this is going to affect our country; right?

Dr. McDONALD. Right.

Mr. CONTE. So could you give me some experts so that I can look up the material in the Library of Congress?

Dr. McDONALD. You mean France and America?

Mr. CONTE. No, no; France and England.

Dr. McDONALD. There is no evidence that I have seen that anybody has recognized this as a problem in France and England. If you ask me for the names of some English scientists who are concerned with UV carcinogenesis, I could find some in the literature I dug into; but there is no indication that this particular problem has been identified and examined quantitatively to date.

Mr. MINSHALL. Mr. Chairman, I have only one question. The question on UFO's was brought up by Mr. Conte. I would just like to point out to you, Doctor, that I serve along with Chairman Mahon on the Defense Appropriations Subcommittee, and we have discussed the sighting of UFO's with the Defense Department witnesses who have appeared before that subcommittee. We have held secret hearings on it, we have held open hearings on it, and I think the hearings are now open to public inspection; and all the experts, both civilian and military, absolutely discounted any possibility of actual incursion into airspace by people from the outer planets.

Dr. McDONALD. Yes, I am quite familiar with all the open testimony such as the Rivers committee hearing in 1966.

Mr. MINSHALL. A lot of this was behind closed doors as well.

Dr. McDONALD. Well, are you asking for a comment on this? I am afraid that all of the indications are that the full measure of that problem has been no more laid before Congress than the skin cancer problem has been laid before you prior to today. It is one of those cases.

Mr. MINSHALL. We went into it quite thoroughly.

Dr. McDONALD. I would be most interested to have an opportunity to study the closed hearings.

Mr. MINSHALL. Thank you.

Mr. MAHON. We will stand in recess for a few minutes until the roll-call has been completed. Thank you.

Dr. McDONALD. Thank you.

(Recess.)

Mr. YATES. I think Mr. Steed wanted to question the witness.

#### STATEMENT ON U.S. OR FOREIGN SST'S POLLUTING THE ATMOSPHERE

Mr. STEED. On page 13 of your statement under item 5, you say if SST's are going to pollute our atmosphere, it is better to have it polluted by U.S. SST's than by the same number of foreign SST's.

I assume you attribute this statement to someone, but I do not recall having heard anybody make such a statement. What is the source of that quotation?

Dr. McDONALD. It is not intended as a verbatim quotation, but it is from a television program. I cannot recall the particular individual

who was involved in it. This is not a statement I am agreeing with. You understand I am saying simply that this assertion has been made.

Mr. STEED. I do not recall that that statement has been made in this committee hearing.

Dr. McDONALD. I do not think it has. It was made on a television interview that I heard about 2 months or so ago, that if there is to be a pollution problem, if you are going to have pollution anyhow, wouldn't it be better to have American SST's involved than being polluted by foreign SST's.

Mr. STEED. You are the first one I ever heard make a statement like that. If the SST is to pollute, if we did not have more than theory to back us up, we would not have very much chance of bringing world opinion to bear against all SST's regardless of their national origin. I was interested in where that came from.

Dr. McDONALD. I am sorry I cannot recall the particular person who said it or the program it was on. In any event, if you have not heard that before, concentrate your attention on the following discussion which does point out the main thing, that if there is a problem it will be an international problem, that it will have to be handled symmetrically all the way around.

Mr. STEED. As I followed the hearings, the weight of all the consideration here has been that if SST's are going to pollute, national origin has nothing to do with it.

Dr. McDONALD. We are in agreement on that.

#### OZONE REDUCTION

Mr. STEED. I tried to follow what you say, but I am not sure I understood it all. Apparently you do admit that some thunderstorms penetrate the stratosphere. Then, as I understood you, water in the stratosphere eats up the ozone. We have been having thunderstorms a long time, and apparently are going to keep on having thunderstorms. If they put water in the stratosphere and eat up the ozone, aren't we all doomed anyway, whether we ever have an SST or not? If water in the stratosphere eats up the ozone and thunderstorms, even to a small extent, put it there, there is bound to be a lot less ozone now than when the world started. Presumably, since no one knows any way to stop thunderstorms, it is just a matter of time until there isn't any ozone.

Dr. McDONALD. The answer to your question is that there is less ozone in the atmosphere under natural circumstances than there would have been if there were no water vapor in the terrestrial atmosphere. The injection of water vapor is only slightly due to thunderstorms as far as any available evidence would indicate. The bulk of it is due to slow ascent of moisture over equatorial tropical latitudes.

In any event, the point is that that water vapor that gets in the stratosphere does reduce the content of ozone and, in fact, this was how the whole water vapor effect was detected about 5 years ago by Hampson, a Canadian, Hunt, and others. They got improved reaction cross sections that go with the dry atmosphere ozone balance, and they did not check the observed water vapor. There was less ozone than the dry theory called for. Do you get the picture?

Mr. STEED. How long will it be before natural causes reduce the amount of ozone until we cannot survive on the earth anyway?

Dr. McDONALD. No, I am not calling attention to any cyclical trend and a steady rise. I am talking about the steady state, natural balance of all these processes, which include a little bit from thunderstorms, a lot from general equatorial ascent, maintaining on the average three or four parts per million, and nothing changes until you come along with technology and add to it. Then we talk about a change.

On your question, I would remark there was a puzzling increase which the Naval Research Lab has detected in recent years from balloon soundings, not understood. That is an apparently natural increase. But I am not directing attention to that. It is over and above any and all such factors that we come along with a new technological addition to it and get a corresponding small, seemingly trivial but in fact possibly significant reduction over and above all these natural processes. That was the point I tried to make.

Mr. STEED. I am not sure I follow. I have no way of understanding just what you mean by complex photochemical reaction between water and the ozone. Put that in lay language.

Dr. McDONALD. It is put in language on the dittoed sheets that I laid in front of you that represent the DOT briefing sheets.

If you would look on page 3, you will see a reaction scheme for roughly 14 photochemical reactions that have to be programed into a computer to do the sort of thing that gives you these answers. That is complex photochemistry. Beyond that, we have to talk—

#### DR. M'DONALD'S BACKGROUND

Mr. STEED. Are you a photochemist, too, along with your other talents?

Dr. McDONALD. My bachelor's degree is in chemistry. My field is atmospheric physics. One does not get very far in atmospheric physics without having to worry about this kind of photochemistry.

The same thing with respect to the organic chemistry that is on the fringes of this cell biological approach. Am I an outstanding expert in photochemistry? No. I am using other people's work, like Boeing's results. That would not be by anyone in my field who would be identified as an expert in photochemistry. Julian London might be, and so on, down the line. One draws on other people's work. That is what is involved here.

Mr. STEED. I am not sure I really understand the difference between one scientist and another, but I do have what I think is a general idea of what a physicist is. It seems to me that when you talk of the reaction of ultraviolet rays on the human body, this would be a field in which medical doctors and physiologists would be authoritative. Do you have a degree in either of those subjects?

Dr. McDONALD. No. That is why I immediately started talking to people like those at Oak Ridge, Stanford, Temple, and Baylor—people who are familiar with these problems. That is why I began looking at the literature of skin cancer. As a matter of fact, when you get down to it, there is a lot of it that is basically physics and organic chemistry at the cell level. It is not so far from my own background.

Mr. STEED. You have told us that the subject you have been stressing here today has been a recent revelation. How come no one in those fields has been certain about this before? It seems to me that

with all the scientific people we have in the fields of medicine and physiology, some of them would have been concerned about it.

Dr. McDONALD. One could ask why marine ecologists were not concerned about mercury in the environment. The problems are not automatically detected and recognized in any scientific field.

The whole SST problem has been largely ignored. It is not at all surprising, looking at the past history of this problem, that this particular one was not talked about earlier.

Furthermore, I did sketch why the SCEP group at MIT, after getting subtle reductions, did ignore it. I went through the reasoning why they ignored it. I pointed out I, too, thought there was sufficient reason to ignore it.

Then I did a doubletake and realized, but there is this gradient of skin cancer from north to south which will be altered systematically, and I said to myself, maybe the numbers will be significant. I examined them some months back and was rather startled by the numbers, and started from there.

That is how problems get detected, and that is what happens next. People start worrying about them.

Mr. STEED. If I understood you correctly, you said that these kind of problems are not nationalized, but are international in their impact and scope.

Dr. McDONALD. That is correct.

#### NEED FOR TWO PROTOTYPES

Mr. STEED. Let us assume that these questions you have raised are answered in the positive and it does pose the kind of threat that you outline here, would you agree that with the research they tell us they are going into and the research you say can be done and should be done, if we do not have the additional influence or prestige of having built two prototypes and tested them, if we go to an international conference to try to persuade other countries that this danger is real, we would not be as well off at such a conference unless we have had these prototypes and have had the benefit of these tests?

Why don't the scientists of Russia, of England and France speak out? They already have this question. You are not going to solve any SST danger by just stopping the American SST. The others are already here. If it is to be the danger, you say if we are to be the ones who determine it, we will have to have some way to bring world opinion to bear to stop the further development of this machine by other countries.

I just do not see how we could go to an international conference with anything like the persuasive powers that we would need unless we had the advantage of being able to say we built two prototypes and tested them, and these are the facts.

Dr. McDONALD. I see your question, but I do not see your implied answer.

Mr. STEED. How are we to stop Russia and France and England from going ahead with what they are already doing, if we do not have something to back us up with positiveness?

Dr. McDONALD. A very close parallel. Did India and South America, Egypt, and, say, France in 1955 have atomic bombs when the first

international examination of the international implications of that potential global problem came under review? The answer is no. It was not required that only people who had atomic bombs be admitted to discussion of the potential global hazards from bomb test radioactivity.

Mr. STEED. We are faced here with the proposition where we have already stuck the American taxpayer for \$1.1 billion and know no answers. Are we going ahead with this for a little bit more? We have two prototypes where, hopefully, we can get the answers that are disturbing you and men like you. It seems to me this is a very odd date in time for us to shut America down and close your opportunity to get any of these answers.

Dr. McDONALD. It is a proverbial problem of concern to us, but it isn't anything I have any basis to speak on. All I can say is that there is only one secondary area where prototypes would provide answers not available by other means. Hence, prototypes or no prototypes, research examination of this whole question of contamination of the stratosphere can be and should be pursued immediately. The two are easily decoupled, and that is as far as my comments went.

Mr. STEED. I, for one, am a strong advocate of finishing what we start. That does not by any manner of means mean that I would be a supporter of anything beyond that. I hope and we have been assured that we will have ongoing and parallel research that will bring something more than guesswork and questions into the picture so policymakers will have something of a dependable and provable scientific nature on which to base future decisions.

I am at a loss to know how we can get the kind of answers that this country must have on whether we go no further or go ahead, unless we finish what we have started.

Dr. McDONALD. If you are thereby asking me to start listing specific research problems that should be examined with great speed, I would be prepared to talk at length. There are specific things that need to be done and should be done.

Mr. STEED. I agree there are many things that need to be done, but I think they can be done parallel, and I think some of the answers will never be in a position where you can bring world opinion to bear unless we have obtained those answers through building prototypes and running these tests.

That is all, Mr. Chairman.

Mr. McFALL. Thank you, Mr. Steed.

Mr. MINSHALL. I have no further questions.

Mr. CONTE. Professor, when I asked you my question—and I emphasize my question—I had read a great deal of your testimony, and I remember the hearings. I would like to give you the opportunity, if you like, to elaborate on that when you get back.

Dr. McDONALD. I am sorry, I do not know what you mean. Elaborate on?

Mr. CONTE. If you want to say something further, aside from what you have said here and explain it.

Dr. McDONALD. You mean on the details of the carcinogenesis mechanism? What are you talking about?

Mr. CONTE. The unidentified flying objects.

Dr. McDONALD. As I say, it is obvious there isn't any relationship. I see no relationship at all. If I did, I would elaborate.

#### DAILY VARIATION IN OZONE LAYER

Mr. EDWARDS. Dr. McDonald, is there any daily natural variation in the ozone layer normally?

Dr. McDONALD. Yes; there are changes as large as 5 or 10 percent. When a big front goes through North America, let us say, the total of ozone can change quite commonly by that order of magnitude, which was one of the reasons that misled the first people who examined this problem to ignore a mere change of only 1 percent. One is a change in the mean, and one is a day-to-day change.

Mr. EDWARDS. A 5- to 10-percent change is something that is known, or is this a theory?

Dr. McDONALD. No; there are a variety of tests. The spectrophotometer is used in a number of places around the world. It is by no means unusual to have a spectrum of photoelectric records of ozone changes of that percentage among them.

#### POSSIBLE VARIATION CAUSED BY THE SST

Mr. EDWARDS. Have you any data that would give us any percentages by which the SST might cause a further change?

Dr. McDONALD. Yes. I have remarked on the calculations by London and Parks at the University of Colorado, and I remarked on Boeing's calculations. There are other calculations by B. G. Hunt. These are the calculations that I am drawing on for the numbers that I have used; 2 to 4 percent is the figure that I quoted.

Mr. EDWARDS. In other words, you are saying that if you have a 5- to 10-percent daily variation in the ozone present, that might vary by another 2 to 4 percent because of the SST?

Dr. McDONALD. Let us put it in terms of the parallel SST problem which might by chance make the heart of this clearer to you.

The daily temperature in most parts of the country varies by 20 or so degrees Fahrenheit between night and day. If a good front comes through, then it may change by 30 to 40 degrees Fahrenheit. We all know what that means in the short term. But when you go to changes in the ecologic sense, then these seemingly tiny changes that have been talked about in the SST connection, two-tenths of a degree centigrade, three-tenths, and so on, in the mean, in the average temperature, which look negligible compared to day-to-day weather changes, are known in fact to be of very significant proportions when averaged over a good many years.

The entire fishing industry, the cod fisheries of Greenland just fell apart. It was a Danish governmental problem that resulted from changes between 1890 and 1940 that amounted to only about six-tenths of a degree centigrade which, compared with the difference between tonight and tomorrow looks utterly unimportant.

Changes in the average, ozone or temperature, can have long-term implications of a degree of seriousness that is belied by comparing them with short-term fluctuations.

Mr. EDWARDS. Perhaps I am not making myself clear. You say it is a certainty as to the daily variation of ozone?

Dr. McDONALD. Yes.

Mr. EDWARDS. Has there been any demonstration to a certain degree as far as the SST is concerned, or is that speculation?

Dr. McDONALD. You mean from the military traffic?

Mr. EDWARDS. From any method.

Dr. McDONALD. The only aeronautical traffic in the stratosphere to date—

Mr. EDWARDS. In other words, are we still dealing in theory when we are talking about the SST as opposed to certainty when we are talking about the normal daily variation?

Dr. McDONALD. Indeed. The mere 200,000 hours of military logged time in the stratosphere would imply a change over the 20 years of ozone that is away below the threshold of detection. It is only a percent or so of the magnitude of the water vapor emission that would go with the projected SST. So, there is nothing surprising about that at all. The instrumentation is not capable of detecting that.

Mr. EDWARDS. So, there is no certainty at this point as to the effect the SST would have?

Dr. McDONALD. It is not demonstrable with the instruments. It is based on photochemical theory of response of ozone to water vapor. That is a theoretical conclusion; yes.

Mr. EDWARDS. You are calling for more study. You are not saying with certainty that the SST would do all the damage that has been stated.

Dr. McDONALD. Many of these things can be illuminated far more than they have been today by theoretical and computational and laboratory processes. There are many other programs. When the AEC got word about radioactivity, there was a host of laboratory-type and theoretical calculations that had to be done.

Mr. EDWARDS. Thank you.

Mr. McFALL. Thank you very much, Dr. McDonald. You had a long stay on the witness stand.

Dr. McDONALD. Thank you. My apologies for taking so long.

Mr. McFALL. Thank you.

#### STATEMENT OF HON. STEWART L. UDALL

Mr. McFALL. We will now have testimony from the Hon. Stewart L. Udall, representing the coalition against the SST, a former Member of Congress, a former Secretary of the Interior, and a friend of everyone on the committee.

We shall be pleased to have your testimony at this time.

Mr. UDALL. Mr. Chairman, I appreciate the opportunity to appear today on behalf of the coalition against the SST, to sum up their arguments against this research and development effort, and to urge that the SST program be terminated forthwith.

The coalition against the SST approaches this issue with far more than a concern about noise levels (as important as that neglected subject is, in a society where the noise level is doubling every 8 years). We speak on behalf of the real needs of the people of our country. We want to redirect the powerful technology of the country so that it will

improve the living standards, the environmental health and the economic well-being of all the American people.

I have been an opponent of the SST nearly 6 years. In 1966, as Secretary of the Interior, I appointed a distinguished team of scientists, who made the first searching analysis of this project. The project was a dubious—and extravagant—exercise then. It is a potential economic and environmental disaster today.

By reputation, the Appropriations Committees of the Congress are the tough-minded, hard-headed groups that protect the taxpayers against the misguided use of public funds. I will waste no time this afternoon on side issues. There are, in my view, three hard-headed, very pragmatic reasons why this program should be sidetracked.

#### STATE OF THE AIRLINE INDUSTRY

The first argument we advance against the SST is that it is an airborne Edsel. Today the commercial airline industry of this country is sick—we face not one, but several potential “flying Penn Centrals.” I have talked with high-placed airline officials in recent weeks. Most of them will not appear here (and the few who do will come out of duty, having foolishly pledged their support to the pro-SST coalition several years ago). These officials are privately appalled at the prospect of having to sign solid contracts for these aircraft. They are already in deep financial trouble trying to meet their obligations for the current generation of jet aircraft. A few weeks ago Charles A. Lindbergh, who started the whole thing, I might say in passing, forthrightly spoke their fears when he expressed the judgement that—this is his letter to Congressman Yates:

My impression is that the SST is within the state of the art technically but not economically or environmentally. Seat-mile costs are too high, and the pollution of the upper atmosphere too dangerous on the basis of present knowledge. I believe it would be a mistake to become committed to a multibillion dollar SST program without reasonable certainty that SST's will be practical economically and acceptable environmentally.

Gentlemen, Lockheed is on the ropes—and Rolls Royce is in bankruptcy. You should want to save Boeing from a similar peril. With all candor, I am opposed to this project because I want to save the jobs of U.S. working men and women. It is far better—far more prudent and hard-headed—to seek alternative forms of work for these people than to charge ahead throwing good money after bad and ending up with tens of thousands of American abruptly out of work the way Rolls Royce employees are right this day.

This, I believe, is the most compelling issue over the SST at this time—and not the umpteen ghost jobs that supposedly would be created by the success of this project. The only outside chance for this fleet to fly and make economic sense—this is what my science committee reported to me 5 years ago—is for it to fly supersonically overland across the United States.

#### ENVIRONMENTAL RISKS

Our second argument is that the environmental risks are too severe and there are too many unresearched, unknown factors for this project

to proceed. Eminent scientists will present testimony on this topic, so I will not consume the time of the committee except to say that I concur in their judgements and reservations.

#### NATIONAL PRIORITIES

The third argument we advance is the issue of national priorities. Putting economics aside, the SST, even if it were the brilliant success its backers suggest, is a technology that will provide dubious benefit for only a small fraction of our citizens. These people, VIP's (such as ourselves), the international jet set, and the super-affluent elite constitute, at most, one-half of 1 percent of our citizens. How important, we ask, is a faster plane to serve a tiny elite when our cities are sick and the overall environment is deteriorating before our eyes?

My presentation is devoid of any partisanship. The tragedy of the SST (a serious misjudgment of national needs by three administrations) is that the \$800 millions could have been spent on research and development that would have produced vital economic, social and environmental gains for everyone.

One striking example will make the point. If we had spent these taxpayer dollars on perfecting and subsidizing the air-cushion train—the greatest enthusiast for this is Secretary Volpe—today we would be building a swift, largely pollution-free form of transportation that would be a convenience and benefit to every American. It would serve all of the densely populated urban corridors, connect the major cities of this country—and would be providing, in 1971, well over 100,000 industrial and construction jobs for U.S. workmen.

We did not do that. We went for the SST. The folly of the SST is starkly revealed when we consider what might have been, had we used American ingenuity and resources in the right way.

We are in the grips of what can only be called a kind of technological hubris—a good Greek word. This is the lesson of Lockheed, of the C5-A fiasco, of the Rolls Royce bankruptcy. In pursuit of the idea that a bigger or faster machine is always better—that has been part of the American creed up to now—and a surefire success in the marketplace, we have arrogantly used our skills to create new problems for man, not to enhance life. There is still time to redirect our energies and change our priorities. This is the challenge confronting this committee.

With reluctance, I must mention one other subject, and then I am finished. As a citizen I am appalled at the situation that has developed—I believe there is no precedent for this, Mr. Chairman—with the formation of the “volunteers” committee for the SST—a group that announced a few weeks ago it would spend \$350,000 to win approval of this project. Who is putting up this money? Who organized this committee? Who is paying the salaries of its lobby team? These are questions this committee should ask. If you do, I believe you will find that the very corporations who have profited and will prospectively profit from the SST contracts are (directly or indirectly) using the same taxpayers' money voted earlier by this committee to persuade you to squander more of our money for this solid-gold flying Cadillac for a travel elite.

We, the opponents, find ourselves in a David-versus-Goliath fight here today. The conservation-environment forces are, as always, fin-

anced by pennies. Dr. McDonald, myself, and all of us are here as volunteers. Our scientific witnesses are true volunteers who are unpaid advocates of what they view as the national interest. I believe the people of this country—the growing group who are informed on this issue—are overwhelmingly against further down-the-rathole spending for the SST. But are they to be overwhelmed by corporations who are spending taxpayers' money to high-pressure Congress? It is as though the defense contractors came in here with a lobby to lobby for the Defense budget.

This is the moral issue in this room today. It cannot be avoided—and, gentlemen, it is not hysterical sloganeering.

Thank you very much.

#### AIRLINES AND THE SST

MR. MCFALL. Thank you, Mr. Udall.

Would it be possible for you to identify any of the highly placed airline officials who you say are appalled at the prospect of having to sign solid contracts for the SST?

MR. UDALL. No, I could not do that, Congressman. I think what we witnessed over the last weekend with BOAC in Great Britain is a good example of that. The story appeared in the press on Saturday that they did not want the planes. By Monday, a company put out a statement that this was not quite true. These were conversations I have had.

MR. MCFALL. Have you any evidence that the airline people were in any way coerced?

MR. UDALL. No, of course not. I know only what I read about that.

#### SST ECONOMICS

MR. MCFALL. Would you submit to the committee any studies which support your contention that the only chance for a fleet of SST's to make economic sense is to fly supersonically overland across the United States?

MR. UDALL. Congressman, the study on that—I am sure the staff can get it for you—is the study made by the scientific team that I appointed as Secretary of the Interior in 1966. Their conclusion was because this is the country that is overwhelmingly dominant in terms of air travel, their conclusion was that if the plane flew supersonically over this country, you would sell three times as many planes and thereby recover back the investment that the Government has made. In other words, they pointed out that we were creating a situation where if you did not allow the plane to fly overland with the sonic boom problem, inevitably the money which the country had invested in the project would never be recovered, and the economics would be fatally impaired.

MR. MCFALL. Do you dispute Mr. Magruder's analysis which he has given the committee, that we can sell 300 to 500 planes and have them fly over water?

MR. UDALL. It is interesting, because a year ago we were still fighting the overland flight problem. Now tactically the pro-SST people, Senator Magnuson and others, say: "No, no. We don't intend to do that. We are just considering international flights."

Frankly, I do not think that this is meaningful, because if we go ahead with this project, if we decide we are to go into full construction, I think we will end up with economics forcing us to fly overland. This is the reason I am for quitting on this project at this point, because I think there is a point of no return, where the pressures become very strong to do this.

I have not studied the economics. I would not argue with Mr. Magruder directly on this.

I want to say to the committee, I think the track record of the FAA on this project is pretty miserable. You look back at what General Quesada said that they were considering 10 years ago, that this would largely be done by industry, and the Government would spend \$100 to \$200 million. Five years ago we were told what? Go back and look at the record; \$400 or \$500 million. Now it is up over a billion dollars.

The FAA and the airline industry were telling us 2 years ago that the jumbo jets were going to mean a reduction in fares. What has happened is that the fares have gone up.

Most of the economic studies that I have seen of the FAA in the past few years are full of holes. I think you had better have some reservations on anything that is presented to you here today.

#### NUMBER OF PEOPLE SERVED

Mr. McFALL. In your statement you say:

Putting economics aside, even the SST, even if it were the brilliant success its backers suggest, is a technology that will provide dubious benefits for only a small fraction of our citizens.

You refer to these people as VIP's and as superaffluent elite.

How many people are there, in your conception of this elite?

Mr. UDALL. In the Western World, under half a million. I think the people who flew on international flights last year were probably under half a million. I don't know. I am just pulling a figure out of the air. I imagine it is in that range.

Mr. McFALL. Do you know of some of the projections which Mr. Magruder has recently given to the committee? Are you not familiar with those figures?

Mr. UDALL. No. I am skeptical of them. I will be very candid with you.

Mr. McFALL. Do you have any economic studies that would lead you to this conclusion, that only this small number of people would be served? Did you pull that figure out of the air?

Mr. UDALL. Congressman, I do not have the resources that the FAA has. I haven't made any economic analysis. Mr. Magruder is a very brilliant salesman. One of the great feats in this city was his keeping this project alive, in my judgment. I think if Henry Ford had picked him up, he probably could have sold the Edsel earlier.

I ask you to look at the track record of the FAA on this project, all their projections. What did they tell the Congress and the country in 1959, in 1960, and in 1965? That is the place to look at the figures, instead of what they are passing out here today, in my judgment.

Mr. McFALL. I am interested in your figures right now. One of your three main arguments is that only the jet set will be served. I am trying to find out from you how you arrive at that conclusion.

Mr. UDALL. Congressman, everything that I have seen recently—I have the resources of one citizen at my beck and call—indicates that there will be a surcharge—they talk about it in the range of 30 to 40 percent above what you would now pay for this aircraft. I ask you the question: How many people are going to pay that surcharge? The people who think they are really important and are really in a hurry; they are the superaffluent.

That is the reason I am very skeptical of any figures which say there are hundreds of thousands of people who are going to pay a surcharge because they get there a little faster and have a little more time to struggle on the ground to get in to London or somewhere.

#### LOCKHEED AND ROLLS ROYCE

Mr. McFALL. You refer to the lessons of Lockheed and the Rolls Royce bankruptcy as arguments for stopping the SST. Are you familiar with the problems of Lockheed?

Mr. UDALL. Congressman, I have followed it very closely in the last several months. I have been asking myself the question: What is the lesson of the C-5A, of the trouble Lockheed is in, of the trouble Rolls Royce is in? It is just one man's judgment. It seems to me that a message is trying to get through; that the idea that succeeded up to a point in this country, of always building a bigger, faster machine, that is always better, that will always sell, may have reached the end of the line, at least to the point where we stop and do a lot more research and development, rather than go bulling on ahead. That is my reaction to the troubles that Lockheed is having.

Mr. McFALL. It is possible, of course, that there is some connection between the economic problem that Lockheed has and that which Rolls Royce has. You may be right, but can you show us any closer connection than you have?

Mr. UDALL. I guess the best I can do is to say I am tossing the problem to the committee to mull over in your minds. What do we learn from this? Is there a lesson involved in this? Maybe there isn't. Maybe we just plow more money in and bail Lockheed out the way they asked the Congress to bail Penn Central out.

The thing that disturbs me about U.S. aviation right now—last year they were in their worst recession. They are having their great depression right now. The load factor on U.S. airlines fell below 50 percent. That means over half the seats were empty. All of us know that.

As an environmentalist, I not only say there is an enormous waste and inefficiency. We use twice as much energy as we had to on that industry and produced twice as much pollution and noise. Can we afford that kind of competition?

I think we have to start asking ourselves some very basic questions about the way we organize things in this country, confronted with something like that.

Mr. McFALL. Questions on this side?

## FOREIGN COMPETITION

Mr. MAHON. May I ask one question?

Mr. Udall, you are a man of faith in the country. You have held out hope to the American people for the future. In view of the fact that this airplane is not scheduled to be available to the airlines for quite a number of years, and in view of the fact that other countries in the world are building their version of the SST, do you think we can afford not to go forward and produce these two prototypes to see what they can do? If they do not prove to be an economic success, or if it is discovered that the environment will be so contaminated that we cannot afford to fly them, then we should try to dissuade others from flying them, and the \$1.2 billion or \$1.3 billion will not be completely recovered.

But in view of the fact that mankind from the beginning has gone faster and faster—some thought quite a long time ago that we were going fast enough, but, nevertheless, the trend is for more speed—is this gamble of approximately \$1.5 billion worth taking? If we are wrong, we have lost about \$1.5 billion. We did, however, spend a billion dollars on trying to make a nuclear-powered airplane and we said, "So sorry, it won't work," and the program was stopped. But should we quit now, after making this heavy investment in the SST?

If we had not already made this heavy investment, your argument would seem to be the more convincing. What do you say in reaction to these observations?

Mr. UDALL. Mr. Chairman, this is a very critical question. I know the appeal of the arguments that are made on this side. I would rather answer it on two or three different levels.

In the first place, I think the foreign competition is not really there. I make the prediction to this committee today that the British and French will put the Concorde on the back burner before this year is out, for economic reasons. I do not think this country need be concerned about the Soviet Union. They have a very large continent. They have their own problems. They are not in the international air field the way airlines in the other countries are.

I do believe, Mr. Chairman, very deeply, very sincerely, as a citizen, as someone concerned about the environment, that the SST is different. When you break that sound barrier, when you go up in the stratosphere, this isn't just another airplane. You have raised a whole series of new problems.

I think the mistake that we made, all of us, in starting out with this idea, is in not recognizing that it is not just another machine and we were encountering a whole series of new problems, from the sound barrier on up.

Quite frankly, my third answer is this: In our country, with all its problems, we know how much we can do in learning to begin to recycle wastes, getting the air-cushion train started, any number of ways to use technology, to use the talents of Boeing and of the aerospace industry. We are finally beginning to talk about improving our cities, improving housing, to use all of these energies. I think this is what we are all waiting for the Congress to do.

On the SST, I think you are just throwing good money after bad, Mr. Chairman. I have to express that as merely one man's opinion.

Mr. MAHON. This is a country that is estimated to achieve a one trillion dollar gross national product next year. Should a country that has this tremendous power invest \$1.5 billion in trying to unravel this problem which might be—we cannot prove it, necessarily—very significant to the long-range future of this country and which might be very important from the standpoint of jobs for labor? Can we afford not to complete the two prototypes to discover whether or not we should go further?

A great and powerful Nation like ours should be able to afford to complete the prototype program. That is only a very small fraction of our resources.

Of course, what you say about the environment and the overall welfare of the country otherwise is significant and important, but is it not also important to venture further with this project until you can be more certain of the answer?

Mr. UDALL. I know, Mr. Chairman, this is a key question that a Congressman such as yourself, with the conscientious way you approach the problem, has to wrestle with. I frankly, as one person, say that there are so many of these unknowns with regard to the environmental consequences. We have two schools of scientists. There are some speaking from both sides. That says to me: "Go slow. Don't rush on ahead."

The thing that is tragic to me, because I believe the No. 1 thing that this Nation needs in transportation today is mass transit, inter-urban transit—this air-cushion train is a marvelous vehicle—is that we should have started with it 10 years ago. Most of the people who travel between big cities in the densely populated corridors, 10 years from now ought to be moving on air-cushion trains. We ought to be spending a half billion or a billion dollars a year on that. We would produce jobs for machinists and for all these people. It would be a wonderful thing for the country.

I would put this way down at the bottom of my list of priorities, to be quite frank with you.

Mr. MAHON. We are spending a lot of effort and money in connection with mass transit and these other programs of which you speak. Maybe we should spend more. I am not saying that we should forget all our other problems for the SST. I am just wondering if we can afford at this stage to follow your suggestion.

Mr. UDALL. The final point I would make to you, Mr. Chairman: Any problem involving technology involves jobs. But who does it serve? That is the final question. Any way you slice it, this serves a very small group of people.

#### SST EMPLOYMENT AND CONTRACTOR VIABILITY

Mr. MAHON. If it serves the United States, it serves over 200 million people. Anything that keeps the United States in the forefront is very important. By producing over 80 percent of the aircraft for the free world, we are in the forefront in this industry. We must not jeopardize that position.

Maybe stopping the SST program would not seriously jeopardize it, but maybe it would.

Mr. UDALL. I see a great future for the aircraft manufacturers and the airline industry if we will concentrate on efficiency, economy, and staying away from environmental problems. I think the 747 has a great future for another 20 years. I think there is plenty of time to wait for this project and do the kind of research that we have not done.

Mr. MAHON. Thank you, Mr. Secretary.

Mr. McFALL. Mr. Conte.

Mr. CONTE. Mr. Secretary, I want to welcome you before this committee. It brings back pleasant memories of projects we have worked on together during the years that you served as Secretary of the Interior and in the House.

You state that in 1966 you appointed a team of scientists who made the first searching analysis of the SST project. Could you give us the findings of that team?

Mr. UDALL. Congressman, I haven't even gone back to read it. I haven't had time. It is published and can be secured from the Interior Department.

Mr. YATES. It is in the record of the previous hearings.

Mr. CONTE. On page 2, it is your suggestion that the continued Government funding of the SST program would not realistically postpone bankruptcy.

The officials of that company certainly do not share that dismal economic assessment of the plane as you do.

Mr. UDALL. Congressman, I do not want to overstate that. I read Boeing's earnings statement in the Wall Street Journal yesterday. Despite all their troubles, this is a well run company. They have been cutting back. They are in trouble. But they showed a profit last year.

This project, one way or the other, will not force Boeing into bankruptcy unless they are completely foolish. If they tend to put too many of their eggs in this basket and we find the economics do not sell, it could find itself in a position similar to, maybe not quite as bad as, the one Lockheed is in. They have had two disasters in a row.

Mr. CONTE. I am still not clear in my own mind. We have had a lot of conflicting evidence in the last two days, both pro and con.

First of all, the Secretary of Transportation stated that it is very essential to have two prototype airplanes to test all these problems that the plane might encounter in regard to the environment.

Then we had Mr. Ruckelshaus who stated we do not need the two prototypes, that these experiments could be carried on without the prototypes.

However, then he went on to say that we have to have the prototypes for economic reasons.

How do you feel in regard to having the prototype phase of the SST program. Does it endanger or pose a threat to the environment?

#### ABILITY TO STOP THE SST AFTER THE PROTOTYPE PROGRAM

Mr. UDALL. Congressman, the threat to the environment is not the prototypes, as Dr. McDonald himself said. There are people speaking out of both sides of their mouths. You have to watch this. On the one hand, it is being said: "We have gone this far; let's just build the two prototypes." But the other people are saying: "This is going to be a

great new industry, 150,000 jobs, and so on. It is either one or the other.

If this committee is determined to go ahead with the project and you wanted to write in language and say two prototypes, research for 10 years and no more, that is going one road, but it is not the 150,000 job road. Let us understand that.

My own feeling, knowing the momentum that projects of this kind get, is that there are really only two roads, and one is go all-out and build it and try to make it commercial and try to sell it; and the other is, stop now, do the research, and come back to it 10 years from now when we might have solved some of these problems.

Mr. CONTE. You mentioned we should be spending half a billion dollars on mass transit and air-cushion vehicles. I might mention we appropriated last year \$600 million for mass transit. It was a real step forward. Much more has to be done. I hope this year it will be a billion dollars or more for this field.

As you know, we are going to try this air-cushion vehicle from Dulles Airport down to McLean and maybe connect with National Airport. I agree with you, it is a real breakthrough.

Mr. UDALL. Congressman, our great problems in transportation in this country today are on the ground, not in the air. We are doing very well there.

Mr. CONTE. Of course, here again, even though we have troubles on the ground, we have to be careful that we protect the environment with a type of air-cushion vehicle that will not pollute the air.

Thank you.

#### AIRLINE AND OTHER COMMENTS

Mr. YATES. Mr. Secretary, I welcome you, too. As one who has fought the SST in the House for 4 years, I welcome your analogy to David versus Goliath.

You may not want to mention names of the airlines' executives, but there are letters from them already in the record, and I would like to read one to you that appeared in the record of the hearings for the year 1970 at page 173. The name is not disclosed in the hearings but subsequently the name was disclosed after the Secretary of Transportation persuaded some of the airlines to change the letters they had written previously.

This was a letter that was written to the Cabinet Committee at a time when the frank and full views of the airlines was requested and received. This is from United Air Lines. This is what George Keck said on February 18, 1969, addressed to the Acting Administrator of FAA. He said:

DEAR DAVE: I have just completed a review of the redesign features as well as the operating economics of the Boeing SST with United Air Lines. This review has resulted in some alteration of United's position relative to the SST development program. You are aware that throughout the initial years of development, United has taken a positive approach to this new technology, and has participated fully with the airlines committee. However, the recent SST review along with an assessment of the environment in which we are currently operating has led us to take a different posture than has been the case to date. The factors influencing this change are:

1. The operating economics of the presently proposed SST indicates that a substantial fare premium undoubtedly will be required to match the economic performance of the present generation of subsonic jets.

That is true. That has been testified to.

2. There appears to be a serious question that the SST can meet existing or proposed airport noise criteria.

That is true. They are talking about a new breakthrough, but at the present time that is true as well.

3. The SST undoubtedly will be limited to overwater operation because of the sonic boom problem.

That is true.

4. The final cost per airplane will undoubtedly fall in the \$40 million to \$50 million area, representing an enormous risk per single vehicle."

That is true, because they have talked about a price of \$51 million for the plane when it is ready, when it comes off the assembly line.

5. Important and costly improvements are immediately required to bring both our airways and airports up to a capacity compatible with the current and future traffic demand.

Anybody who flies today knows that if he goes into O'Hare or Kennedy or into Los Angeles or Miami, he is liable to be stacked up for as long as an hour or possibly an hour and a half when the pressures really build up, and that what the American taxpayer and the American airplane rider want is not an SST but, rather, a solution to the problems of air traffic congestion so he can get to and from his home much more quickly.

There are other factors which weigh against unqualified comment to the SST development schedule, but the above are the most important ones, in my view. In light of the somewhat negative aspects bearing upon the SST program as of now and our existing capital commitments, I would be unwilling to recommend to the United's board of directors the venturing of any additional risk capital beyond the \$3 million we already contributed in addition to our \$3 million deposit for delivery positions.

If our Government's assessment of this program indicates that the United States must retain its dominant position in the aircraft manufacturing industry for national reasons, then it is my opinion that the development cost risk must be assumed by the Government.

Finally, if our country must make a choice between appropriations for improvements of our airways-airports system or furthering the development of the SST, there is no question that the airways-airports must be the choice.

In summation, the provision of completely adequate airways and airports in this country must take precedence over any other consideration if the vigor of our economy is to be maintained. If there are funds available after the above need is satisfied, then these funds should go toward the orderly development of an SST at whatever rate of progress is possible.

I hope the above may be helpful to Secretary Volpe in arriving at a sound decision on the future of the program.

That was George Keck's letter.

All these letters are in the record. These are Cabinet committee letters of the airline.

Subsequently, the Secretary of Transportation and the Federal Aviation Administration persuaded the airlines to give further opinions, and the opinions became more favorable to the SST as more letters came in.

My good friend, Chairman Mahon, has talked about what we will learn from the prototype. I do not know which airline this is because it is blank, but I can supply the name from a packet of airline letters I have in my office. This is a letter dated February 25. I will not put this name in the record.

DEAR MR. THOMAS: We have reviewed the most recent B-2707 design submitted by the Boeing Company for a prototype supersonic transport as well as the evaluation conducted by your office. As you know, ———airlines has invested

almost a million and a vast amount of technical and economic effort in this program. Consequently, we have a vital interest in its success. However, we continue to be concerned about many of the technical aspects of the program, including weight and balance, flutter and dynamics, engine inlet design, and airport and community noise.

These are the concerns raised by Neil Armstrong, too, in the NASA letter that I made public yesterday.

Experience has indicated that solutions to problems of this type invariably add complexity and weight to an aircraft. Since the design payload range characteristics already appear marginal, we question whether an economically viable airplane can be produced until these solutions are accurately defined. We believe that some of the current problem areas lend themselves to further analysis, whereas others will require extensive hardware development and a flight testing program. We feel that the prototype flight test program as proposed may be inadequate to develop solutions to the major technical problems.

May be inadequate, Mr. Chairman.

It is our recommendation, therefore, that: (1) Boeing be directed to complete those analyses which can be meaningfully undertaken prior to a final definition of a prototype aircraft, (2) upon completion of these analyses, a two-prototype aircraft program be undertaken without a commitment of resources to a production aircraft program. We believe that the prototype aircraft program should be conducted in a manner such that there will be no expenditure of funds related to a production program until the prototype aircraft program has met the technical development objectives.

#### COMPARISON ON PROTOTYPE WITH PRODUCTION VERSION

The point I want to make is that the SST administration is now engaged in developing a prototype which will not have the engine that is going into the production version of the craft. It does not have a fuel sealant that will go into the production version of the craft. It will have a temporary fuel sealant for purposes of operating the two prototypes.

It will not have the braking system. It will not have the environmental control system. It will not have the landing gear. There will be a new wing too.

Mr. McFALL. May I ask that you confine yourself to questioning the witness, rather than giving testimony?

Mr. YATES. I am going to ask him a question. He has testified, Mr. Chairman, about the fact that he could not give you the name of the airlines. I gave you the name of one airline. Mr. Mahon asked a question about the prototypes. Should we construct a prototype? I am certainly bearing on that in connection with the question that I am going to ask him.

Mr. McFALL. You will have an opportunity to make your arguments on the floor. We are faced with a time problem. Perhaps if we can get Mr. Udall's testimony it would be better, because I know what your testimony is.

Mr. YATES. You do not know what all my testimony is, Mr. Chairman. You have a good idea, but you do not know what all of it is.

Mr. McFALL. I have listened to it for several years.

Mr. YATES. More and more is coming out every year. And apparently, DOT has listened to it, too, because they are now moving to make changes we have urged upon them for years.

Mr. Udall, have you any comment with respect to my delineation of what the state of the prototype is?

Mr. UDALL. No.

## STATE OF THE AIRLINE INDUSTRY

Mr. YATES. I want to refer your attention to the testimony that took place recently before Senator Magnuson's committee. Mr. Tipton of the ATA, told that committee about the depressed state of the air carrier industry, the excess capacity, the reduced traffic, the airlines were hard-pressed to purchase SSTs today. Is this in line with the conversations you had with the airline executives concerning the testimony you gave a few moments ago?

Mr. UDALL. I think Mr. Keck is a rather good reflection of the rather hardheaded attitude of the airline executives. It is curious that the two airlines, the international carriers that are supposed to buy most of these, TWA and PanAm just take a look at their balance sheet last year. They are in trouble. I think we ought to want to get them out of trouble and not push them into more trouble by making them sign up for more planes. That is my view as one citizen.

Mr. YATES. I have here a Library of Congress reproduction of an ad that appeared in full color in the Chicago Tribune magazine. It shows a projection of the SST, and it is taken out by the Northern Illinois Gas Company. It says this:

One of these days you may be able to fly from Chicago to Los Angeles faster than you can drive home from the loop today.

Well, the automobile traffic is getting that bad but I don't think they had that in mind.

In a plane powered by natural gas the same natural gas that warms and cools your home and dries your clothes. For supersonic transport jet the natural gas will be cooled to a point where it becomes a liquid. What is in it for you? Lower fares for one thing.

We know that Mr. Magruder has testified there is going to be a premium fare.

Liquefied natural gas costs less per pound than conventional jet fuel and it packs more energy per pound so the fuel load will be less expensive and lighter giving the SST up to 30 percent reduction in operating cost. That means your ticket will probably cost a lot less. Natural gas is safer too.

And so forth.

That is the ad that is appearing on behalf of the SST.

The point I want to make is that this is an ad that discusses flying to the coast in less time than it takes to drive from your home to the loop. The only way that can be done is by flying supersonically. Inasmuch as it is promised not to fly supersonically over land, there is a misrepresentation here. I want to thank you, Mr. Secretary, for your testimony.

Mr. McFALL. Do you have any questions?

## COALITION AGAINST THE SST

Mr. MINSHALL. Yes.

Mr. Secretary, I too would like to reminisce and remind you that you and I came to the Congress in the same year, longer ago than I care to remember.

I have enjoyed your testimony, but there are several questions I should like to ask you about the organization that you are representing. You said initially in your statement that you were appalled at the

recent formation of a volunteer committee for the support of the SST. The coalition against the SST, of course, has been in existence now for some time. They have been lobbying against this program. Although you said they have only spent pennies, it comes to mind that I have seen full page newspaper ads against the SST, and they weren't donated by the newspapers. I should like to ask you when was this coalition formed?

Mr. UDALL. I am not all that knowledgeable, Congressman, on the Coalition Against the SST. I think it came into existence last year, and one of the groups that are heading it are here and will testify. Dave Brower is here, from Friends of the Earth. The coalition is an attempt to have a paper organization that coordinates the activities of various conservation and environmental groups, and I think you will find they do have pennies. These ads that you refer to probably were the ads that Friends of the Earth put in the New York Times or Washington Post.

Mr. MINSHALL. What are the other organizations? You mentioned Friends of the Earth. What other organizations are members of the coalition?

Mr. UDALL. I can't answer that because I am not that knowledgeable.

Mr. CONTE. The Sierra Club.

Mr. UDALL. I am sure the Sierra Club, Wilderness Society, National Wildlife Federation—

Mr. MINSHALL. Do you have any idea how much this coalition has raised?

Mr. UDALL. I have no facts.

Mr. MINSHALL. Can you find that out, or is there anybody here who can testify to that?

Mr. UDALL. I am sure the people who head up the coalition, the Friends of the Earth, or some of these people will be glad to help you.

Mr. MINSHALL. You have no idea how much money they have spent to date, over the years, to defeat the SST program?

Mr. UDALL. I know these organizations, Congressman, and they have no money, except enough to send some letters out, hire staffs, and things of that kind.

Mr. MINSHALL. Full newspaper ads.

Mr. UDALL. I haven't seen any full page newspaper ads unless Friends of the Earth or the Sierra Club ran one, which they run, you know, with a coupon that says, "Send one to your Congressman and also send us some money so we can go stronger," but they don't make any great amount of money on those.

Mr. MINSHALL. In what capacity are you here today?

Mr. UDALL. They asked me last week if I would be a spokesman for the coalition. I followed their work over the last several months, and I said I would, because I like the way they handle themselves. This gentleman here says he has the answer, if you want, to the question.

Mr. MINSHALL. I have some other questions I would like to ask you first.

Have you received any reimbursement or been promised any reimbursement in the way of pay and/or honorariums?

Mr. UDALL. None whatsoever. I have given the day to fight against the SST.

Mr. MINSHALL. Are you supported by any foundation of any kind?

Mr. UDALL. No.

Mr. MINSHALL. You are here at your own personal expense?

Mr. UDALL. That is right exactly, the same as Dr. McDonald.

Mr. MINSHALL. I understand Dr. McDonald was underwritten by someone here. I don't know who it was.

Mr. UDALL. They probably bought him a plane ticket maybe. I don't know.

Mr. MINSHALL. Can you tell us who the gentleman with you is? Will you identify yourself, please?

#### EXPENDITURES BY THE COALITION

Mr. SOUCIE. Gary Soucie. It means "worry." I am chairman of the Coalition Against the SST, and conservation director of Friends of the Earth.

To answer your question, Mr. Minshall, the coalition's total expenditure over the past year has been \$18,500. The coalition has no staff. We did for a short time have one staff member but she decided to go to England to get married, where she is now working against the Concorde. The coalition has run one ad in cooperation with Friends of the Earth and that was in the Modesto Bee. Friends of the Earth ran a full page ad against the SST back in March of 1970 in the New York Times, and in the San Francisco Chronicle.

Mr. MINSHALL. But your total intake has been only \$17,000?

Mr. SOUCIE. \$18.5. I think we have got approximately \$500—

Mr. MINSHALL. Who paid for the full page ads?

Mr. SOUCIE. That was paid for by Friends of the Earth.

Mr. MINSHALL. How many other organizations are supporting your coalition?

Mr. SOUCIE. There are 30-some organizations.

Mr. MINSHALL. Thirty-some?

Mr. SOUCIE. Yes, sir.

Mr. MINSHALL. Can you name some of the key ones?

Mr. SOUCIE. Yes, I sure can. In fact, here is a list, The national organizations include the Citizens Committee on Natural Resources, Citizens League Against the Sonic Boom, Environmental Action, Environment, Inc.—

#### ORGANIZATIONS IN THE COALITION AGAINST THE SST

Mr. MINSHALL. You can supply that list for the record, but how much have these organizations given to this coalition's financial effort? (The information follows:)

#### ORGANIZATIONS COOPERATING IN THE COALITION AGAINST THE SST

##### NATIONAL ORGANIZATIONS

Citizens Committee on Natural Resources  
 Citizens League Against the Sonic Boom  
 Environmental Action  
 Environment, Inc.  
 Federation of American Scientists

Friends of the Earth  
 International Longshoremen's & Warehousemen's Union  
 National Federation of Social Service Employees  
 National Tax Action, Inc.  
 National Taxpayers Union  
 National Wildlife Federation  
 Oil, Chemical & Atomic Workers International Union  
 Sierra Club  
 The Wilderness Society  
 Zero Population Growth, Inc.

STATE AND LOCAL ORGANIZATIONS

Air Conservation Committee, Tuberculosis Association of Cleveland and Cuyahoga County (Ohio)

The Alabama Conservancy  
 Committee for Green Foothills (California)  
 Earth Action Council, UCLA  
 Federation of Western Outdoor Clubs  
 Idaho Environmental Council  
 Natural Resources Council of Maine  
 North Minnesota Committee Against the SST  
 O'Hare Area Noise Abatement Council  
 Peninsula Conservation Center (California)  
 Ecology Action for Rhode Island  
 Tennessee Wilderness Action Committee  
 Texas Committee on Natural Resources  
 Town-Village Aircraft Safety & Noise Abatement Committee (New York)

Mr. SOUCIE. Almost nothing. The point is—

Mr. MINSHALL. Wait a second. You just told me they had paid for full page ads in the San Francisco papers and full page ads in the Times.

Mr. SOUCIE. That was not on behalf of the coalition, sir.

Mr. MINSHALL. On whose behalf was it?

Mr. SOUCIE. The organization that paid for it. In this case Friends of the Earth ran the ad.

Mr. MINSHALL. That is just my point. They ran the ad under their own name, that doesn't mean—

Mr. SOUCIE. The coalition did not exist at the time. There was no coalition. The coalition, as Mr. Udall pointed out, is essentially a paper organization to serve as a coordinating group to make sure that all of the organizations who are opposed to the SST don't duplicate each other's efforts.

Mr. MINSHALL. How much have these 30-some organizations that you mentioned paid in their efforts to advertise or lobby against the SST program.

Mr. SOUCIE. I should think in the case of Friends of the Earth and the Sierra Club it would represent a commitment almost at the same level, or a little more, than the coalition itself has spent. In the case of several of these organizations, not very much in terms of dollar outlay.

Mr. MINSHALL. You may wish to supply some more information for the record on this matter.

Mr. SOUCIE. I would be glad to. I wish we had \$350,000 to spend in 30 days, though.

(The information follows:)

COALITION AGAINST THE SST,  
Washington, D.C., March 7, 1971.

Hon. JOHN J. MCFALL,  
Chairman, Subcommittee on Transportation,  
House Appropriations Committee,  
Washington, D.C.

DEAR MR. CHAIRMAN: At the hearings on Tuesday afternoon, in response to Mr. Minshall's question, I volunteered to supply information on the activities of the Coalition Against the SST.

Contributions to the Coalition to date have totaled \$19,828.66. This includes a \$1,000 contribution of which I was unaware when I testified on Tuesday.

The largest single expense has been the consultant fee paid to the Coalition's full-time research coordinator between April and December 1970. We have also paid travel expenses of several scientists and citizen leaders who came to Washington on their own time to assist the Coalition. Other major expenditures include printing and telephone expenses. The Coalition also paid for one newspaper advertisement in the Modesto Bee in May 1970, in cooperation with Friends of the Earth.

If we can be of further assistance, please call on me, or on George Alderson, the present Coordinator of the Coalition, at 638-2525 in Washington.

Sincerely,

GARY A. SOUCIE,  
Chairman.

Mr. YATES. Mr. Minshall, would you like to know about Mr. McDonald? I have got the information. He came to Washington to take part in a meeting of the President's Science Advisory Committee last Friday. He stayed over at his own expense.

Mr. MINSHALL. He came here at Government expense?

Mr. YATES. He is on the President's Science Advisory Committee. He had a meeting and he stayed over at his own expense.

Mr. MINSHALL. I have no other questions.

Mr. MCFALL. Mr. Steed.

#### LOCKHEED SITUATION

Mr. STEED. Yes. Mr. Secretary, since you quoted Colonel Lindbergh, I would like to repeat one sentence that I want to make some comment on. In the quotation you said he said:

I believe it would be a mistake to become committed to a multi-billion dollar SST program without reasonable certainty that SST's will be practicable economically, and acceptable environmentally.

Well, I couldn't agree more, but up to this time, as a member of this subcommittee, I haven't been asked to make any such commitment, and I am not faced with any such commitment now, but I also think it would be just as big a mistake to make a commitment against the SST as it would be to be committed for it at this stage in time. That is why I think until and unless we build these prototypes and test them and get these answers, there will be no way on earth that we could ever comply with what Colonel Lindbergh thinks is important to know before any further decisions are made.

Now then, on page 4 of your statement, you have referred to the lesson of Lockheed, the C-5A fiasco. Are you saying that Lockheed as a manufacturer is a fiasco, or is the plane a fiasco?

Mr. UDALL. I think that the chairman of the full committee and others can answer that better than I. All that I read about the C5-A is that it is an economic fiasco, certainly for Lockheed. I am not saying

that from an engineering or technical standpoint it is a fiasco, although they appear to be having a lot of problems with it. It certainly has not had the performance characteristics and the ease of solving engineering problems that we were led to believe a few years ago.

Mr. STEED. I asked this question because the airbase where the training for the crews to operate this plane happens to be situated in my congressional district and I imagine I have seen more C5-A's in operation and talked to more men who fly them than probably anybody in this room, and whatever the financial problem Lockheed may have had in making it, certainly the men who operate the plane, and those who know what its mission is think that it is a tremendous success. It gives our Air Force a brandnew dimension in airlift, and so apparently those who know most about the plane and its problems are almost, as far as I know, unanimous in their approval of it as a plane. I wouldn't want the implication to go out that the plane as such was a fiasco.

Mr. UDALL. Congressman, I wouldn't quarrel with you for a moment on anything you say about its performance. I think in terms of the economics for Lockheed, it was a fiasco, and that is all I was trying to say. I was not trying to go beyond that and I am glad you brought me up short on that point.

Mr. STEED. Now then, the last few paragraphs of your statement gave me some concern. I am not sure that I don't resent the import of it.

As I see it, we have two questions before this subcommittee. Do we stop or do we go ahead? Now you say, apparently the import as I read what you say here, is that you are the good guys, and if we don't stop, then of course that means we have decided to go ahead, and that makes us immoral.

Mr. UDALL. No.

#### QUESTION OF STOPPING THE PROTOTYPE PROGRAM

Mr. STEED. What about the moral question if we stop and tell the American taxpayer that he has been stuck for \$1.1 billion, and has nothing to show for it; whereas the testimony here shows that for an additional between \$200 million and \$300 million we can have two prototypes, we can have the tests, and we can get the answers.

8he arguments you make would be acceptable, if we hadn't started, or they might be, some of them, acceptable if we had the two prototype tests and the answers, but the proposition here is we are in midstream. Do we stop and drown, or do we try to get to the other shore? This is why I have some difficulty understanding why people who are so conscientiously concerned about the environment and the other factors that are involved here are so adamant about wanting us to go that one more step and get the answers, so we will know what this is all about. I just don't see how I can consider myself moral if I vote now to wipe off \$1.1 billion in taxpayers' money, and have no results to show for it, when for a very reasonable additional amount. I can put this country in a position of having gotten the actual answers economically and environmentally.

I would think that if the concern about the environment is as real as the opponents think it is, that they should be the first to want us to go

ahead and prove out what the prototypes will have to prove, if the environment is going to be adversely affected.

Mr. UDALL. Congressman, let me straighten out—

Mr. STEED. I hope you are not implying—

Mr. UDALL. No.

Mr. STEED. (continuing). That if I don't happen to stop here in mid-stream that I am immoral.

Mr. UDALL. No, indeed. In fact, I was trying to make quite a different point. Bear in mind that I have sat on that side of the table, and I have been in the high levels of the Government. I have seen it from every side, and now I am sitting here in another capacity today, and we are here today, environment groups, conservation groups, citizens' groups and so on. Believe me, we have very few resources. We are fighting, we are taking on the Government. The Government has been here with all of its witnesses. They have got all the resources that the Government has. Now, in addition to this, we are asked to fight—it is amazing we could even win the way we won last year in the Senate—we are asked to fight off this industry, which has been paid taxpayers' money to develop a project. I know they put it in one pocket and take it out of the other, but indirectly they are using taxpayers' money to come in here and lobby for us to give them more money to spend on this project.

Now if the committee doesn't feel that this raises a moral issue, that is the moral issue I am raising, not that the Members of the Congress face a moral issue. Then you see—

#### COMMITMENT OF THE FEDERAL GOVERNMENT

Mr. STEED. I want to emphasize that I have no feeling that I have been asked yet by anybody to make a decision that commits me beyond the two prototypes. If we get the two prototypes, and if the actual tests and these scientific people come in here and say that their fears have been well founded, that this is environmentally bad, I assure you that I would have absolutely no inconsistency in my mind or no compunction of being over on the other side with you, when it came to going from that point on, but I just can't see how, in good judgment at this state in time, with the responsibility to account to the taxpayers for what has already been done to them, and what will have to be done to them if we quit, why we don't go ahead and finish what we started, when we are this near to the point of where these very vital answers need to be obtained.

I have been on this subcommittee for 2 years, and if there are any people representing any of these companies in this room, I don't know them. None of them showed the interest to talk to me. The only information I have on this subject has been gained in these committee hearings, and sitting here next to my dear colleague from Chicago, I have heard a whole lot more anti SST than I have heard pro SST, but I still come back to this thing that we have to say we stop or we go ahead. That is the only thing we can decide. As a matter of just plain economics, I think we have to go ahead.

Mr. UDALL. This is a question Congressman Mahon asked, and I want to deal with it again, because if there were a piece of authorizing legislation, or if there were limits written into the appropriations bill

that committees have passed, in which you said, "We are going to produce two prototypes, and then we are going to test them and we are going to go into the environmental questions, and then we will later make a decision whether we do something," that would be one situation.

This is not our situation. This is an open ended ball game, and the gung ho people who have been presenting testimony, and who are sitting in this room, are talking about the 150,000 jobs and off we go. Quite frankly, I think that we would have a different issue here, if it weren't for the fact that the building of the prototypes is making the decision to go ahead. That is what really bothers us.

Mr. STEED. I don't feel that way at all. The testimony here is that this wraps it up as far as the expenditures are concerned.

Mr. UDALL. Congressman, you see, once you have spent the \$1.2 billion or \$1.5 billion or whatever it turns out to be on the prototypes, the Government is through then. It is out of your hands. It is in the hands of industry. This is the reason we have to raise the issue now.

#### ABILITY TO STOP THE SST AFTER THE PROTOTYPE PROGRAM

Mr. STEED. No. There is one factor here now that didn't exist last year. We have the Environmental Protection Agency now, and if the prototype tests prove that this has environmental effects that are unacceptable, it can be vetoed.

In addition to that, with that kind of information, and with the actual tests of our own prototypes, since the British and the Russians are making SSTs, we would have something to go into an international conference with that would have meaningful effect in trying to stop other people from polluting the atmosphere with this type plane.

If the whole ball game was just whether we stopped or went ahead, if that solved the whole SST thing, that would be one thing, but it doesn't. It just decides what part we will play in it, and it means that we won't be able to play an effective part to stop it or to start it. When you think of it in those terms, I just can't see any logic to not going this one more step, because if it is going to be as bad as the opponents say, we are certainly going to need all the weight and argument that we can get, when we go to international conferences, to see to it that somebody else doesn't pollute the world we live in.

Mr. UDALL. In my view, Congressman, once you make about two more appropriations, you have done your bit, and it is in the hands of the industry. You are out of it.

Mr. STEED. But if the Environmental Protection Agency has found out by its research by that time that it shouldn't be built they can block it.

Mr. UDALL. I doubt it.

Mr. STEED. They have that authority. They testified so.

Mr. CONTE. Would the gentleman yield?

Mr. STEED. Yes.

Mr. CONTE. I am intrigued. I think you have come up with a very good idea here, a good thought. What you are saying is that you wouldn't be opposed to this if some language were put into the bill—

Mr. UDALL. No, I didn't say that.

Mr. CONTE. Let me have it again, the limitation language.

Mr. UDALL. No, what I said, Congressman, that it would be a different ball game if there were authorizing legislation that everybody was bound to.

Mr. CONTE. Not this committee, the authorizing committee.

Mr. UDALL. That is right, so that the country understood, the industry understood we were going to build prototypes really as experimental aircraft, and we were going to take a 5- or 7- or 10-year period then to do all kinds of experiments, and then we would come back and make a decision, but we are not in that kind of a ballpark here today.

Mr. STEED. Mr. Chairman, I just want to close with one statement. I want to reassure my friend that no one with \$350,000 or no one with pennies has made any overtures to me, and so far as I am concerned that is a worry that you don't have to have.

Mr. UDALL. I know the Congressman too well to——

#### LIMITING THE GOVERNMENT'S COMMITMENT

Mr. YATES. Will you yield for a question?

Why isn't it a good idea for the Appropriations Committee to point out that the limitation or the obligation of the Government will stop at the conclusion of appropriations for the two prototypes?

Mr. UDALL. Congressman, you are talking about not the flying prototypes, but about the engineering prototypes.

Mr. YATES. I am talking about the two prototypes. I think they will be inadequate. They will probably fly, but the testimony shows that there will have to be a tremendous amount of experimentation on the production version of the plane that is going to have to be paid for by industry. I don't think industry will want to come up with that money. That is why I wonder whether you meant what you said a few minutes ago, when you said that when we make two appropriations, that is all as far as we are concerned.

I think that industry is going to come back to us and ask us to finance the production version of the plane.

Mr. CONTE. That is what I was driving at.

Mr. UDALL. Yes, you are probably right.

Mr. McFALL. Mr. Edwards.

#### DISCUSSIONS WITH AIRLINE EXECUTIVES

Mr. EDWARDS. I thank you, Mr. Chairman.

I join with my colleague on the other end of the aisle, Mr. Steed. Maybe he and I are so far down the line that none of these lobbyists care about us, but I haven't seen any of these folks either, and I am a little worried about the way the word "lobbyist" has been thrown around in here, because I think it leaves a bad connotation in the record. If they are spending \$350,000. I don't know where it is being spent. Certainly I haven't seen any of the results of it.

When did you have your discussion with the airlines' presidents that you referred to?

Mr. UDALL. That has been over the past several months, and it has been casual. It is people that I happen to know.

Mr. EDWARDS. Cocktail party type discussions?

Mr. UDALL. Casual. This is both present and former airline executives.

Mr. EDWARDS. When did you become Secretary of the Interior?

Mr. UDALL. Ten years ago last January.

Mr. EDWARDS. And you were Secretary during the Kennedy administration, and were you Secretary during the Johnson administration?

Mr. UDALL. Yes, the entire 8 years.

#### STATEMENT AGAINST THE SST

Mr. EDWARDS. When was the first time you ever spoke out against the SST?

Mr. UDALL. Oh, I did a great deal of arguing with people in the White House in the early sixties when it was first talked about, and then later when it came up when President Johnson made a decision in 1965 and 1966.

Mr. EDWARDS. I mean publicly.

Mr. UDALL. I appointed the committee very publicly. I think it was a second page story in the Washington Post, in 1966. I will tell you about it, to give you a little flavor of the Johnson administration. This appeared in the Washington Post that morning. I got a call—

Mr. EDWARDS. Are you talking about the appointment of the committee or the report?

Mr. UDALL. The appointment of the committee. I got a call from Joe Califano who ran things on the domestic side for President Johnson. He said, "Are you out of your mind? You are counter-acting. The President has made a decision for the SST."

I said:

"Just a minute, Joe. The President has made a decision to go ahead with the research and development program. No decision has been made on whether this flies over land, and I am responsible for national parks and wilderness and historic sites and all these other things that I believe are threatened, and this committee is studying the effect of the sonic boom within this country."

I was out in the open on this, and the only reason I could hold him off was, I said, "That question hasn't been decided. The administration has decided to go ahead with the research. It hasn't been decided whether it flies over land."

#### SUPERSONIC FLIGHTS OVER LAND

Mr. EDWARDS. But it has been decided now, hasn't it?

Mr. UDALL. No.

Mr. EDWARDS. Oh!

Mr. UDALL. Whether it flies over land? I don't think so. I don't think this administration has said so conclusively.

Mr. EDWARDS. I think this committee would be mighty surprised if that plane ever flew over land.

Mr. CONTE. Supersonically?

Mr. EDWARDS. I am talking about supersonically.

Mr. UDALL. Supersonically. I was very skeptical of DOT and FAA while I was still in government about statements. These were press statements that were made, that didn't bind anybody to anything, because the science committee that I appointed, as I said, came back to me and they said:

If it is built, it will fly over land, because that is the only way that it will pay off economically. You will sell three times as many planes if it flies over land.

That is what they said to me.

Mr. EDWARDS. That was 5 years ago.

Mr. UDALL. That is right.

Mr. EDWARDS. And a lot has happened since then, including the testimony of many people like you, and the concern of many scientists. Perhaps for lack of a better word you can say that compromises have been made, with perhaps what had been planned in the mid-sixties, but I think the testimony has been very clear here, from the Secretary of the Department of Transportation, from the FAA, and others, that this plane will not fly supersonically, not only over our land, but over anybody's land.

I recall a year ago bringing this very point out that we were not just talking about our country, but that we were talking about any land mass, and we had the assurance a year ago that this was not going to take place.

Mr. UDALL. Congressman, I will feel very uneasy about any statements, you know, as a former Cabinet officer, until Congress writes a law on it. If you wrote a law and the President signed it I would feel a little bit easier. I will be frank with you.

Mr. CONTE. That is what I used to try to tell you about quotas on residual oil.

Mr. EDWARDS. To wind this thing up, let me get it in proper perspective. You are here on behalf of the coalition against the SST, but you have made it pretty clear in your testimony that you are speaking as one man, and I think it is fair to say with a minimum of expertise, but more as an interested citizen concerned with the environment. Is that a fair way to put your testimony?

Mr. UDALL. Congressman, you characterize it any way you want. I have been probably as deep in this environment thing the last 10 years as anybody and I am not a scientist, and in my statement I don't pretend to give you scientific testimony. But somebody has to try and sum the thing up, and that is where my experience in Congress and in government has been. That is all I have tried to do for these people today.

Mr. EDWARDS. For example, you say that you are skeptical of Mr. Magruder's figures, but I am not sure on what basis you are skeptical.

Mr. UDALL. I am skeptical because of the track record of the FAA. Look at it. I invite the Congressman from Illinois to take a look at it. I think the whole history of the FAA on this project is pretty shabby and pretty wrong, and I have watched it over the years.

Mr. McFALL. Thank you, Mr. Edwards. We thank you, Mr. Udall. We appreciate your testimony and are glad to have you here and glad to see you again.

Mr. UDALL. Glad to be here.

Mr. McFALL. Now we shall hear from our good friend, Congressman Henry Reuss.

## STATEMENT OF HON. HENRY S. REUSS

Mr. REUSS. Thank you very much, Mr. Chairman, for letting me be with you. The hour is late and you and your subcommittee have been enormously patient. I have a statement which I regret to say is 22 pages long, and I would like to ask consent to put that in the record and then proceed very briefly.

Mr. McFALL. You have everybody on your side on that.  
(Mr. Reuss' statement follows:)

Statement of Rep. Henry S. Reuss (D-Wis.) before the Subcommittee on Transportation of the House Committee on Appropriations 10:00 AM Tuesday, March 2, 1971 Room 2251, Rayburn House Office Building

Mr. Chairman, I appreciate this opportunity to appear before the Subcommittee.

I urge that Federal financial support for the SST be ended. I do so for the following reasons, which I will elaborate in my testimony:

- 1) Continued Federal financing of a luxury commercial aircraft will establish a precedent which could haunt the Federal Government in years to come.
- 2) An end to Federal financing would not kill the American SST, but would simply delay it.
- 3) The adverse consequences of such a delay have been exaggerated, since foreign SSTs are not as formidable a competitive threat as has been claimed.
- 4) A delay would permit the SST program to be financed by private money in response to true market demand, and would allow time for the resolution of environmental problems and uncertainties.

## I. AN UNWISE PRECEDENT

The SST is the first commercial aircraft financed directly by the Federal Government. Other commercial jets have benefitted from the technology developed in Federally-financed military aircraft programs, but never before has the Government undertaken to develop an airplane solely for commercial use. It is, as the editor of Aviation Week proclaimed on January 5, 1970, "a new type of government-industry partnership."

Is this just a one-shot deal, or does it mean that the Federal Government is going to have to subsidize every new generation of commercial aircraft from this time forward? If the Transportation Department's justification for government financing of the SST is taken at face value, that is precisely what it means.

SST Director William H. Magruder put it this way on August 12, 1970:

At the present time a unique situation has developed -- the commercial aircraft technology for large aircraft in the SST area has exceeded military technology. We do not have the military research and development programs to underwrite the development cost of a commercial SST. This situation produced a need for a new approach to government participation in commercial aircraft development. ("The SST and the National Interest," paper presented to the National Aeronautics Association)

But this situation is not "unique" in the sense that it will not happen again. The age of the manned bomber is over. Even the Air Force "Bomber Generals" acknowledge that the bomber currently being developed, the B-1, will be the last manned bomber, and there is still a great deal of doubt that that plane will ever be built. It is unlikely, therefore, that the commercial aircraft industry will have much military aircraft technology to build on in the years to come.

If the SST goes forward as now planned, therefore, it can be cited as precedent for a direct Federal subsidy for every new generation of commercial aircraft from this time forward. This kind of subsidy may or may not be a good idea -- my view is that it might be justifiable if the aircraft in question was designed to benefit a large enough portion of the population. But on this test, the SST clearly fails.

It greatly pains the Department of Transportation to hear the SST described as an airplane for the "jet set." But it is hard to think of any other way to characterize it. SST Director Magruder himself admitted last August that only 10 percent of the American people would be flying internationally by 1985. (Hearings before the Senate Transportation Appropriations Subcommittee, August 27, 1970, p. 1357) But that is not the whole story. At the present time, only 8-10 percent of those who fly internationally pay first class fares. If the SST is going to be principally a first-class, premium-fare plane (and most of its proponents acknowledge that it will be, if only to avoid driving subsonics out of the market), then only around 10 percent of international travelers will be using the SST. That comes out to 1 percent of the population, and that is surely a "jet set."

If we look at the question another way, and ask who travels internationally on a regular basis (an average of one trip per year), it turns out that only about one-half of one percent of the country's population does so at the present time (see Hearings on the SST before the Subcommittee on Economy in Government of the Joint Economic Committee, May 11, 1970, p. 989). This percentage may well increase over the next 10 or 15 years, but not enough to make regular international travelers a significant portion of the population.

## II. DELAY, NOT DEATH

I do not think that even the Transportation Department would say that an end to Federal funding of the SST would irretrievably doom the plane. It would delay it, to be sure, but I don't think there is much doubt that an SST can eventually be built without Federal money.

A bit of history might be instructive on this point. In the late 1940's there was considerable support in the aircraft industry for proposals that the Federal government finance the construction of a jet transport prototype. The price tag was put at anywhere from \$100 to \$250 million. Federal support was needed, the industry said, to meet the competition of the British, who were investing some \$300 million in a jet transport prototype of their own.

But Congress balked at these proposals for government intrusion into the private marketplace, and there the matter ended. Ended, that is, until 1952, when the Boeing Company decided to invest \$16 million of its own money in the construction of a jet transport prototype. With this investment -- one-tenth of the prototype costs estimated a few years before -- Boeing succeeded in building a jet transport prototype which started them on a highly successful privately-financed commercial aircraft program.

As for the British, their government-subsidized entry, the ill-fated Comet, never was able to compete with the privately-financed American jets, despite its head start.

This history was recounted by Dr. George Eads, a Princeton economist, at the Senate Hearings on the SST last August 28 (Senate Hearings, pp. 1736-44). The reason why \$16 million was enough to develop a prototype in 1952, when estimates had run more than ten times higher a few years before, Dr. Eads testified:

was that jet engine technology, the primary limiting factor, had advanced to a point where, without paying the great costs always associated with any attempt to expand the technological base rapidly, the industry could build a commercially viable transport offering increases in speed at no increase in seat-mile operating costs. (p. 1738)

I am no expert on aircraft technology or economics, but it takes no expert to deduce a lesson from this. Little is gained, I suggest, by forcing development of a commercial aircraft before the technology is ready and the market requires the plane. And the fact that the Federal government must haul the SST into existence by main force and the investment of more than a billion dollars of the taxpayers' money is the best possible evidence that this is exactly the mistake that is being made now.

If Federal financing is ended now, as I propose, the Government will receive all the work that has been done (see Senate Hearings, August 27, 1970, p. 1459). Under the Government's contract with Boeing, this includes:

- "the fabricated or unfabricated parts, work in process, completed work, supplies, and other material ..."
- "the completed or partially completed plans, drawings, information, and other property ..."
- "the jigs, dies, and fixtures, and other special tools and tooling acquired or manufactured..."

(Contract FA-SS-67-3, n. CP-7)

At such time as Boeing or another aircraft manufacturer is ready to go forward with the SST with its own money, the benefit of all the work done so far will be available to it from the Government, on what we must assume will be reasonable terms.

How long this will be after Federal financing is ended I am not qualified to say. This is, of course, a critical question, and one the Transportation Department might well be asked to answer.

Let us assume, however, that it will be five years, so that American SSTs will begin flying commercially in 1985 rather than 1980. What are the likely consequences of such a delay?

### III. THE CONSEQUENCES OF DELAY

#### A. Jobs

An end to Federal funding and a delay in the program would mean that some jobs would be lost. According to the Transportation Department's latest public estimate, there are now some 14,000 people working on the SST -- 6,300 with Boeing, 3,600 with Boeing subcontractors, 1600 at General Electric, and 2000 with GE subcontractors (Aviation Week, December 14, 1970, pp. 16-17). Many if not most of them would lose their jobs if Federal support for the SST were ended.

This consequence should not be minimized. It would make the current bad situation in the aerospace industry worse. But it is part of a larger problem. Boeing's employment in Seattle has declined from 101,000 to 45,000 in the past two years despite the SST (Aviation Week, November 9, 1970, p. 23). Lockheed laid off 6,500 of its California employees in early February because of the Rolls-Royce bankruptcy (Aviation Week, February 15, 1971, p. 34). And in the aerospace industry as a whole, some 400,000 jobs have been lost in the last two years, down from the 1968 high of 1,418,000. (Aerospace News, November 10, 1970)

The SST is not going to solve the unemployment problems of the aerospace industry -- it is a deception to hold it out as a mammoth work-relief program. The solution to the aerospace industry's problems does not lie in keeping men at work on marginal and uneconomic programs -- it lies rather in retraining workers and converting firms to more vital work, and we should get busy on that rather than allowing our attention to be diverted by technological WPA programs.

#### B. The Balance of Payments

Delaying the SST until private funding becomes available could have an adverse <sup>effect</sup> ~~consequence~~ on our balance of payments if the first-generation French-British Concorde is highly successful and if a second generation "Concorde II" is developed, and if a number of other things happen. But no one really knows what the consequences will be. As John Kenneth Galbraith has put it:

All judgments on the balance of payments effects of building the SST are purely speculative. By choosing the figures and selecting the assumptions, one can reach whatever results he wants... The truth is that these calculations are strictly fraudulent and should detain no one. (Cong. Rec., Sept. 15, 1970, p. S15400)

Even SST Director Magruder admits that his prophecies of balance of payments doom from failure to fund the SST "at best ... only convey possibilities of what could happen." (Senate Hearings, August 27, 1970, p. 1346)

It is worthwhile, however, to look for a moment at the American SST's foreign competition, to see just how formidable it is likely to be.

The British-French Concorde is scheduled to enter airline service in 1974. But there are many hurdles which must be overcome first.

Enthusiasm for the Concorde among the world's airlines is less than total. According to a February 20, 1971, report in the London Observer, BOAC has told the British government that it "sees no way of operating the ... Concorde economically." And an analysis of the Concorde's economics by Air France, the French national airline, came out "even worse than BOAC's." Both airlines calculate, the report said, that the Concorde will cost twice as much to operate as the Boeing 747 jumbo jet.

According to BOAC and Air France analysts, the Observer reported, "operating losses are expected even with the most favorable seating and fare structure."

"Already," the report goes on, "potential airline customers for Concorde are having grave doubts about securing enough passengers to justify services before 1980."

The Concorde's poor economics is not the only problem. The Concorde is a very noisy plane. According to the manufacturers (British Aircraft Corporation and Aerospatiale), the Concorde will have the following noise figures when it enters service in 1974: sideline, 111 EPNdb; takeoff, 114 EPNdb; and approach, 116 EPNdb. (Aviation Week, February 8, 1971, p. 77) It will be higher at every measuring point, therefore, than the maximum noise level permitted for new subsonic aircraft under Federal Aviation Administration regulations.

If this noise limitation (108 EPNdb) is applied to supersonic aircraft -- and there are strong indications that it will be -- then the Concorde will be barred from all American airports. The implications of the FAA's pending supersonic airport noise rule have not been lost on the French and British. In comments submitted to the FAA by the French Embassy last November, French aeronautical authorities said that applying the subsonic noise rule to supersonic aircraft "would be tantamount to denying supersonic transports the right to exist."

The British Government was a little more cautious in its comments to the FAA, arguing that it would not be "appropriate" to apply the subsonic noise rules to the Concorde since their application for airworthiness certification was made back in 1962 before the new noise standards were developed. (Both comments can be found in FAA Docket No. 10494, Comments on the Advance Notice of Proposed Rule Making on Civil Supersonic Aircraft Noise Type Certification Standards)

The proposed FAA rule is not the Concorde's only problem, however. Bills pending in many states would prohibit new aircraft with noise levels as high as the Concorde's from landing in the state. The New York bill, for example, would set noise limits at the same level as the FAA rule for new subsonics (108EPNdb). According to Anthony Wedgwood Benn, former Labor Minister of Technology and a Member of Parliament from Bristol, where the British Concorde is being made, the New York bill would "effectively kill the Anglo-French supersonic transport." (Washington Post, February 23, 1971)

The Concorde's manufacturers are apparently saying as little as possible about the plane's noise difficulties in their discussions with potential airline customers. As one airline official put it, the manufacturers' attitude seems to be "Let's sweep it under the rug, because the airplane will be so wonderful you won't have to worry about noise." (Aviation Week, February 8, 1971, p. 31)

Another of Concorde's trials has been the Rolls-Royce bankruptcy. Rolls-Royce's refusal thusfar to continue with the engine it was building for Lockheed's L-1011 airbus has, according to Lockheed Chairman Daniel J. Haughton, "created a serious lack of confidence in British industry's ability to fulfill other contractual obligations." Another U. S. airline official involved in the Rolls-Royce-Lockheed negotiations was more explicit:

If this program is dead, you can be damned sure the Concorde is dead as far as we are concerned.

(Aviation Week, February 15, 1971, p. 35)

The most unkindest cut of all may come from the British and French governments themselves.

Aviation Week reported in its special February 8, 1971, issue on the Concorde that:

There is quiet, behind the scenes opposition to the Concorde in top government and aerospace industry circles in both countries, nurtured by a fear that the Concorde's development funding is so large it continues at the expense of funding other smaller projects that could have national and export values. (p. 84)

A recent speech by British Prime Minister Edward Heath lends some confirmation to this. Commenting on the Rolls-Royce bankruptcy, Heath said:

Governments must rid themselves of the illusion that you can find the way to prosperity by pouring out the taxpayers' money in perpetual subsidies for uneconomic ventures. (New York Times, February 8, 1971)

And in a column in the February 22, 1971, New York Times, London Bureau chief Anthony Lewis reported that "the British Treasury would dearly love to be relieved of Concorde."

A decision on the Concorde is expected to come at the end of this month, when British Minister of Aviation Frederick Corfield is scheduled to meet again with his French opposite number, Transport Minister Jean Chamant.

\* \* \* \* \*

The Transportation Department's fears are not aroused as much by the first-generation Concorde, however, as they are by a possible second-generation Concorde that would be more competitive in speed and payload with the American SST. This would be the real competition if the American SST is delayed until the mid-1980's. But how real is the spectre of Concorde II?

Right now it is just a gleam in a designer's eye. Aviation Week reports that a French advanced design team has started preliminary work on a second-generation Concorde that could be ready some time in the period 1980-85 (Aviation Week, February 8, 1971, p. 41). It would take considerable optimism however, to suppose that the British, who have tried repeatedly to rid themselves of the first-generation Concorde, would allow the French to seduce them into an encore with a wholly new, second-generation aircraft.

Just three months ago, the British government decided not to fund two aircraft -- the BAC 311 and the A-300 Airbus -- that are part of the European "family of aircraft" often cited by SST Director Magruder as posing a competitive threat to the U.S. aircraft industry. In announcing the Government's decision, British Aviation Minister Frederick Corfield said the investment of public money required for the planes was excessive (Aviation Week, December 7, 1970). This is not the action, I suggest, of a government that would be eager to enter into the financing of a second-generation Concorde.

There is of course a Russian SST, the Tu-144, scheduled to go into service in the next year or so. The Soviets have put an ad or two touting their aircraft in the aviation trade press, but as far as I know no Western airline has any thought of buying the Tu-144.

General Elwood Quesada, a member of the board of American Airlines, told the House-Senate Subcommittee on Economy in Government last May 7, 1970, that:

It is often suggested that if we do not develop the airplane the Russians will. Let the Russians develop it. If they do nobody will buy it. They never have. I do not know of a single Russian airplane that has ever been purchased on this side of the Iron Curtain. I doubt very much if any airplane in the Russian inventory today could be given away this side of the Iron Curtain. (Hearings, p. 927)

#### IV. THE ADVANTAGES OF DELAY

Delaying the American SST by ending Federal financing would have two principal advantages:

- 1) it would give the airlines more time to lift themselves out of their current economic doldrums and absorb the new jumbo jets and airbuses; and
- 2) it would allow more time for the development of quieter SST engines, and for the resolution of uncertainties about the SST's impact on the upper atmosphere, weather, and climate.

A. For The Airlines

U.S. airlines lost around \$170 million last year, and future passenger growth is uncertain. At the same time, they are in the process of acquiring large numbers of new, jumbo-size aircraft -- principally Boeing 747 jumbo jets, and the DC-10 and Lockheed L-1011 (maybe) airbuses.

Given this situation, their attitude toward the SST seems to be, not surprisingly: "We'll buy it if we have to, but we're not in any hurry."

Just last month, Robert F. Six, President of Continental Airlines (which has reserved three SST delivery positions) told the Senate Aviation Subcommittee: "I don't think there is a rush for the SST." (February 3, 1971, transcript, p. 353)

Others in the industry have stronger feelings about it. Former FAA head General Elwood Quesada, now a member of the board of American Airlines, told the House-Senate Subcommittee on Economy in Government last May 7, 1970, that:

There are a lot of people that say that the airlines wish the airplane would go away. And I am one of them.  
(Hearings on SST development, p. 937)

Six European airlines have reserved a total of 29 SST delivery positions. According to Aviation Week for December 14, 1970, "None of the airlines is particularly eager to take early delivery on supersonic aircraft." Privately, this report said, these airlines hope for a stretchout "that will give them time to absorb the wide-body jets before the supersonic transport is ready for service." (p.19)

B. For The Environment

1. Airport Noise

A delay in developing the SST would allow more time to solve the SST's airport noise problem.

Just last week, Boeing, GE, and the Transportation Department began proclaiming that the SST's airport noise problem has been solved. The production SST, they said, will be able to meet the 108 EPNdb maximum noise level set for new subsonic aircraft by the FAA on approach, takeoff, and at the sideline. (New York Times, February 23, 1971)

There is a little more to this than meets the eye, however. First of all, when this claim is put officially on the record, it becomes more cautious. In a letter to me dated February 19, 1971, SST Director Magruder put it this way:

We are now optimistic that prior to production commitment, the capability of the commercial SST to achieve noise levels consistent with those required for certification of new four-engined, intercontinental subsonic aircraft will be demonstrated.

Furthermore, what effect are these new developments going to have on the range, payload, and economics of the SST? The major factor in this projected noise level improvement is a decision to increase the size of the engine in the production version of the SST. According to Aviation Week, a GE official has conceded that:

The planned changes in engine size will have some adverse impact on the economic characteristics of the production version of the aircraft.... He said the most likely result of the engine change is that the return on investment to the airlines could suffer due to the increased price of the engine. The payload fraction of the total gross weight will decline, he for ~~ca: t~~ and the gross weight will increase as well. (Aviation Week, February 15, 1971, p. 26)

In his letter to me, Mr. Magruder alluded to this problem:

These improvements in aircraft and suppression performance were only recently identified; therefore, we have not been able at this point in time to fully analyze the impact, if any, on the economics of the aircraft.... We are certainly optimistic that the technology is now in hand to afford this significant reduction in SST noise without a prohibitive adverse effect on the performance or economics of the United States SST.

But even if all goes well, and SST noise is reduced to 108 EPNdb without significant performance or economic penalties, is this going to be enough to satisfy the noise-plagued communities that now surround airports? The SST, after all, will not enter airline service until 1978 or 1980. Suppose the noise of subsonic aircraft has been reduced well below 108 EPNdb by that time -- will a 108 EPNdb SST still be acceptable?

An indication of the answer to that question is contained in the comments of the Airport Operators Council International on the proposed FAA supersonic airport noise regulations. AOCI member airports handle virtually all of the international scheduled airline traffic in this country. In a letter to the FAA dated October 26, 1970, AOCI President Matthias E. Lukens said:

Neither the public nor Congress will tolerate the introduction of a new airplane, built largely with public funds, with noise levels greater than that produced by aircraft which will have been in operation for the preceding eight years. (FAA Docket No. 10494)

This view is supported by the comments of the Transportation Administration of the City of New York, signed by Commissioner Charles Leedham of the Department of Marine and Aviation:

It is the essence of this position and comment that certification of any supersonic aircraft must be withheld unless that aircraft is capable of operation without increasing the present aviation noise imposition on any community area around or near an airport...

There is certainly no other course open if any SST is to operate at an airport in New York City. (FAA Docket No. 10494)

The question then becomes, can the noise of the subsonics be reduced below 108 EPNdb? There is strong evidence that it can. A just-published study by the National Academy of Sciences - National Academy of Engineering entitled "Jamaica Bay and Kennedy Airport", reviews two programs to reduce engine noise which have been underway at NASA since 1966. The NAS-NAE report concludes that "the present fleet of 707 and DC-8 aircraft could be quieted to 95 PNdb for an added investment of approximately \$4,000,000 per aircraft." In addition, "new aircraft with engines properly optimized to noise criteria, should be able to meet a new noise rule, 10 EPNdb lower than FAR 36 [the rule establishing the 108 EPNdb maximum], with less than 10 percent cost penalty." (Volume II, p. 116)

The NAS-NAE study group therefore recommended that the Department of Transportation "establish a regulation requiring that all new aircraft have engines that are quieter by 10 EPNdb (effective perceived noise level) below present standards by 1975." (Volume... I, p.2)

In issuing the present 108 EPNdb rule for new subsonics, the FAA committed itself to achieving additional noise reductions "as soon as technology permits":

The FAA cannot responsibly accept [the 108 EPNdb level] as satisfactory where further noise reductions are available and reasonable. (Fed. Reg., Vol. 34, No. 221, Nov. 18, 1969)

Even if the SST can meet the 108 EPNdb limit by 1978, therefore, it is not going to be good enough. With more time and research, it may well be possible to develop an SST that will be no noisier than subsonic jets of the same era. But to continue the program now with no prospect of reducing the noise below 108EPNdb would be folly. A much better course would be to end Federal funding of the SST now, while continuing to devote funds to programs aimed at reducing engine noise.

## 2. Upper Atmosphere

The MIT Study of Critical Environmental Problems in July, 1970, concluded that the potential impact of the SST on the upper atmosphere and on weather and climate was a matter of "genuine concern" :

We perceive that man's activities as he flies the projected 500 SSTs can have a clearly measurable effect in large regions of the world where they will fly, and quite possibly on a global scale. The effects will be most pronounced in the stratosphere, but we cannot exclude the possibility of significant effects at the surface. We must emphasize that, due to the uncertainties in the available information and its interpretation, we cannot be certain about the magnitude of the various effects.

Therefore, we recommend that uncertainties about SST contamination and its effects be resolved before large-scale operation of SSTs is implemented. (Report of the Study of Critical Environmental Problems, p. 107)

As the MIT study makes clear, we just don't know what the impact of the SST will be on the upper atmosphere, and a great deal of scientific work is needed before we will know.

On July 20, 1970, SST Director Magruder announced a \$27 million research program to explore SST environmental problems, including the possibility of upper atmosphere pollution and weather and climate modification. Mr. Magruder told the Senate Transportation Appropriations Subcommittee on August 27, 1970, that this research program would provide "unequivocal" answers before the decision on SST production is made sometime in 1973-74. (Senate Hearings, p. 1337)

However, in a June 5, 1970, report describing the weather and climate modification research, Dr. Robert M. White, Administrator of the Environmental Science Services Administration told Mr. Magruder that, while the scheduled program "should have answers to many of the questions about climatic effects from aviation by 1973 when a decision concerning the production of a fleet of U.S. SST aircraft must be made":

Many of the problems being investigated are exceedingly complex and positive assurance of success by 1973 is impossible. Further, new problems may be uncovered; in many cases the new proposed programs examine virgin fields of the atmosphere and its properties.

Despite Mr. Magruder's assurances that all the answers will be found by 1973, therefore, it appears that more time will be needed to determine just what the SST's impact on the upper atmosphere will be.

However, Mr. Magruder has also contended that the impact of the SST on the upper atmosphere cannot be determined without flying the two proposed SST prototypes:

~~The~~ desired degree of certainty about these matters has not been attained, and for that matter cannot be attained until the prototype SSTs are test flown. These two airplanes provide an additional and potentially very useful test-bed to evaluate fully the above environmental questions - to bridge the gap between the real and theoretical world. ("The SST and the National Interest", presented on August 12, 1970, to the Executive Committee of the National Aeronautics Association)

This contention is challenged, however, by Dr. Richard L. Garwin, who headed a review of the SST in early 1969 by a panel of the President's Science Advisory Committee:

It is not the prototype construction or flight test which answers the environmental questions -- it is the research program, completely independent of the prototype. When Mr. Magruder says the prototype is an excellent opportunity to acquire experimental data of broad environmental and meteorological value, he much overstates the case. The U-2 flies very inexpensively at present in the altitude region of the SST, and the SR-71 flies both higher and faster. Most of the research would be done without any actual flying in that region, e.g. by balloon flights, etc., but what flying is required could be done just as well by the U-2 and with occasional involvement of the SR-71. (Supplement to prepared oral presentation before the Senate Transportation Appropriations Subcommittee, August 28, 1970)

Dr. Garwin's view is confirmed by the comprehensive description of DOT's upper atmosphere research program prepared by Dr. White of the Environmental Science Services Administration, which I mentioned earlier. As described there, the program involves monitoring the stratosphere with existing aircraft, simulated laboratory experiments, mathematical and geophysical "modelling" of the upper atmosphere, and the formation of contrails in the stratosphere with existing aircraft. Nowhere is there any suggestion that the two SST prototypes will be needed or used.

This research into possible upper atmosphere pollution and weather and climate changes should be continued until solid answers are found. The SST prototypes are not needed for this research. Federal funding of the SST should be ended, therefore, so that the research can go forward at an orderly pace without "crash program" pressures and distortions.

#### V. CONCLUSION

I come to delay the SST, not to bury it. Let us vote an end to the further expenditure of taxpayers' money on the SST. Then, if private industry can build an environmentally-sound SST with private money in a few more years, let us give them our blessing.

In the meantime, we should bring to bear the full resources of the Federal government in order to aid the 14,000 aerospace workers who may be laid off as a result of this action. They, along with other unemployed or underemployed aerospace industry workers, should be given retraining if retraining is necessary. Then every effort should be made to channel them into new work that will benefit them and the nation. New skills and new ideas are needed in mass transit, pollution control, housing, health care, and a host of other areas. The men and women who have proved their ability and inventiveness in the aerospace industry can make a contribution here that can have truly lasting value.

## STATEMENT BY MR. REUSS

Mr. REUSS. Thank you, Mr. Chairman, and I will obey the admonition of the Secretary of Transportation from yesterday that we opponents of the SST refrain from hysterical slogans. I am not going to utter any hysterical slogans. I am going to refrain, for instance, from looking at the opinion polls which show that 90 percent of the American people don't want the SST or don't want to pay for it, and I am not going to shout "power to the people," so there will be no problem with hysterical slogans at all.

I want to talk briefly not about ecology, which has been discussed by earlier witnesses, but about economics, and I suggest that the fundamental question before your subcommittee and before us all in Congress is whether the Government ought to subsidize private activity except where the general welfare is clearly involved. My point here is that in the SST program the general welfare is not involved.

About one-half of 1 percent of the American people now take an international trip by airplane every year and only 8 to 10 percent of international travelers are able to pay a premium fare. That means that about one in 2,000 Americans is a candidate for the SST today.

If you take Mr. Magruder's projections for 1985, he says then that 10 percent of our people will be flying internationally. Well, assuming the same 8 to 10 percent who can pay first class will be flying on the SST, that would be at most 1 percent of the American people in 15 years.

Now, whether it is 1 percent or one-twentieth of 1 percent, that number obviously doesn't represent the general welfare. It represents a limited group. It probably is true that 1 percent of the American people like yachts. I don't hear anybody suggesting, and I am glad we don't, that the Federal Government therefore subsidize yachts. This would make jobs, I suppose, but it is not under consideration because it obviously is not for the general welfare.

I think that it would be a mistake to continue the SST. It is too bad that we have expended \$1 billion or more on it, but to pour further hundreds of millions into it seems to me a mistake.

This committee showed us all a good example which I heartily supported a year or two ago when, though the Congress had poured many millions of dollars into the Mohole project for digging a hole underneath the Pacific, we decided to stop funding that program. I think that was a wise decision. The decision was basically that when one has made a mistake one should cut one's losses. I don't think we made a mistake at the outset. When we started the Mohole it seemed like a good idea. Equally, I don't think we made a mistake when we realized that circumstances had changed and therefore we weren't going to go on with it.

I say this because I think that every member of this committee, and certainly Chairman Mahon, your great chairman, has as a philosophical precept in all of their appropriations matters that the taxpayers of the United States ought not to subsidize private activity except where it is for the general welfare.

If we stop the SST this would affect the 4,000 workers at Boeing and a total of about 10,000 more, 14,000 in all, at GE and the various subcontractors, and I am deeply sensitive to their plight. Our Government Operations Committee through the Conservation Subcommittee which

I have the honor to chair, held hearings 2 or 3 months ago on whether the United States could not marshal its existing programs and appropriations for air pollution, water pollution, mass transit, so as to get on with those essential jobs and at the same time cushion the shock to Boeing and the aerospace industry generally, and we had a wealth of testimony that the peculiar genius of the aerospace industry, which is in large systems approaches, could well be transferred to this.

So I would be very hopeful that if the Committee on Appropriations decides that further expenditures on the SST are not conducive to the general welfare, that it would use its superintendence over the other programs which it has in these important fields to cushion the shock.

As far as Boeing itself is concerned and as far as its stockholders are concerned, I am very interested in the hardheaded estimate of a prominent Wall Street investment firm, Clark, Dodge & Co., which a couple of months ago advised its clients, and I am quoting from their newsletter:

We feel that cancellation of SST will enhance Boeing's near term profitability while greatly improving its chances to increase its aircraft market share and earnings in the mid-seventies.

And it spells that out at great length, saying that even though Boeing apparently wants the SST, it would be a more profitable and economical company if it didn't get this help from the Government.

Now, I have to recognize that if our Government decides that further public funding of the SST should not be continued, we would have to recognize that that does give the first round to the Concorde and the Russian TU-144. The question that I ask myself is, is that so bad? Let's look at history.

In 1948 we were obviously on the threshold of the age of the civilian jet. There was a large group of sincere people—I don't call them a lobby—who wanted a subsidy for Boeing and others in order to permit them to be the first on the scene. By a governmental decision at the time it was decided not to subsidize Boeing, so the British got in there first, and this is what the group urging the subsidy had been warning against. The British produced the Comet with government subsidies and the Comet was an economic and commercial dud.

Meanwhile, Boeing all on its own without Government subsidy produced to its great credit the 707 and the whole series culminating in the 747 and helped to make America the leader in the air world. I think that sound decisions were made because the Government did not intervene and distort market decisions.

Now, Mr. Volpe testified yesterday about the Russian TU-144, contending that the Russians were working very hard to see that, and he said, "You can bet that they'll be taking orders at the Paris Air Show."

Well, in my judgment you can bet that they will not be getting any orders there because I think that the generality of Western airline leaders is going to agree with a distinguished member of the Board of American Airlines, Gen. Elwood Quesada, who recently said, and I want to quote him:

It is often suggested that if we do not develop the airplane the Russians will. Let the Russians develop it. If they do, nobody will buy it. They never have. I do not know of a single Russian airplane that has ever been purchased on this side of the Iron Curtain. I doubt very much if any airplane in the Russian inventory today could be given away this side of the Iron Curtain.

As far as the Concorde is concerned, its proprietors, the British and French, seem to be increasingly fearful that it is going to be uneconomic. They are fearful about the denial of landing rights by environmentally conscious States and localities, and they are very fearful that its seating capacity is not enough to provide an economic payload.

Just the other day the French proprietors of the Concorde announced, in their phrase, that the Concorde is not a restaurant and so they are thinking of cutting out eating facilities in order to find 10 extra seats. We can contemplate that one day they are going to announce that the Concorde is not a comfort station and cut out the lavatories. But operating in this way on both ends of the alimentary canal is not going to conduce to a plane the people will want to travel on. So I say leave to the British, the French, and the Russians the first, and I think commercially ill-fated, round of the SST. Let Boeing bide its time and take advantage of the \$1 billion-plus of subsidy it has received from the Government. Let it use market determinations in deciding whether, when, and what kind of environmentally sound second round SST needs to be produced and meanwhile—for I share whatever initial judgments were made on this that turned out to be erroneous—let us all admit that we are big enough to correct a mistake before it consumes several hundred million more of the taxpayers' hard-earned dollars.

Thank you very much, Mr. Chairman.

#### THE GENERAL WELFARE AND THE SST

Mr. McFALL. In the testimony before this committee the director of the program, Mr. Magruder, pointed out that this plane is highly productive, and will do several times as much work as any other aircraft previously built. I wonder why you refer to it as a luxury commercial aircraft?

Mr. REUSS. Simply because, even using Mr. Magruder's figures, it affects at most 1 percent of the American people. I would think that the figure I gave you of one-twentieth of 1 percent is nearer right, but I will accept Mr. Magruder's figure. Thus, it is not in my judgment a general welfare program.

Our canals, our railroads, our merchant marine, our waterways, are general welfare programs. They carry goods or persons for the great bulk of our people. But the SST does not do that any more than the great luxury liners that were paid for by the taxpayers of England and France and Italy in the inter-war period were for the general welfare of their people, and that is why they were given up.

Mr. McFALL. My understanding of what you say is that you feel that it would serve only a very small fraction of the people of the United States, would have very little economic effect, and would be a luxury we can't afford. Is that about what you are saying?

Mr. REUSS. That is precisely it in terms of those who benefit directly. Now, any economic activity which employs directly 14,000 people as the SST now does has some indirect benefits. I think it would also employ as many as 50,000 people in the two prime and the many subcontractors if we actually got into a 500-plane production, and then the butcher, the baker, and the candlestick maker of course have a

multiplier effect. All of that is good arithmetic and good economics, but we come back to the fundamental question: should the Government put into motion something which is not, if I am right, for the general welfare.

The rulers of Egypt who built the Pyramids thought that the Pyramids were in the Egyptian national interest. History takes a less exalted view of it. I am not comparing the SST and the Pyramids, but the real question is: Is a given governmental project of broad enough interest so we should subsidize it?

Thus, as Mr. McFall knows, I vote for projects which involve Government subsidy but which I feel benefit large numbers of people. This one I don't believe does except in the indirect sense that if we had the Government subsidizing the building of yachts that would put people to work and the butcher, baker, and candlestick maker would profit by it.

Mr. McFALL. You are familiar with, but not impressed by, the statistics that Mr. Magruder gives showing the rather large number of people who would be using the SST?

Mr. REUSS. Yes; I have used his statistics. At most, it is 1 percent of our people. He says that by 1985 10 percent of the American people will be flying internationally. That is 10 times as many as fly now. I concede his estimate. I can't disprove it. But even taking that and taking the fact that only about 8 to 10 percent of the people are willing to pay a premium price—and unless you pay a premium price for the SST you are simply going to drive out the subsonics—I come out at 1 percent on Mr. Magruder's figures and to me that is not enough. For there to be a general welfare subsidy I believe it should require direct benefits to the great majority of American people.

#### MILITARY TECHNOLOGICAL BENEFITS

Mr. McFALL. We have heard testimony from Mr. Magruder that the 707 and many of the other airplanes that we have in our inventory at the present time are the result of investment by our country in military planes amounting to approximately \$2 billion. You made a statement indicating that the 707 was built by Boeing without Government help. I wonder if you are familiar with this statement made by Mr. Magruder?

Mr. REUSS. Oh, yes. In fact, I quote director Magruder's statement, or part of it, on page 2 of my lengthier statement. What Mr. Magruder says is, and I quote from him on August 12:

At the present time a unique situation has developed—the commercial aircraft technology for large aircraft in the SST area has exceeded military technology.

What he is saying is something that should be of great concern to all of us. He is saying that there is not going to be any spinoff any more. Therefore, if we establish a precedent with the SST, I am afraid the Government is going to be asked to displace the market place and economic considerations from here on out.

It is true that the 707 profited from military jet aircraft technology. However, Boeing received not a cent for its RD&D on the 707. Boeing is welcome to profit from military supersonic aircraft technology today and I presume is doing so.

Mr. McFALL. Except that Mr. Magruder says they used all the technology that had been developed and put it into the 707.

Mr. REUSS. Yes, and this is one statement of Mr. Magruder's that I can't quarrel with. I think, however, he opens our eyes to a rather alarming prospect, namely, that the taxpayers of the United States will be called upon from here on out to subsidize the research, development and demonstration of generations to come of private commercial planes, and that involves a very fundamental question of the general welfare.

We have gotten our domestic mainline air travel off of subsidy now. I think the pioneering work of this committee in guiding them off of subsidy was in the national interest, but, whereas our domestic airlines do carry a substantial number of Americans and thus can be said to trench on the public general interest, certainly this can't be said of the international SST now or in the future.

#### THE CONCORDE AND TU-144

Mr. McFALL. The testimony that we have received is that the Concorde is going to be a successful plane, and I gather from your testimony that you don't feel that it is going to be a success at all.

Mr. REUSS. I think it will not be a commercial success. That is to say, an airline, Pan Am or whoever, which feels itself locked in and goes through with its commitment or its option to buy, will buy it. The people who fly on that Concorde are going to enjoy that luxury by dint of the tax subsidy of the taxpayers of Great Britain and France, and that isn't economic. We could, as I said before, subsidize yacht ownership in this country. Nobody is suggesting that, but we could do so, and yachting could be relatively cheap because the Government could pick up the tab with yacht stamps, or something like that, but that doesn't make it part of the general welfare.

Mr. McFALL. If the taxpayers in Britain and France do, however, decide to subsidize the Concorde and the Concorde becomes a good flying airplane, wouldn't it have an effect upon our general welfare, particularly if they take over the leadership role in the field of building airplanes?

Mr. REUSS. No. Honestly, no, Mr. Chairman. From the standpoint of our general welfare the 1 percent of the Americans—I will call them no fancy names—the 1 percent of the Americans who want to fly SST can then do so on a Russian TU-144 or Concorde, or whatever they want. Then America and American industry will be turned loose along guidelines which have made American industry great, namely, that we don't go in much for State socialism here. We go in for a market economy; and they will, including I hope Boeing, be figuring out what the world needs on a market basis for the second generation of SST's.

This whole conversation, incidentally, yours and mine, presumes that the environmental problem will be solved. But assuming that is done, then Boeing will get on with it as it did so well in 1950 and 1952. If Boeing determines that there is no sense in a second generation SST because the public doesn't want it, then we ought to thank God for the American free enterprise system. And if the British, the Russians, and the French are such fools as to want to pour their public

funds into a continuation of such an uneconomic first or second generation plane, let them. Let our 1 percent who want to fly them take advantage of that, just as we took advantage of the *Homeric*, *Titanic*, the *Ile de France*, the *Bremen*, and all the other defunct liners of the interwar period.

Mr. McFALL. You seem to be saying eventually we are going to build an SST, but economically it would be better for us to stop this project now and let the French and British go ahead with the Concorde. You imply that it would be economically better for us to drop the \$1 billion that we have invested in the SST, and wait until the Concorde is tested by the French and the British, and then we will be able to pick up the ball and beat the French and British very easily. Is that what you are saying?

Mr. REUSS. Substantially. Then we can pick up the ball if that great determiner of economic activity, the free market, convinces Boeing that this is the thing to do. And again just to protect the record, I want to express that both you, Mr. Chairman, and I have been conducting this discussion exenvironmental considerations. We have assumed there are no environmental problems because they will alter it either way, but if there were no environmental problems and we were just talking economics, I would be just as zealous in my feeling that we should not further fund the SST.

Mr. McFALL. How long do you think we can safely delay this program?

Mr. REUSS. Oh, I think we have had it. I think that the investment has to be for practical purposes written off as was the investment on the Mohole, the Florida Ship Canal, and all the other ideas whose time came and then passed.

#### NEED FOR GOVERNMENT FINANCING

Mr. McFALL. Then sometime in the indefinite future we would start over?

Mr. REUSS. Not we, the Government. I don't think we, the Government, should subsidize any more a transportation system of such limited general benefit as the SST. What I was suggesting was that if the market does want a good second generation SST, an environmentally sound one, if travelers—if the 500,000 Americans who think of themselves as SST passengers—are willing to pay for it, then I think that Boeing will go right ahead and Chase Manhattan and First National City will be delighted to grubstake them and that play of free economics which has made our country great will once again enjoy its own.

I frankly don't think that the grandeur of the United States resides in its flirtations with Soviet-type socialism. Let them make the TU-144. They don't have a marketplace determining pleasures and pains. That is why Czechoslovak shoe factories made all size 12 shoes for a dreadful year or two, because the market wasn't in there dictating what they ought to make.

We have a market economy and it is so ironic to me that the administration of Mr. Nixon which professes dedication to the market economy, which thinks well of Professor Milton Friedman in general market terms, should be blowing the horn for state socialism in the form of SST.

Mr. McFALL. Then leaving the environmental points aside, your opposition to the SST is not really on whether or not we ought to have a SST, but whether the Government ought to indulge in this—

Mr. REUSS. Subsidy.

Let's not say terrible or good. A subsidy which does not benefit the generality of people in the country. It benefits a limited few.

I think not. You have to have some philosophy of subsidy. Otherwise, we could be subsidizing everybody. My own is that the general welfare must be affected before we subsidize private industry. I would be surprised to find that Chairman Mahon disagreed with that.

McFALL. He is going to get to you in just a second.

Have you any questions, Mr. Chairman?

Mr. MAHON. No questions.

Mr. McFALL. Any questions, Mr. Conte?

Mr. CONTE. I want to take this opportunity to congratulate our colleague. There is no doubt, whether you agree with him or not, he has done his homework and done it well. No matter where he appears here in the Congress, he does an excellent job.

He and I have been on the same side of the issue many times over the years. I have always found him to be fair and one who, as I say, does his homework.

This particular project has bipartisan support, whether we like it or not.

Mr. REUSS. I think that is correct.

Mr. CONTE. Thank you.

Mr. McFALL. Mr. Yates?

#### CONCORDE AND THE SST

Mr. YATES. I want to congratulate our distinguished colleague for a very fine statement. I thought he handled very well the arguments on both sides of the issue before coming out logically and conclusively against the SST.

Do you agree with me, Mr. Reuss, that the relationship between the Concorde and the SST is one in which they feed on themselves; that the SST takes sustenance from the Concorde, and the Concorde takes sustenance from the SST? Do you have the impression that I have, that when BOAC committed its gaffe of telling the truth about what the Concorde's earnings were likely to be, there must have been an explosion in the Department of Transportation that reverberated all the way across the Atlantic to the companies that were making the Concorde?

Mr. REUSS. I am sure there was. I have to add, there is nothing sinister about that. All of us when we espouse a cause, espouse it for all it is worth. I guess I am guilty of that myself today.

Mr. YATES. I must confess that I plead guilty to the same. And with that, again I think our colleague is to be commended for a very fine presentation.

Mr. McFALL. Ten o'clock tomorrow morning.

WEDNESDAY, MARCH 3, 1971.

WITNESSES

RUSSELL A. BROWN, COALITION AGAINST THE SST  
 MISS LOUISE DUNLAP, ASSISTANT COORDINATOR, COALITION  
 AGAINST THE SST  
 LAURENCE I. MOSS, THE SIERRA CLUB  
 DAVID BROWER, PRESIDENT, FRIENDS OF THE EARTH  
 GARY A. SOUCIE, CONSERVATION DIRECTOR, FRIENDS OF THE  
 EARTH  
 GEORGE ALDERSON, LEGISLATIVE DIRECTOR, FRIENDS OF THE  
 EARTH  
 DUANE YORK, TECHNICAL AND FINANCIAL CONSULTANT  
 WILLIAM M. MAGRUDER, DIRECTOR, SUPERSONIC TRANSPORT  
 DEVELOPMENT, DOT  
 B. J. VIERLING, DEPUTY DIRECTOR, OFFICE OF SUPERSONIC  
 DEVELOPMENT, DOT  
 R. E. PARSONS, ACTING DEPUTY DIRECTOR, OFFICE OF SUPERSONIC  
 TRANSPORT DEVELOPMENT, DOT  
 HON. CLARENCE BROWN, U.S. REPRESENTATIVE FROM OHIO  
 FLOYD E. SMITH, PRESIDENT, INTERNATIONAL ASSOCIATION OF  
 MACHINISTS AND AEROSPACE WORKERS  
 DR. FRED SINGER, DEPUTY ASSISTANT SECRETARY FOR SCIENTIFIC  
 PROGRAMS, DEPARTMENT OF INTERIOR; CHAIRMAN, SUPERSONIC  
 TRANSPORT ENVIRONMENTAL ADVISORY COMMITTEE  
 DR. WILL KELLOGG, DIRECTOR, LABORATORY OF ATMOSPHERIC  
 SCIENCES  
 DR. LEO BERANEK, CHIEF SCIENTIST, BOLT, BERANEK & NEWMAN,  
 INC.; CHAIRMAN, SUPERSONIC TRANSPORT COMMUNITY NOISE  
 ADVISORY COMMITTEE

Mr. McFALL. The committee will come to order.

We will begin with Mr. Russell Brown, and Miss Louise Dunlap, who has asked to introduce Russell Brown.

So that you may understand the schedule, we will proceed then with Laurence Moss, David Brower, Duane Yorke, and Floyd Smith from the International Association of Machinists this morning, if we can. If we can't, we will start as soon as we can this afternoon with Floyd Smith, Congressman Clarence Brown, and then we will bring back Mr. Magruder with Dr. Singer, Dr. Kellogg, and Dr. Beranek.

Mr. YATES. Mr. Chairman, what do you mean by with them? You don't mean they are going to testify the same time he does?

Mr. McFALL. What we would like to do would be to have Dr. Singer present his statement, Dr. Kellogg present his statement, Dr. Beranek present his statement, and then have Mr. Magruder come back for the cross-examination. We would have all the scientists to answer any questions that relate to their particular field of expertise.

Mr. YATES. Well, I wanted to ask Mr. Magruder about certain aspects of the contract which do not relate to the scientists.

Mr. McFALL. He will be available for that.

Mr. YATES. OK. Very good.

Mr. McFALL. However, since some of the questions presented to him would be in the field of the environmentalists, you might be able to get better information in those areas from them.

Mr. YATES. OK. I think that makes sense.

Mr. McFALL. We welcome you before the committee, Miss Dunlap. We will be pleased to have you introduce Mr. Brown.

STATEMENT OF LOUISE DUNLAP, REPRESENTING COALITION  
AGAINST THE SST

Miss DUNLAP. Good morning, Mr. Chairman and members of the subcommittee. My name is Louise Dunlap. I am assistant coordinator of the Coalition Against the SST. Before introducing the first witness this morning I would like to very briefly submit several things for the hearing record to help complete the data available. First, is a letter from Dr. Milton Friedman, the economist at the University of Chicago. It is a letter to Senator Jack Miller, dated December 2, 1970, stating why Dr. Friedman on purely economic grounds sees no justification whatsoever for the Government financing of the SST. Second, a brief analysis by Dr. Richard Garwin, industrial physicist and member of the President's Science Advisory Committee, stating why the SST prototypes will not be useful in testing the environmental impact of the SST. Third, an analysis by Dr. George Eads, of the Department of Economics at Princeton, which reflects the 44 States that would lose money on the SST based on Department of Transportation figures and industry figures. Fourth, a column by Dan Coughlin of the Seattle Post Intelligencer, dated January 1, 1971, entitled "The SST: Does Boeing Need It?" And, finally, an analysis of the employment based on industry figures, which we will submit before the end of the week for the formal hearing record.

INFORMATION SUPPLIED FOR THE RECORD BY THE COALITION  
AGAINST THE SST

Mr. McFALL. We shall include the information you referred to at this point in the record.

(The information follows:)

DECEMBER 2, 1970.

Senator JACK MILLER,  
*United States Senate,*  
*Washington, D.C.*

DEAR SENATOR MILLER: Prof. David Nelson of Luther College has asked whether I would write to you about my views on the SST. I am glad to do so.

1. On purely economic grounds I see no justification whatsoever for Government financing of the SST. The real issue is not whether the SST should be built, but whether it should be subsidized by the U.S. Government. The SST should be built if it is a commercially feasible proposition that will repay its costs. If it is, then no Federal subsidy is needed. It will be in the self-interest of the aircraft companies to build it. If it is not in their self-interest to build it without a subsidy, then on economic grounds it is not in the social interest to build it with a subsidy. That is simply to throw good money away. The arguments made that it will give jobs or that it will add to our balance-of-payments surplus and the like are all red herrings that have no economic validity whatsoever. If no subsidy is given to the SST, then taxes can be reduced by that much or other Government expenditures increased by that much. The dollars left in private hands or the other Government expenditures will have just as much of an impact on employment as money spent on the SST.

2. Just as the employment and balance-of-payments arguments made for the SST seem to me utterly invalid, so I must state in all candor that the ecology and pollution arguments against the SST seem to me invalid. Pollution will come predominantly from the carriage of passengers by air regardless of the kind of airplane. The sonic boom argument is, of course, entirely valid insofar as it is special to the SST and not to other types of aircraft which would substitute for it.

3. The argument that we must build an SST to compete with France and Britain's Concorde project seems to me utterly false. If their project is not commercially justified, they will lose money on it that will reduce their economic strength. Their throwing good money out is no reason for us to do so. On the other hand, if their project is commercially justified, then I expect an SST to be commercially justified for our own aircraft manufacturers without government subsidy. So whether the Concorde venture is a major mistake, as many people in France and Britain now believe, or whether it is a sound and desirable venture, it does not justify our subsidizing the SST.

4. The only valid argument that I can see for a subsidy to the SST is one that has not been made openly. That argument is that the current mood of the country and of Congress is starving the military for research funds, that there will be a military spin-off from the work on the civilian SST, and that this is the only way to get funds appropriated for an essentially military purpose. I have much sympathy with the view that the present climate of opinion is reducing too much of the funds available for military research, but I cannot accept the morality of doing by deception what the public at large is not willing to do directly. Insofar as this argument is valid, it calls for a direct attack on the public attitude.

I conclude, therefore, that if I were a Senator, I would vote against an appropriation for the SST.

Sincerely yours,

MILTON FRIEDMAN.

From: Coalition Against the SST, 235 Massachusetts Avenue NE, Washington, D.C. 20002 638-2525 February 20, 1971

*What the Prototypes Would Not Settle*

The SST prototypes will not be useful in testing the environmental impact of the SST. Dr. Richard Garwin, an industrial physicist and member of the President's Science Advisory Committee, testified as follows before the Senate Appropriations Committee on August 28, 1970:

There is some confusion about the purpose of the prototypes. These prototypes do not have the purpose of exploring the Mach 2.7 flight regime and the altitude regime of 60 to 70,000 feet—this is already far better explored by the years of experience with an operational fleet of SR-71 reconnaissance aircraft which fly at Mach 3+ at this altitude and higher.

The SST prototypes do not fill the function of determining passenger response to the provision of SST travel, since in the planned flight-test period, they will make only two or three oceanic crossings, if any, and without passengers. The SST prototypes are *manufacturing* prototypes, which serve only to confirm the designs of the Boeing and General Electric Company. There are few pleasant surprises in testing of this type of prototype—there are many unpleasant surprises. The knowledge of manufacturing cost of the prototypes will be of little value in determining production cost on the actual SST, since that is likely to be manufactured by different processes.

Nor will the prototype serve to alleviate any environmental concerns, since the production of sulfur-bearing particulate matter, the influence of water vapor in the stratosphere, etc., can never be determined by a brief flight test of one or two aircraft, but must be investigated by real research not involving high-speed aircraft.

Further, the sonic boom on the ground beneath the aircraft which is predicted by Boeing to exceed 2.5 pounds per square foot during cruise and 3.5 pounds per square foot during acceleration, and which will be felt along a swath more than 50 miles wide below the aircraft track, has no chance in the production aircraft of being weaker than the predicted figures. Finally, the airport noise, which is such a tremendous problem with the SST, can be perfectly well determined without a prototype aircraft in hand, since it is a function of the engine

design and of the aircraft characteristics which are determined by the design and not by the building of the aircraft.

Boeing and DOT scientists corroborated Dr. Garwin's point with respect to upper atmosphere testing, during discussions at the Conference on Aircraft and the Environment (Washington, D.C., February 8, 1971). Atmospheric testing, they said, would be done with balloons, telemetry, and military supersonic aircraft such as the SR-71; the prototypes could help, at best, only by confirming the results of these tests.

---

#### 44 STATES LOSE MONEY ON THE SST

SST proponents have urged Congressmen to vote for the SST to keep their states from "losing" potential subcontract money. But they have failed to point out that this Federal money is not free; it comes from the taxpayers' pockets.

This fact sheet aims to give a more realistic picture by presenting costs as well as benefits—showing what your State will *have* to pay for subcontracts it *might* receive.

Forty-four States lose money on the SST program. Comparison of the potential subcontracts with the state's minimum tax contribution (its share of the \$1.3 billion Federal subsidy for SST design and prototype phases) shows a net loss in these States. Taxpayers would have to pay out more in taxes for the SST than their States might receive through subcontracts and contracts. The extent of this loss is shown below.

The Department of Transportation admits that the "potential subcontracts" figure is inflated, because where a particular subcontract could go to either of two companies in different States, the value of that subcontract is reflected in both States' subcontract figures, even though only one of them will finally get the job.

*Source of data shown on the following page*

**SST Tax Support:** Computed by taking the State's percentage of total U.S. income taxes paid by individuals and corporations (U.S. Statistical Abstracts for 1969, page 389). This percentage was then applied to the \$1.3 billion Federal share of prototype program.

**Potential Subcontracts:** Department of Transportation map J-3-300, dated July 10, 1970 (showing potential subcontract funds for the entire prototype program).

**Potential Contracts:** Department of Transportation.

Source: Dr. George Eads—Dept. of Economics, Princeton.

State	SST tax support (millions)	Potential subcontracts	Potential contracts	Difference
Alaska.....	\$1.3	\$0	\$0	-\$1.3
Alabama.....	11.7	.8	0	-10.9
Arizona.....	6.5	23.9	0	+17.4
Arkansas.....	5.2	.2	0	-5.0
California.....	149.5	176.6	0	+27.1
Colorado.....	19.5	.1	0	-19.4
Connecticut.....	27.3	36.7	0	+9.4
Delaware.....	7.8	.2	0	-7.6
Florida.....	28.6	3.2	0	-25.4
Georgia.....	22.1	.08	0	-22.02
Hawaii.....	5.2	0	0	-5.2
Idaho.....	3.9	0	0	-3.9
Illinois.....	115.7	33.2	0	-82.5
Indiana.....	35.1	21.1	0	-14.0
Iowa.....	13.0	2.6	0	-10.4
Kansas.....	10.4	23.0	(1)	(1)
Kentucky.....	11.7	3.8	0	-7.9
Louisiana.....	14.3	.002	0	-14.3
Maine.....	3.9	0	0	-3.9
Maryland and D.C.....	40.8	18.5	0	-22.3
Massachusetts.....	44.2	21.7	4.0	-18.5
Michigan.....	89.7	52.5	0	-37.2
Minnesota.....	26.0	14.3	0	-11.7
Mississippi.....	5.2	0	0	-5.2
Missouri.....	39.3	1.3	0	-38.0
Montana.....	2.6	0	0	-2.6
Nebraska.....	9.1	.03	0	-9.07
Nevada.....	2.6	.1	0	-2.5
New Hampshire.....	3.9	.2	0	-3.7
New Jersey.....	50.7	16.8	0	-33.9
New Mexico.....	3.9	.1	0	-3.8
New York.....	245.7	54.2	1.0	-190.5
North Carolina.....	20.8	.4	0	-20.4
North Dakota.....	2.6	0	0	-2.6
Ohio.....	87.1	88.1	(1)	(1)
Oklahoma.....	11.7	.6	0	-11.1
Oregon.....	11.7	3.4	0	-8.3
Pennsylvania.....	94.9	13.7	.1	-81.1
Rhode Island.....	7.8	.1	0	-7.7
South Carolina.....	7.8	.01	0	-7.8
South Dakota.....	2.6	0	0	-2.6
Tennessee.....	15.6	6.9	0	-8.7
Texas.....	57.2	27.3	0	-29.9
Utah.....	3.9	0	0	-3.9
Vermont.....	1.3	.4	.6	-0.3
Virginia.....	20.8	2.5	0	-18.3
Washington.....	23.4	1.3	(1)	(1)
West Virginia.....	5.2	.1	0	-5.1
Wisconsin.....	27.3	9.2	0	-18.1
Wyoming.....	1.3	0	0	-1.3

<sup>1</sup> Figures not available.

<sup>2</sup> Includes subcontracts awarded as of July 1, 1970—Source Boeing and G.E.

[Seattle Post Intelligencer, Friday, Jan. 1, 1971]

#### DAN COUGHLIN: THE SST: DOES BOEING NEED IT?

The Boeing Co. as well as this region may be better off if Congress mixes the U.S. supersonic transport program.

If such a thought sounds like dangerous heresy in this airplane building capital of the world, so be it.

To be sure, an almost overwhelming argument exists in support of the SST's construction. The country surely will lose if we turn our backs on the project.

The psychological impact if the program is not funded is terrifying to contemplate. The area needs a bit of good economic news for a change.

And nobody can seriously argue that the loss of 4,800 jobs—that's the number of persons currently employed at Boeing on the SST—would have a bouyant effect hereabouts.

But in balance we'd come out ahead.

Such a conclusion has nothing to do with misplaced environmentalist concern, either. The myth that the plane will cause some kind of vast upper-atmospheric pollution has been demolished by reputable scientists.

It is, rather, based on several financial facts and figures that mean the end of the world won't occur if the lawmakers ultimately go against the plane.

Stephen Bepler, aerospace analyst for Clark, Dodge, and Co., goes so far as to recommend purchase of Boeing stock in event of an adverse Congressional decision.

In contrast to the job-creating aspects of it all that we've been focusing on in our concert for SST, Bepler instead looks at the company's cash position along with other aircraft that would prove better for the company and the rest of us if the firm's attention were shifted out of the high-speed business and into another kind of aircraft.

He describes the paradoxical situation as "interesting" from an investor's standpoint. Let's look at his assessment:

"With the elimination of the current significant investment Boeing is funding in the SST, near-term earnings should improve.

"Further, the absence of a required massive future investment (to initiate production) could well allow the company to turn its attention to other, nearer term and potentially far more profitable programs—specifically, a wide-bodied twinjet.

"Boeing's ability to do so will be enhanced by a government return of company funds already expended on the SST, the freeing-up of its top engineering and design team and the fact that the logical competitors for such a plane—McDonnell-Douglas, Lockheed, the British Aircraft Corp. and the European A-300B Consortium—are all in a position where a full thrust program on a wide-twin seems either technically or financially impossible."

A company spokesman poo-pooed the idea, but that could have been because his job is to push the SST. Aside from SST and company projects currently being worked on, the spokesman said "we have nothing announced or planned." But Bepler couldn't have just dreamed up the idea. And Boeing would get \$40 million or so back from the government if SST is canceled.

The key word in Bepler's analysis, of course, is "profitability."

And that leads to jobs just as surely as SST, with a lot less turmoil. It adds up.

---

OIL, CHEMICAL, &  
ATOMIC WORKERS INTERNATIONAL UNION  
*Washington, D.C., March 6, 1971.*

*To all Members of Congress.*

I am writing to urge you to vote against the Supersonic Transport appropriations. The environmental arguments for and against the construction of the plane have been made by eminent scientists. You may recall the environmental controversy some years ago about fallout from nuclear weapons testing. Then, as now, eminent scientists lined up on both sides of the question. Time ultimately resolved who was right in that controversy. However, the harm that we now know occurred is irreversible.

Our experience with that environmental controversy demonstrates the validity of the observation of the eminent French physiologist, Claude Bernard, who said, "True science teaches us to doubt and in ignorance to refrain." Bernard's admonition is especially valid in the case of the SST.

As a labor union, we are extremely concerned over the possible loss of jobs if the decision is made not to construct the SST. In this instance, Congress has a responsibility to enact legislation to provide funds for projects that will utilize the skills of the workers affected. It is unnecessary for me to detail these projects. We are all aware of the present state of our environment and the great unmet social needs of our society. There is much work to be done that will benefit man.

Let me point out that the unemployment situation will even be more pronounced if a decision to build the plane is reached and then it turns out that the environmental doubt we possess turns out to be true. Our Nation must be turned around from its dead end environmental direction. An opportunity exists now to use the proposed SST work force in constructive pursuits. We urgently hope that Congress chooses that direction.

Sincerely yours,

ANTHONY MAZZOCCHI,  
*Director, Citizenship-Legislative Department.*

Miss DUNLAP. And now I would like to introduce Russell A. Brown, Senior Research Engineer, the Idaho Nuclear Corporation. Mr. Brown is also Chairman of the SST Study Committee, and a director of the Idaho environmental council. Today he is representing the coalition against the SST as well as the Idaho environmental council.

#### STATEMENT OF RUSSELL A. BROWN

Mr. BROWN. Mr. Chairman, members of the subcommittee, my name is Russell Brown of Idaho Falls, Idaho. I am a research chemical engineer with a special interest in the field of applied mathematics. My testimony is on behalf of the coalition against the SST and the Idaho environmental council.

The last line of defense for the supersonic transport concept seems to be the notion of its inevitability. After all other arguments have failed, the promoters and supporters of the SST have fallen back on the idea that, like death and dawn, it is a part of man's future. "If it is to be, they declaim, it might as well be ours". If one ignores the noise, the sonic booms, and all the potential environmental hazards of the SST, the argument of inevitability has a certain passive, albeit amoral charm. But that argument has a gross flaw. The objective of my testimony today will be to explore and define that flaw and, in the process, to demonstrate that the supersonic transport would be a tragic waste of our money.

My purpose is to expose the deception and weakness in the SST promotion by describing its true potential as a transportation system. The essence of the SST promotional campaign is its portrayal as "progress", as the next step forward in transportation efficiency. This siren song of "progress" is the true "motherhood" statement of the age of technology.

What is the reality behind this promise of progress? What of this lure of a better system of transportation? What of the hope of advancement to the third generation of air transport systems? If we examine the SST clinically, if we strip away the uncommonly generous optimism of the boosters, what can we learn?

#### WHAT CLAIMS HAVE BEEN MADE FOR THE SST?

On August 27, 1970, the Director of the SST program for the Department of Transportation, William M. Magruder, testified before the Senate Appropriations Committee. He stated that the SST was "twice as productive as the largest jumbo jet" (that figure has been widely used by supporters of the SST to help justify it—and is still being used). It was used yesterday by Mr. Magruder, and the day before by Mr. Volpe.

Mr. Magruder, an air transportation industry specialist, sold a productivity standard that had little value; his glowing claim was based on seat-miles per hour for an SST traveling at top speed \* \* \* strangely forgotten was the time required for takeoff and landing, acceleration and deceleration, refueling, passenger, and baggage transfer, and, strangest of all, operating costs. A true standard of transportation efficiency is seat-miles per dollar. Mr. Magruder did not err nor was he careless. His carefully packaged statement was a deliberate

attempt to mislead the Congress. While true in the literal sense, Mr. Magruder's claim was in the spirit of advertisements for patent medicines, where great things seem to be promised, but are seldom delivered. Mr. Magruder's testimony seemed to promise double productivity when widely published industry figures show that it could not be delivered. If the SST does not offer any efficiency advantage over existing systems, the claims of progress seem hollow indeed.

#### A METHOD FOR CALCULATING TRANSPORTATION EFFICIENCY

A simple method for determining a significant transportation efficiency standard is to calculate seat-miles per dollar from the following three factors:

1. The maximum number of passengers that the system can carry to calculate maximum possible efficiency.

The relative cost-efficiencies are obtained for different operating costs by a similar calculation. If the average hourly operating costs of the SST were, for example, 50 percent higher than the 747, the cost-corrected efficiency is obtained by dividing the "equal cost" SST efficiency by the ratio of the SST to 747 costs, that is, 150/100 or 1.5. Thus, for the same base case:

$$\left. \begin{array}{l} E_{747} = 81.7 \\ E_{SST} = \frac{99.3}{1.5} = 66.2 \end{array} \right\} \begin{array}{l} \text{Cost-corrected basis shows relative magnitudes of efficiencies} \\ \text{as passenger-trips/dollar} \end{array}$$

Thus, for the same base case listed above the efficiency for the 747 would be 81.7 and the cost-corrected efficiency for the SST would be 66.2.

The cost-corrected efficiencies may be further generalized by converting the data to percentage efficiencies of one system relative to the other. If the percentage is based on the relative percentage efficiency of the SST to the 747, a positive value will indicate superiority of the SST and a negative value superiority of the 747.

For  $E_{747} = 81.7$  and  $E_{SST} = 99.3$ , the relative efficiency of the SST to the 747 is defined as:

$$\frac{99.3}{81.7} = 1.217$$

or an SST advantage of +21.7 percent in terms of its ultimate capability to carry passengers on a dollar basis.

2. The long-term average time (flighttime plus groundtime) for a given trip length.

3. The average hourly operational cost.

We may further clarify and simplify the determination by comparing one system to another system (for example, the SST against the Boeing 747 Jumbo Jet). This comparison only demands an estimate of relative (rather than absolute) operating costs.

The effectiveness of a transport system is defined as:

$$E_x = \frac{N_x}{\theta_{F_x} + \theta_{TA}}$$

where:  $E_x$  = Efficiency—passenger trips/hour of system  $x$   
 $N_x$  = Number of passengers carried in system  $x$   
 $\theta_{F_x}$  = Actual flight time of system  $x$   
 $\theta_{TA}$  = Average turnaround time.

Therefore, the passenger trips/hour for the 747 and the SST are:

$$E_{747} = \frac{N_{747}}{\theta_{747} + \theta_{TA}}$$

$$E_{SST} = \frac{N_{SST}}{\theta_{SST} + \theta_{TA}}$$

where, for a full load,  $N_{747} = 490$  and  $N_{SST} = 298$ .

The effectiveness of a transport system is defined as the number of passengers a system may carry and, if you are calculating maximum efficiency, that maximum number divided by the total time per trip. That total time includes the flight time and the turnaround time. In the calculations I have used here I have used the estimated full load figures of 490 for the 747, and 298 passengers for the SST. Present variations that are planned now are 440 for the 747 and I believe 270 for the SST.

The passenger-carrying efficiencies defined above are also the base figures for the cost efficiencies for the two systems. In fact, if the hourly operating costs for both the 747 and the SST were equal, the calculated E-values would be a measure of the relative passenger trips per dollar. The absolute dollar-based figures may be calculated if the hourly costs are known. For the purposes of this study, the relative efficiencies will suffice.

If  $E_{747} = 81.7$  and  $E_{SST} = 99.3$  (see first values in table I), the cost efficiencies can be obtained by dividing the E's by the hourly operating costs. If the costs were equal, the relative magnitudes of the calculated efficiencies would not change; e.g.,

$$E_{747} = \frac{81.7}{\$100/\text{hr.}} = 0.817 \text{ passenger trips/dollar}$$

$$E_{SST} = \frac{99.3}{\$100/\text{hr.}} = 0.993 \text{ passenger trips/dollar.}$$

If, for example, the efficiency of the 747 was a figure of 81.7 passenger trips per hour for a given trip length, say, 3,600 miles, and an efficiency figure for the SST were 99.3, the cost efficiencies can then be obtained by dividing the efficiencies by the hourly operating costs.

For the cost-corrected figures based on a 50 percent higher SST operating cost, where  $E_{747} = 81.7$  and  $E_{SST} = 66.2$ , the relative efficiency of the 747 to the SST is:

$$\frac{81.7}{66.2} = 1.234$$

or an SST "advantage" of -23.4 percent (an algebraic description of an SST disadvantage of 23.4 percent).

The general formula for calculation of the cost-corrected efficiencies on a percentage basis is:

$$\text{Percentage advantage of SST relative to 747} = \left[ \frac{E_{SST}}{E_{747}} - 1.0 \right] 100.$$

$$\text{Percentage disadvantage* of SST relative to 747} = \left[ \frac{E_{747}}{E_{SST}} - 1.0 \right] 100.$$

\*Expressed as a minus number.

The general formula for the calculation of the cost-corrected efficiencies on a percentage basis is included in my testimony. There is no point in reading that.

#### THE PARAMETRIC STUDY

The next step in examining this question in a general way is to conduct what is called a parametric study, and I will explain it very briefly here.

A parametric study is a "brute force" technique for overwhelming ignorance. The significant variables in a system are identified and their expected ranges are established. An equation such as I have defined earlier, defining the desired response, is derived from known relationships. The response is then calculated for all combinations of the significant variables (parameters).

The completed calculation yields a matrix (something like the grid points on a map) of responses. The defined response surface is then used to evaluate the critical parameters and, if one or more of the parameters were accurately specified, predict the exact response or possible range of responses.

The parametric study of the SST and the 747 is described in the attached report, which I have submitted for the record, "The SST vs. the 747." Cost-corrected transportation efficiencies were calculated for 180 different combinations of four important parameters:

1. Trip distance.
2. SST to 747 speed ratio (determining the terminal to terminal times).
3. Turnaround time (reflecting the average ground time for each trip, entering the holding pattern to departure after clearance).
4. SST/747 operating cost ratio.

The 180 combinations were the product of three trip distances (3000, 3600, and 4200 miles), that last figure being outside the presently announced range of the SST, three SST to 747 speed ratios (2.50, 2.22, and 2.00), four average turnaround times (1, 2, 3, and 4 hours), and five operating cost ratios (ranging from 0.9 to 1.5). The results are shown in Table 1. The calculations were then reduced to relative efficiencies for sample values, shown in Table II.<sup>1</sup> While the exact operat-

<sup>1</sup> Table II and Figures 2 and 2A in the attached report are valid descriptions of systems, but did not show equal values for equal differences because of the standard anomaly of relative percentages.

ing levels for the systems are not known, the calculation of efficiencies over the ranges described should include the true values. Consideration of the type of response surface that can be drawn from these data can show general behavior characteristics of the system (just as one can determine the nature of a mountain slope by studying the contour map of the area).

#### RESULTS OF THE PARAMETRIC STUDY

A qualitative map of the responses shown in Table II is illustrated in Figure 1. This plot shown zones of advantage and disadvantage of the SST as a function of both the turnaround time and the hourly operating cost ratios. At a turnaround time of 2 hours and at a cost ratio of 1.2 (SST is 20 percent higher) the SST is less efficient than the 747.

Figure 2 provides a quantitative plot of the data described qualitatively in Figure 1. The efficiency response surface is shown by lines of constant relative efficiency. For the example used in Figure 1, the SST is 16 percent less efficient than the 747. The data used in Figure 2 is for a 3600-mile flight. Similar plots for 3000- or 4200-mile flights if they become possible may be obtained from table II. The response surfaces from these data will be very similar of that of figure 2.

Figure 3 shows the effect of assumed constraints on the potential operating efficiencies of an SST. If SST hourly operating costs are not less than 1.25 times 747 costs and if turnaround-time could not be less than 1.5 hours, the SST system would operate at an efficiency disadvantage of 15 percent or more (compared to the 747).

#### CONCLUSIONS

1. The SST is not generally competitive with the 747 on an overall efficiency basis. If efficiency estimates are based on passenger-miles per dollar, the SST is inferior over much of the operating space considered in this parametric study. Generous estimates of the critical operating parameters (turnaround time, speed-ratio, and operating cost) still result in the SST operating at a 15 percent to 35 percent disadvantage compared to the 747. This estimate is in line with estimates provided for the surcharge that would be necessary for the SST to be profitable. Longer flight lengths (say a maximum of 4,000 miles) would improve its performance slightly, but do not change the general characteristics of efficiency.

Just as the SST is a time intensive system and derives its advantages from being fast, it is also very sensitive to delay.

(NOTE: The capital cost of an SST will be approximately 2.5 times that of a 747 and the fuel consumption will be 40 percent to 60 percent higher on a passenger-mile basis.)

2. The performance of the SST is extremely sensitive to turnaround time and hourly operating cost (relative to the 747).

3. The effects of unequal turnaround times and passenger loading factors were not included in this study. Turnaround effects can be extracted from Table I. Equal percentage load factors will not change the relative transport efficiencies of the two systems. Unequal load factors could be studied in further detailed parameters studies.

4. The most probable rebuttal to the lower efficiency of the SST is that the time saved by its use outweighs its inefficiency as a mass transportation system. While valid for much longer time periods (e.g., 6 hours by plane vs. 6 days by ship), this argument decays as the time differences approach the hours and minutes range. Considering the known ground transport lags, the New York to Paris trip will require approximately 6 hours from city to city by SST and 9 hours by 747. The advantages of arriving in Paris at 3:00 p.m. instead of 6:00 p.m. seem somewhat ephemeral.

5. This study has not touched upon the well-documented environmental hazards, safety risks, and economic and technical uncertainties associated with the SST. When these factors are coupled with failure of the SST to provide even equivalent (to existing systems) transportation efficiency, the modest time savings provide insufficient justification for further funding.

The claims of progress and productivity for the SST have clearly been oversold. When we examine those critical factors which control productivity, we find that there is a high probability that the SST system will not be, as Mr. Magruder said, twice as productive, but will be less efficient than existing planes. The simple analysis used as a basis for my testimony could have predicted the recently announced economic problems of the Concorde. Even the super-salesmen of the DOT must be hard-pressed to defend that sinking swan. Recent estimates indicate that the operating costs of the Concorde will be double those of the 747. The people of Britain and France have wasted billions of dollars on a system that never had a chance.

The same fiscal and political gymnastics that were used to promote the Concorde have and are being used to sell the U.S. SST. The bizarre aspect of the whole situation is that perfectly competent technologists have been spending their time desperately trying to create a justification for a loser. Once a program of this nature is started, the natural instincts of a scientist to objectively evaluate the probabilities of success are completely subordinated to an effort to defend the program. If reasonable assumptions indicate that the project may fail, more hospitable assumptions are used. If projected fuel consumption figures make the system look bad, a domesticated expert is acquired to play jiggery-pokery with the units until, somehow, they look better. My instinctive reaction to such trickery is an expanding distrust of any of the claims made by the promoters.

The Department of Transportation's presentation yesterday was a masterful advertising job. It emphasized the positive. It delineated the rewards in the most optimistic tones. It told us what a superb investment the Nation is making in the SST. It contained a minor paradox to be sure. After assuring us that the DOT would recommend project cancellation if environmental problems were detected, Mr. Magruder spent the rest of his time telling us about the 500 production models

which will be sold and will be flown. One's imagination is stretched by the thought of Mr. Magruder's stream of enthusiasts later recommending cancellation because of any minor problem such as sonic boom or excessive fuel consumption. What Mr. Magruder neglected to describe was the probability, and the price, of failure. I cannot describe those probabilities and prices in more than a speculative way but I can suggest some that should be considered as possible.

The obvious one has been discussed by members of the subcommittee. If canceled at the end of prototype testing, the loss is \$1.3 billion. If an objective market analysis shows that the most probable distribution of sales centers around, for instance, 200 SST's, we lose in the range of \$400 million. If centered about 300, we are supposed to break even. If centered about 500, we are promised \$1 billion return on our investment.

But yet another roll of the dice must be considered. Suppose that another \$1.3 billion is required from the Government to meet the gap between available private capital and the \$5.2 billion to \$5.5 billion required for production. What is the breakeven market then? Would the Nation then be caught in a supersonic crap game that we couldn't win?

These questions were not answered by the DOT, but they must be answered, if only on economic grounds, if Congress is to decide whether or not we are committed to a losing game.

The SST promises dubious benefits at exorbitant cost. When its potential economic failure is added to the wide range of technical uncertainties and environmental hazards, the modest time savings for international travelers provide scant justification for further public subsidy. Private capital will not support this venture. No lesser standard of judgement applied for the use of tax dollars.

We have reached a time for the exercise of technical abstinence. We can no longer afford the luxury of proceeding with a technological project merely because we have the capability to do it. We should discriminate between the necessary and that which is merely novel; we must now substitute the prudent for the possible.

The SST is neither necessary nor prudent.

(The attachments to Mr. Brown's statement follow:)

TABLE I.—CALCULATED EFFECTIVENESS OF THE 747 AND SST AS A FUNCTION OF OPERATING PARAMETERS

[Both planes full: 747—490 passengers, SST—298 passengers]

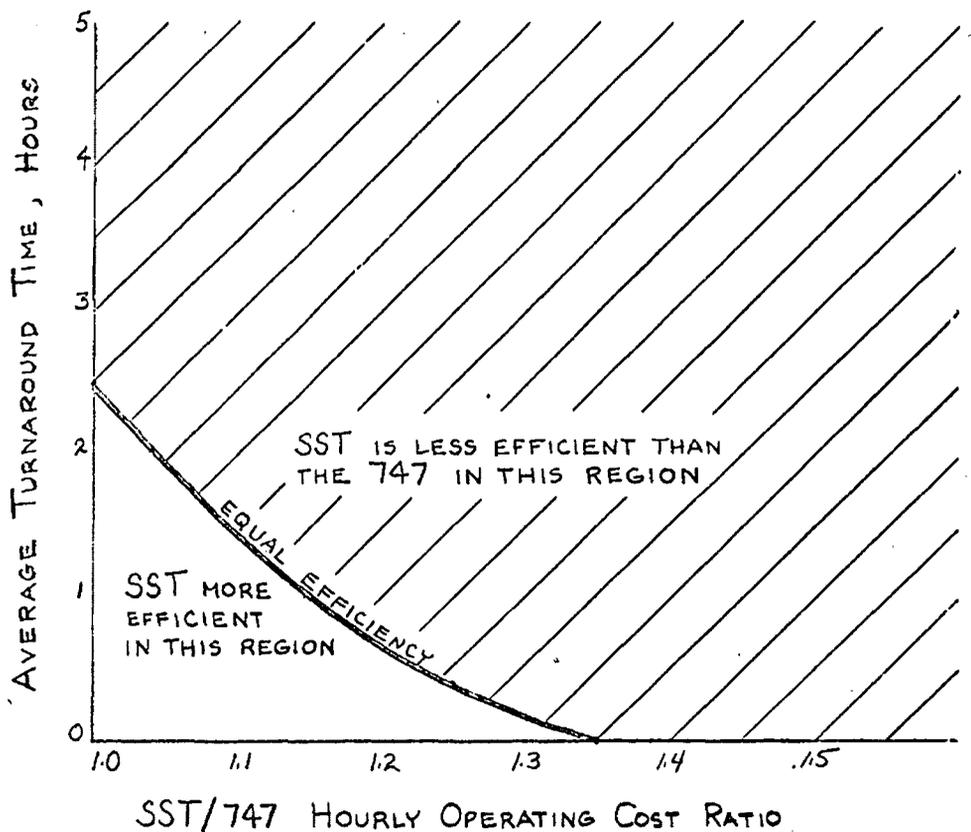
Flight time (hours)		Turn-around time (hours) both	747 effectiveness (passenger trips, hour) E747	SST efficiency cost-corrected passenger trips per hour (SST/747 total hourly operating cost ratios)				
SST	747			ESST(1.5)	ESST(1.2)	ESST(1.1)	ESST(1.0)	ESST(0.9)
				1.5	1.2	1.1	1.0	9
2.00	5.00	1	81.7	66.2	82.8	90.3	99.3	110.3
2.00	5.00	2	70.0	49.7	62.1	67.7	74.5	82.8
2.00	5.00	3	61.3	39.8	49.7	54.2	59.6	66.2
2.00	5.00	4	54.4	33.2	41.4	45.2	49.7	55.2
2.25	5.00	1	81.7	61.1	76.5	83.3	91.7	102.0
2.25	5.00	2	70.0	46.8	58.5	63.7	70.1	79.0
2.25	5.00	3	61.3	37.8	47.3	51.6	56.8	63.1
2.25	5.00	4	54.4	31.8	39.8	43.4	47.7	53.0
2.50	5.00	1	81.7	56.7	71.0	77.4	85.1	94.6
2.50	5.00	2	70.0	44.1	55.1	60.1	66.2	73.6
2.50	5.00	3	61.3	36.2	45.1	49.3	54.2	60.3
2.50	5.00	4	54.4	30.6	38.2	41.6	45.9	51.0
2.40	6.00	1	70.0	58.5	73.1	79.6	87.7	97.5
2.40	6.00	2	61.3	45.2	56.5	61.5	67.8	75.3
2.40	6.00	3	54.4	36.8	46.0	50.2	55.2	61.4
2.40	6.00	4	49.0	31.1	38.8	42.4	46.6	51.8
2.70	6.00	1	70.0	53.7	67.0	73.1	80.5	89.5
2.70	6.00	2	61.3	42.2	52.9	57.5	63.4	70.5
2.70	6.00	3	54.4	34.8	43.6	47.5	52.3	58.1
2.70	6.00	4	49.0	29.7	37.1	40.5	44.5	49.5
3.00	6.00	1	70.0	49.7	62.1	67.7	74.5	82.8
3.00	6.00	2	61.3	39.8	49.7	54.1	59.6	66.2
3.00	6.00	3	54.4	33.2	41.4	45.1	49.7	55.2
3.00	6.00	4	49.0	28.4	35.5	38.8	42.6	47.4
2.80	7.00	1	61.3	52.2	65.3	71.1	78.4	87.1
2.80	7.00	2	54.4	41.4	51.8	56.5	62.1	69.0
2.80	7.00	3	49.0	34.2	42.8	46.7	51.4	57.1
2.80	7.00	4	44.6	29.2	36.5	39.8	43.8	48.7
3.15	7.00	1	61.3	47.9	59.8	65.2	71.8	79.8
3.15	7.00	2	54.4	38.6	48.2	52.5	57.9	64.4
3.15	7.00	3	49.0	32.3	40.4	44.0	48.5	53.9
3.15	7.00	4	44.6	27.8	34.8	37.9	41.7	46.4
3.50	7.00	1	61.3	44.1	55.1	60.1	66.2	73.6
3.50	7.00	2	54.4	36.2	45.2	48.3	54.2	60.3
3.50	7.00	3	49.0	30.6	38.2	41.7	45.9	51.0
3.50	7.00	4	44.6	26.5	33.1	36.1	39.7	44.1

TABLE II.—DATA FROM TABLE I CONVERTED TO RELATIVE ADVANTAGE OF SST TO 747 AS A FUNCTION OF OPERATING PARAMETERS

Flight time		Turnaround time, both (hours)	747 efficiency, passenger trips per hour, E747	Relative efficiency of SST to 747 (from cost-corrected passenger trips per hour) SST/747 hourly operating cost ratios (percent)				
SST (hours)	747 (hours)			1.5	1.2	1.1	1.0	0.9
2.25	5.00	1	81.7	-34.0	-6.9	+2.0	+12.2	+24.8
2.25	5.00	2	70.0	-49.8	-19.7	-9.9	0	+12.9
2.25	5.00	3	61.3	-62.0	-29.6	-19.0	-8.0	+2.9
2.25	5.00	4	54.4	-71.0	-36.7	-25.7	-14.1	-2.7
2.70	6.00	0	81.7	-10.9	+12.6	+22.8	+35.1	+50.0
2.70	6.00	1	70.0	-30.7	-4.5	+4.4	+15.0	+27.9
2.70	6.00	2	61.3	-45.5	-15.7	-6.7	+3.4	+15.0
2.70	6.00	3	54.4	-56.0	-24.9	-14.5	-4.0	+6.8
2.70	6.00	4	49.0	-65.0	-32.3	-21.1	-10.0	+1.0
3.15	7.00	1	61.3	-28.0	-2.5	+6.4	+17.1	+30.2
3.15	7.00	2	54.4	-41.0	-12.9	-3.6	+6.4	+18.4
3.15	7.00	3	49.0	-52.0	-21.5	-11.5	-1.0	+10.0
3.15	7.00	4	44.6	-60.2	-28.5	-18.0	-7.0	+4.0

FIGURE 1

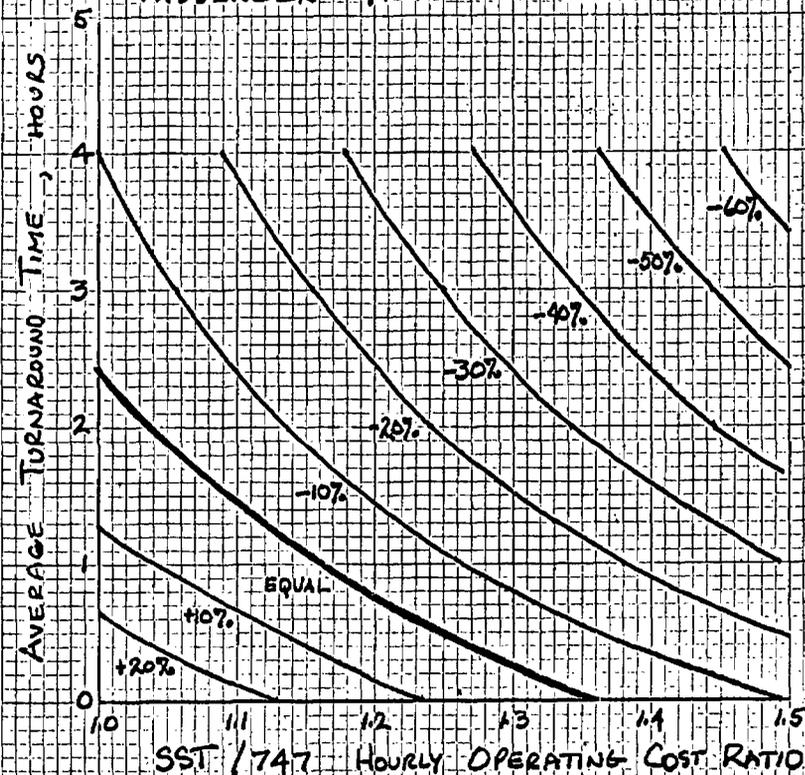
AN EFFICIENCY MAP FOR COMPARISON OF THE  
SST AND THE 747 - A FUNCTION OF  
TURNAROUND TIME AND THE SST/747  
HOURLY OPERATING COST RATIO



FOR A HYPOTHETICAL 3600 MILE TRIP  
FLIGHT TIMES: SST - 2.7 HOURS  
7-7 - 6.0 HOURS  
BOTH PLANES FULLY LOADED

FIGURE 2

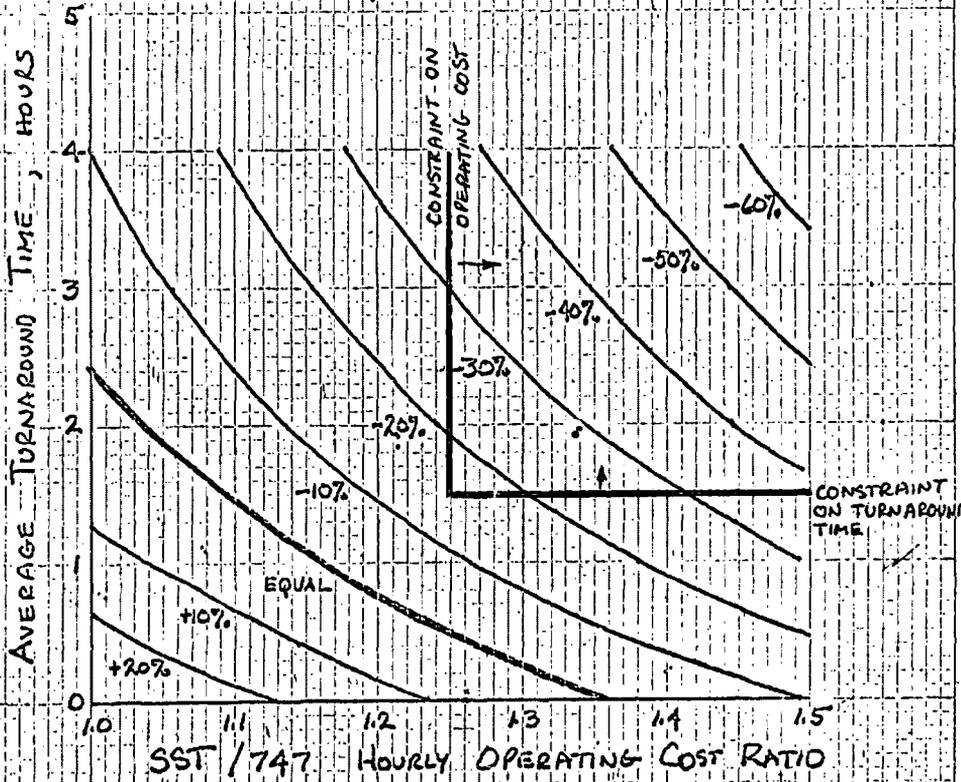
A MAP OF THE RELATIVE EFFICIENCY OF THE SST TO THE 747 - BASED ON COST-CORRECTED PASSENGER - TRIPS PER HOUR



CALCULATED FOR A 3600 MILE TRIP  
 FLIGHT TIMES: SST - 2.7 HOURS  
 747 - 6.0 HOURS  
 BOTH PLANES FULLY LOADED

FIGURE 3

A MAP OF THE RELATIVE EFFICIENCY OF THE SST TO THE 747 - BASED ON COST-CORRECTED PASSENGER - TRIPS PER HOUR



CALCULATED FOR A 3600 MILE TRIP  
 FLIGHT TIMES: SST - 2.7 HOURS  
 747 - 6.0 HOURS  
 BOTH PLANES FULLY LOADED

## REFERENCES

1. William M. Magruder, Testimony before the Senate Appropriations Committee, Aug. 27, 1970.
2. Russell K. Sherburne, "The Supersonic Transport," The Library of Congress Legislative Reference Service, HE 9901, SP 163, p. 19, February 1969.
3. "Astronautics and Aeronautics," p. 50, April 1970.
4. George N. Chatham, "The SST: The Issues of Environmental Compatibility," Science Policy Research Division, Library of Congress, September 21, 1970.

## TECHNICAL BACKGROUND OF WITNESS RUSSELL A. BROWN

B.S. in chemical engineering (with honors), Newark College of Engineering, 1960, M.S. in chemical engineering, Newark College of Engineering, 1964, thesis: Computer Simulation Study, "The Behavior of Recycle Reactors."

Member of Tau Beta Pi, National Engineering Honor Society (College) Omega Chi Epsilon, National Chemical Engineering Honor Society, Omicron Delta Kappa, National Leadership Honor Society.

Professional societies: Simulation Councils, Inc., International Association for Analogue Computation, American Institute of Chemical Engineers.

Special studies: 1962, basic analog computation, EAI, Princeton, N.J.; 1962, chemical and petroleum applications, EAI, Princeton, N.J.; 1962, statistics and experimental design, ASQC, Rochester, N.Y.; 1965, hybrid computation, EAI, Princeton, N.J.; 1970, Environmental Applications of Hybrid Computations, EAI.

Employment: 1953-60, research technician, Allied Chemical Corp., Morristown, N.J.; 1960-62, research chemical engineer, Allied Chemical Corp., Morristown, N.J.; 1962-67, senior research chemical engineer, General Chemical Research; 1967-71, senior research engineer, Idaho Nuclear Corp., Idaho Falls, Idaho.

Mr. McFALL. Thank you, Mr. Brown, for an excellent statement. As you can well imagine, most of the members of the committees are unfamiliar with the technical calculations which you have made, so that in order for us to be able to understand and judge them, it will be necessary for us to have other witnesses give their version of your calculations.

I am sure the members will have some questions related to your testimony. I have a few, which are clarifying in nature, so that when we do get the Department of Transportation witnesses here, we will be able to compare your statement with theirs.

Mr. BROWN. Mr. Chairman, might it be possible in addition to having the Department of Transportation witnesses analyze this study that you also acquire independent study capability, perhaps someone that could be considered impartial, favoring neither side?

Mr. McFALL. I feel we should try to have some comparative analysis of the two statements.

Mr. BROWN. Good.

## CAPACITY OF THE 747

Mr. McFALL. And I am sure that Mr. Yates will have some type of comparative analysis.

In looking at the study which you prepared I noticed that you use 490 passengers for the 747. Why do you use 490 when I understand the airlines are using only 340 to 360?

Mr. BROWN. The ultimate design capability of the 747 and I am sure some of the gentlemen from Boeing could provide help if I am a little bit wrong on this, was originally 490. It may still be 490. At present I think the biggest configuration now ordered is by Irish Airlines and that configuration is 440.

Conversely, I have used a figure of 298 for the SST, and the present plans of industry as best I could find out from the Department of Transportation are 270. It turns out that the 440 or 445 figure and 270 represent a similar percentage decline from the maximum capability I have used and, as I indicated in my testimony, equal percentage drops in load factors will not affect the contours that I have described in my report.

Mr. McFALL. What about the 340 to 360? Isn't that the number of seats the airlines are using in the 747?

Mr. BROWN. I am sorry, sir?

Mr. McFALL. Are the figures of 340 to 360 seats for the 747 used in the calculations made by airlines at the present time?

Mr. BROWN. I am sure they are used at the present time. What I was addressing myself to in this very limited study was what is the maximum capability of each of these systems if we pack as many people into them as possible, looking at it purely in terms of what is the most we can do.

I have prepared side calculations which I did not include in this report which give estimates for different load factors, so those numbers can be easily drawn. It is a matter of multiplying by the percentage of the maximum load. What I was looking for here was to see what we get if we stress the systems to the ultimate. That is the nature of this calculation.

#### RELATION OF TURNAROUND TIME TO PRODUCTIVITY

Mr. McFALL. Then with reference to turnaround time, would you explain to us what the relation of turnaround time is to productivity, if it does not affect daily or annual utilization of the airplane?

Mr. BROWN. The turnaround time I have described in the report is probably too narrowly defined. Actually, what counts in the productivity of the system is how much time it spends carrying passengers, say, on an annual basis; the time it spends on the ground is very costly for an air system. They try and keep them up as much as possible. So the time that a system spends coming into a landing pattern, into a holding pattern, getting down on the ground, and waiting to get off again affects its long-range productivity to a great extent.

The DOT, of course, because they are doing a promotional effort, use the most optimistic figures. In fact, they don't even take the average speed of the SST when they get that double productivity figure. They take the top speed. It turns out that the average, again from their figures, for a New York to Paris trip is more in the range, at least from the numbers I have seen, of 1,400 miles per hour, not 1,800. So they get very optimistic. They forget acceleration, deceleration, climbing, touchdown, holding patterns, and the like.

The turnaround time reflects the time essentially spent in and around the airport. We all know that on foggy days we can be held up a great deal. It turns out that the SST is extremely sensitive to the turnaround time factor, and, as the graphs that I have drawn show, as the turnaround time increases the SST comes to the point where it just cannot compete with the 747.

Mr. McFALL. As it has been explained to me, productivity is essentially the ability of an airplane to carry a payload over a given distance at its design speed. If there would be no effect of turnaround time on utilization, would it still be proper to include it in a measure of productivity?

Mr. BROWN. By all means. If you are trying to figure out what the system can do for you as an optimum transportation system you have to include all the time factors per trip. The trip does not just include the time the plane is flying at top speed in the air. Every trip is in a sense a collection of all time increments that go into it.

If we were to take the SST, for instance, and fly it but once a day it would be undoubtedly the greatest money loser in the world. You couldn't make any money on it. You would have paid \$50 million, \$60 million for the thing, and when it is sitting on the ground it is losing you money. That is why the airlines keep their planes up. So turnaround time is extremely important.

#### TURNAROUND FOR THE SST

Mr. McFALL. The information given to me is that the SST is being designed for a quick turnaround time of an hour or less. Would you have any comment on this?

Mr. BROWN. I believe that that quick turnaround time strictly refers to the time from the time it hits the passenger terminal to the time it takes off from the passenger terminal again. If you wanted to include in flight time, then, all the time spent in holding patterns and the time spent after the plane leaves the terminal to take off, assuming it didn't get priority treatment, the numbers would still add up the same way.

This study that I have done does not presuppose a special knowledge about just how the system will operate. In fact, if the SST promoters can demonstrate that they can get a 1-hour turnaround time on the average, year in, year out, then the efficiency predictions are perfectly obvious in the graph I have prepared. I have included that in the range. In fact, in one of the graphs I went all the way down to zero so that I wouldn't leave anything out. So I have taken that into account. I don't claim to have defined just where it will operate but, to use an analogy, I have defined the mountainside. If you tell me how many steps north and how many steps east you take I can tell you what altitude you will be at.

Mr. YATES. Mr. Chairman, what is the answer to your question? I am not sure I got it. You asked him about turnaround time within an hour, didn't you?

Mr. McFALL. Yes.

Mr. YATES. Was your response that it could make that turnaround time?

Mr. BROWN. I am in no position to judge, but what I say is if it can, if you look at figure 2, if you looked for turnaround time of 1 hour, it is on the graph.

If, for instance, the SST can turn around in an hour and if we include the time in entering a holding pattern and the time getting off the airport, the turnaround time might be an hour and a half still. We can get further testimony on that, I am sure.

If you look at figure 2 and trace to the right from the average turn-around time of 1 hour, you can see the type of efficiency advantage you would have, for instance, if the SST were to operate at equal hourly operating cost with the 747. If with a 1-hour turnaround time it can do that, the SST would have about a 14 percent advantage, again not double, only 14 percent. If the operating costs were 20 percent higher on an hourly basis, including all the extra fuel cost, all the double or triple capital cost, we find that the SST would be operating at a 4 percent disadvantage even with that very sharp optimum.

RESEARCH ANALYSIS CORP. STUDY

Mr. McFALL. You list a study done by the Research Analysis Corp. as a corroborative study.

Mr. BROWN. Yes, in that it places its results in the same ball park that I am describing here.

Mr. McFALL. When was that study completed?

Mr. BROWN. I believe it was completed in 1969. In fact, that analysis was for the 2707-100. There are more recent figures, which are cited in a reference to this report published in the April 1970 issue of *Astronautics and Aeronautics*, on page 50, which bear out these costs per passenger mile. Again, it is right in the same ball park that I have defined. So I have a more modern reference than the RAC report.

Mr. McFALL. That study was completed in 1966?

Mr. BROWN. In 1969, I believe. I am not absolutely sure. That is a second reference. It was obtained from a report done by a man named Sherburne of the legislative reference service.

Mr. McFALL. The reference service study, I am told, was 1969, but the other study was made in 1966.

Mr. BROWN. Good. For that corroborative study I will state that the *Astronautics and Aeronautics* article, April 1970, corroborates again this ball park that I am in. What that article shows is that SST operating costs per seat mile are higher than those for the 747. By the time they get out to 1985 they project that it will be equal or better, but again seeing some of the assumptions that have been used one is not quite sure how they get to that figure.

Mr. McFALL. Have you used the latest cost data available for revised designs of the SST and 747 in your calculation?

Mr. BROWN. I have not used any cost data at all, sir, and I should add that I am not claiming that this study is made as an economist. What I have done is define the response surface, because I do not know the operating costs. I have looked at a ratio of operating costs all the way from an operating cost favoring the SST, that is, 10 percent cheaper, up to 50 percent higher, which seemed to be a reasonable range. Considering the capital and potential operating costs of the system, it seems to fall in line with the figures announced by industry for the higher seat mile cost.

Mr. McFALL. Mr. Boland.

Mr. BOLAND. I have no questions.

Mr. McFALL. Mr. Yates.

Mr. YATES. I would like to commend our witness for his very interesting statement. I think it raises some very searching questions about the operating efficiencies that have been claimed by the SST administration for the SST over the 747. We do know on the basis of reports that have come out that the Concorde operating costs will be as much approximately twice as much as the 747. This was the statement that appeared in the paper attributed to the BOAC before it was retracted the following Monday.

You know, you get reports in the first blush of truth and then something happens and the reports are retracted, but I think your testimony gives us some pause with respect to the figures that have been given us here. It raises, too, again the point that Mr. Boland raised on the day of the first hearing when he said that we ought to get the study that the White House has refused to make available. It is a study made by a science advisory group. The information that I have received is that it doesn't bear on the environment, as one would suppose, but really it bears on the economics and comes to the conclusion that the SST is not the economic giant that its champions contend that it is.

Again, I commend you for your study.

Mr. BROWN. Thank you.

Mr. McFALL. Mr. Conte.

Mr. CONTE. I have no questions.

Mr. McFALL. Mr. Minshall.

Mr. MINSHALL. Mr. Brown, you come here as a representative of the SST study committee, of the Idaho Environmental Council. Who financed your trip here?

Mr. BROWN. So far I have paid all the expenses, sir, and I have been sleeping on a couch in a friend's apartment. I hope to be reimbursed for my plane fare by the Coalition Against the SST.

Mr. MINSHALL. How long have you been in Washington?

Mr. BROWN. I have been in Washington since Sunday night and I have been here on vacation. I have taken vacation time to come here.

Mr. MINSHALL. You are in no way, other than being reimbursed for your transportation, on anyone's payroll, or from a foundation of any kind?

Mr. BROWN. No, sir.

Mr. MINSHALL. Thank you.

Mr. BOLAND. May I ask a question, Mr. Chairman? How much would you expect to be reimbursed by the Coalition Against the SST, Mr. Brown?

Mr. BROWN. My plane expenses and maybe expenses for my meals. The plane expense for this trip here was \$276. They are saving a great deal of money by having me sleep in a sleeping bag on a couch.

#### ADDITIONAL ANALYSIS OF MR. BROWN'S STATEMENT

Mr. BOLAND. Mr. Chairman, Mr. Brown raises some interesting questions here. It is an interesting statement and perhaps it is one that has to be analyzed by experts.

Apparently you are a good mathematician. I suggest that perhaps these figures ought to be analyzed not alone by the Department of Transportation but by some experts outside DOT.

Mr. YATES. You mean objective and impartial experts?

Mr. BOLAND. Well, I don't suggest that the Department of Transportation is not objective or impartial. But I do think, when you get a difference of opinion, particularly on costs and where it is possible to really delineate almost precisely what the costs are, that it might be well to get that kind of analysis.

It is an interesting statement and I certainly appreciate your coming.

Mr. YATES. I think he ought to be commended, too, for taking his vacation time to come here at his own expense and really doing a public service. I think he ought to be commended by the committee for that.

Mr. BOLAND. And we all commend him.

Mr. McFALL. Especially if he is sleeping in a sleeping bag.

Mr. BROWN. Might I add a comment, sir?

Mr. McFALL. Yes.

Mr. BROWN. The mathematics involved in this study are quite literally dining room table mathematics. They were done in two evenings at my dining room table, in September. The arithmetic here can be done by any eighth grader. It is not a complex study. It is quite simple. It involves mathematics or economics no more complex than the housewife uses in the market when she perceives that when eggs are 5 cents apiece, a dollar a dozen is a bad deal.

Mr. CONTE. I have a question, Mr. Chairman.

Mr. McFALL. Mr. Conte.

Mr. CONTE. Mr. Brown, have you submitted your findings comparing the efficiency of the SST with that of the 747 to DOT?

Mr. BROWN. No, sir. I have submitted them after we prepared this document, and on finances, since people are interested. Last fall we learned that there was going to be a vote in the Senate and I went to the Idaho Environmental Council with the study and said "Should we publish this?" We did publish it and the Idaho Environmental Council spent approximately \$130 of its \$170 total treasury to publish the report and mail it to Senators and Congressmen.

#### STANDARD FOR TRANSPORTATION EFFICIENCY

Mr. CONTE. I think it would be good to get their response to your findings.

On page 2 of your statement, would you clarify your assertion that the basis for a true standard of transportation efficiency is seat-miles per dollar rather than seat-miles per hour?

Mr. BROWN. Yes, sir. Perhaps I can clarify by an analogy.

If I may be fanciful, if we were to create a platinum zeppelin to carry 5,000 people at whatever maximum speed, and we were to fuel it with 25-year-old brandy, it might have a great seat-miles per hour rate until you start to compute the cost of fuel.

I do not think any standard of efficiency can be characterized unless you throw in dollars. The dollars control everything. The Saturn rocket might be a great system in terms of seat-miles per hour, but it sure costs a lot to get there.

Mr. CONTE. Have any of your professional colleagues concurred in the findings that you present to our committee today?

Mr. BROWN. I have not submitted it formally. I have asked an economics professor and some associates in the technical field in which I work, to take a look at it and see if they can find flaws. I was very interested that everybody seems to have agreed generally with both this type of approach and that the numbers I have used are good.

#### FUEL USAGE

Mr. CONTE. Have you any expertise in determining how much fuel the SST will use? We have a tremendous shortage of low-sulphur No. 6 crude oils.

Mr. BROWN. I have figures that were published as part of an environmental study that was done for Senator Gravel, included in the Congressional Record on November 17. Senator Gravel quoted a Dr. George Chatham of the Library of Congress who had prepared for him an exhaustive and unbiased report, according to Senator Gravel, on the environmental issues surrounding debate on the SST program. Mr. Chatham's objective report contained the following material on fuel consumption. It contained a table trying to describe the environmental benefits of an SST. He stated:

The work efficiency obtained from a fuel becomes a matter of environmental safety as well as quality. The table below—the table printed in the November 17 Record—compares fuel consumed per horsepower-hour for various types of systems.

He listed a table with five or six or seven values in it, ranging all the way from the craft which consumed 10 pounds of fuel per horsepower-hour to the SST which consumes three-tenths of a pound per horsepower-hour.

He also includes the subsonic jet which, according to his calculation on this basis, consumes four-tenths of a pound per horsepower-hour, a 33 percent increase.

If we look at the raw data supplied in another part of that report, we find the SST fuel consumption in terms of pounds per passenger-mile—perhaps a somewhat more significant statistic, a measure of useful work—we find that the SST consumes 45 to 65 percent more fuel than subsonic jets. That is using Department of Transportation fuel consumption figures of 115,000 pounds per hour for the SST.

If you compare it with autos, which he has in the same table, on the basis of pounds per horsepower-hour, he has the SST being 3 times as efficient as an automobile.

If one does it on the basis of pounds of fuel consumed per passenger-mile, lo and behold, the SST is no longer the fair-haired boy, and it consumes 3 times as much as the auto. And that is not even using Volkswagen mileage.

Mr. CONTE. As our technological expertise increases, would it not be possible to increase the efficiency of the SST to make it truly competitive with or superior to the 747?

Mr. BROWN. Yes, sir, I would have to say it might be. In fact, the response defined in figure 2 in this report certainly includes that possibility. If SST operating costs are reduced enough, if turnaround time is reduced enough, there is a possibility that it will operate as efficiently or more efficiently than the 747.

The purpose of my whole study was to publicize the fact that the figure of double productivity is a smokescreen, a sort of con job being done on Congress, and I think it is time somebody put a stop to it.

Mr. CONTE. Thank you very much.

Let me also add my voice to the congratulations. I think you have done a good job.

Mr. EDWARDS. I am interested in your reference to a "con job." It causes me to turn to page 5 and inquire whether parametric study as a brute force technique is being used by the opponents or the proponents, and whether we are the ones who are ignorant.

Mr. BROWN. The brute force reference did not refer to the gentlemen from the Department of Transportation or me, but, rather, it is a crude study, a study which does not presume special knowledge and goes in and calculates all the points. It is crude because it does not optimize or peak particular optimum regions, but, rather, goes in and calculates the whole world, as it were.

Mr. EDWARDS. You did not answer the second part of my question. Are we the ignorant ones?

Mr. BROWN. I am not qualified to judge that. I am sure by the time the hearing is over, you will be well informed.

#### USE OF SEAT-MILES PER HOUR

Mr. EDWARDS. Let us agree for the moment that seat-miles per dollar is valid in determining transportation efficiency. Is seat-miles per hour invalid as a computation?

Mr. BROWN. It is a perfectly valid computation. It is my opinion, and apparently the opinion of people in industry since they continue to talk about seat-miles per dollar, that it may be of more limited value.

Again, the Saturn rocket might be the most efficient transportation system in the world or the astronauts going around the moon might be going at a fantastic rate, especially if you could stuff 25 of them in a rocket, but in terms of true efficiency, it probably would be terrible.

Mr. EDWARDS. As a practical matter, in the transportation industry seat-miles per hour have some validity, as does seat-miles per dollar, is that not true?

Mr. BROWN. I am afraid I am not qualified to judge that. Instinctively, as a layman, if I were looking for efficiency in a system, I would always want to know how much it cost. I am sure that the people at Boeing and DOT do look at costs, even though they perhaps may not publicize the unfavorable ones as much as one might hope.

#### TURNAROUND TIMES

Mr. EDWARDS. You discussed turnaround time on the SST. You did not say much about the turnaround time on the 747 or other planes. How did you work that into your equation?

Mr. BROWN. These calculations, sir, are based on equal turnaround times for the 747 and the SST. Table 1 of this report contains all the raw figures in the calculation. One can obtain the efficiency for unequal turnaround time if one picks the right values for trip length

and speed ratios. I have included in the raw material of this report the estimates one would need for calculating the effects of unequal turnaround times.

Again, as a first cut at this, I assumed equal turnaround times. Unequal turnaround times can be handled very easily. Those figures can be drawn from table 1.

Mr. EDWARDS. Those are all figures that the average housewife can understand?

Mr. BROWN. Yes, sir.

Mr. EDWARDS. I will take it home tonight to my impartial wife.

Mr. BROWN. It is 8th grade arithmetic.

Mr. EDWARDS. Thank you, Mr. Chairman.

Mr. McFALL. Thank you very much, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

#### STATEMENT OF LAURENCE I. MOSS

Mr. McFALL. The next witness we shall hear is Mr. Laurence I. Moss.

Mr. MOSS. Thank you, Mr. Chairman.

The Sierra Club opposes continued Government subsidy of the SST because of its known adverse environmental impacts (arising from the sonic boom and increased fuel consumption), and from other environmental impacts which range from probable to possible (including takeoff noise and effects on the stratosphere). We further believe that, on economic grounds alone, further Government investment is not desirable. Finally, we say that it is time for the research and development budgets of the Federal Government to reflect all the talk about the need to change national priorities and solve domestic problems.

In commenting on these matters, I will strive to build upon and not repeat my testimony of last year before this committee and the Senate Appropriations Committee, except for certain points whose importance requires reemphasis.

#### ENVIRONMENTAL EFFECTS

The first of the inevitable environmental effects is the production of the sonic boom. It is agreed by both proponents and opponents of the SST that whenever the plane is flying at supersonic speeds it will produce a shock wave. At normal altitude and cruising speed this shock wave will give a boom pressure of 2.2 pounds per square foot at the earth's surface. The boom will be heard in a corridor extending 30 miles to each side of the plane's path, over the entire length of its supersonic flight.

The 1964 Oklahoma City tests demonstrated that a substantial fraction of the population would not tolerate even much lower boom levels (1.3 to 1.7 pounds per square foot).

There is neither a regulation nor a law now in effect which would prohibit commercial supersonic flight over the land area of the United States. We support a law which would do so. We do not believe, however, that such a law would be sufficient to protect the public. For one matter, people traveling on the seas would not be protected.

There are roughly 10,000 to 15,000 people on the seas underneath SST routes on a given day. There could also be an adverse effect on migratory birds. Finally, we simply do not believe that a regulation or a law will stand up indefinitely against the concentrated economic interests represented by an additional market for SST's of tens of billions of dollars if supersonic overland flight should be allowed. We recall the repeated policy statements of FAA administrators in the late 1950's and early 1960's to the effect that Washington National Airport would remain closed to the jets; this policy could not withstand the relatively much smaller pressures or reversal of that position.

Not only do we have jets, we now have the stretched jets. These were brought in as a temporary measure during the air traffic controllers slowdown. It takes no great imagination to speculate that 10 to 15 years from now a choice might have to be made between the bankruptcy of Boeing and several of this country's major airlines (perhaps due to an overcommitment to SST's), and the more reasonable alternative of increasing the market for SST's by allowing supersonic overland flight.

Another major environmental effect of the SST—there is no debate on this one, either—comes about because of its increased fuel consumption, twice that of the Boeing 747 for each seat-mile traveled. Mr. Brown's figure was about 60 percent higher, but that was relative to the Boeing 707. Relative to the 747, it is a factor of about two. The extra fuel consumption of the fleet of 500 SST's will be of the order of the capacity of the proposed trans-Alaskan pipeline. The development, transportation, and refining of this quantity of oil can be expected to have a profound environmental effect. In fact, in the draft environmental impact statement submitted a few weeks ago by the Department of Interior, in which the effects of the trans-Alaskan pipeline were evaluated, many, though not all, of the adverse environmental impacts feared by conservationists were conceded. The impact statement concluded nevertheless that the pipeline should be built for reasons of national security. If the national security requires that an additional domestic supply of this magnitude be developed to meet essential domestic demands, would it not also dictate that unnecessary increases in consumption of the same order of magnitude be prohibited?

A third environmental effect, the noise of the SST on takeoff, is also of concern. Last year Boeing stated that the so-called sideline noise of the SST would be 124 EPNdB at the 0.35 nautical mile measuring point, if the airplane and its engines were built within the limits of present technology. They stated that their objective was to reduce this noise to 112 EPNdB. Within the last month General Electric and Boeing have announced that they believe that the noise from the production version of the SST's can be held to 108 EPNdB, which is what is presently required for newly certificated subsonic jets of the same gross weight. They propose to accomplish this by a number of modifications to the engines and airframe. One of these modifications would eliminate the afterburner. Another, the inclusion of a fan stage, would require an increase in diameter of the engine. These modifications will not be on the prototype airplane, so their feasibility will not be demonstrated by testing the prototypes. The

additional development cost, the loss in thrust and/or engine efficiency, and the loss in payload resulting from increases in weight of engine and structure have not yet been disclosed by G.E. and Boeing.

These companies should be commended for their recognition of the importance of the sideline noise problem, and for their stated intention of reducing that noise to 108 EPNdB. Such a reduction, if accomplished, would greatly lessen the impact of SST operations on the communities near the airports, to the side of the active runways. But it must not be forgotten that these companies have in several previous instances not been able to translate desired objectives into practical designs. In the 1968 contract between Boeing and the Department of Transportation, for example, many requirements were established which will not now be met by the production SST's. One such specification is particularly relevant to this discussion. The contract states that the takeoff noise, measured at a point along the extension of the runway centerline, not exceed 93 EPNdB. The noise expected from the production planes (as well as from the prototypes) far exceeds this.

One further point on the noise problem: It is generally agreed that the present FAA regulation, applying to newly certificated subsonic planes, and limiting the noise at each of the three measuring points to 108 EPNdB, is only a first step toward making airplanes and airports more compatible with the communities they serve. Further steps will no doubt be taken in the 7 or 8 years before production SST's could enter service. The kind of substantial improvement which is feasible is embodied in one of the recommendations of a recent report of the National Academy of Sciences—National Academy of Engineering,<sup>1</sup> to the effect that the Department of Transportation should require that by 1975 all planes meet a standard 10 EPNdB lower than the standard now applying only to new subsonic planes. Thus, if the introduction of SST's in 1978-80 is not to greatly increase the noise above what can be achieved by then with the subsonic planes, the SST's should have a noise level no higher than 98, not 108 EPNdB.

We have another fear: Now that it is becoming accepted that the SST's must be no noisier around airports than the subsonic jets, the FAA might defer the establishment of more stringent standards for the subsonic planes because of their knowledge that the SST would not be able to match them. The entire noise-suppression program might thus be set back.

The probability and extent of a fourth environmental impact, that of changes in the composition of the stratosphere, is more speculative; but the global nature of possible effects makes extreme caution advisable. We share the concern expressed in the report of the M.I.T.-sponsored "Study of Critical Environmental Problems"<sup>2</sup> with respect to increases in cloud cover and concentrations of particulate matter in the stratosphere. Another possibility, that of a reduction in the concentration of ozone and consequent increase in exposure to damaging ultraviolet radiation at the earth's surface, also should be carefully assessed. Here, of course, I refer to the testimony yesterday of Dr. McDonald.

A point to be emphasized is that no important information about takeoff noise or effects on the stratosphere will be obtained from the

<sup>1</sup> Jamaica Bay and Kennedy Airport, NAS-NAE, Washington, D.C. (1971).

<sup>2</sup> M.I.T. Press (1970).

two prototype SST's that cannot be obtained more quickly and at less cost from ground tests of prototype engines and from flight tests using military airplanes which fly in the stratosphere. The only exception to that might be the one quoted by Dr. McDonald yesterday, that of the nitrogen oxides; but for most of the things which concern us relative to environmental effects, the prototypes will not contribute anything that cannot be obtained more easily or quickly by other methods. Mr. Ruckelshaus said the same thing when he testified.

As for the other environmental effects (sonic boom and high fuel consumption), they are known to sufficient accuracy at this time to rule against continuing the program on environmental grounds alone.

I think that is an important point to emphasize, because the members of this committee and of Congress will have to decide if enough information is available to make a decision one way or the other. The prototypes will not increase our information about the environmental effects. We already know about adverse environmental effects which are not contested by the proponents of the SST. I maintain that they are significant enough that the decision now should be against continuing the prototype program.

#### ECONOMICS

With all of the above environmental problems, one would think that the economic case for the SST must be compelling; if not, how could the program get this far? Proponents of the SST argue that it is more productive than subsonic planes, that Government financing is required because of the size of the investment and its risk, and that the SST is needed to maintain our favorable balance of trade. Let us examine these claims.

The claim of higher productivity is based on the following exercise: Since the SST flies at three times the speed of the Boeing 747, and carries two-thirds the passengers, its "productivity" is  $3 \times \frac{2}{3}$  or twice that of the 747.

This is a remarkable way to calculate productivity, for it neglects the cost of purchasing and operating the airplane. If these are properly included, it is found that the direct operating cost per seat-mile of the SST is substantially higher than that for the 747. This point, by the way, was conceded to be true by SST proponents as recently as a year or two ago; since that time, in the face of an acknowledged \$76-million overrun and an engine and airframe modification which will add significantly to the development cost and possibly reduce payload and/or performance, they miraculously claim that the SST's cost per seat-mile will be less than that of the 747. The assumptions in their calculation, such as the one of no significant increase in the price of jet fuel in the next 10 or 15 years, should be critically examined.

On that one point you may remember when Mr. Magruder testified he showed the escalation of the different component costs of the SST and the 747 used in the economic analysis of the FAA; there was a flat line for the cost of jet fuel going all the way out to 1975, 1980, 1990.

In the light of recent developments with respect to the oil negotiations in the Middle East, involving substantial increases in payments to the producer countries; in the light of potential new requirements on tanker design and operation, to increase safety and decrease the

probability of oil spills—for example, requiring double bottoms and sides on tankers, as was recently proposed, along with other changes, to the International Maritime Consulting Organization—which would increase the cost of tankers by a factor of 2 to 3; in the light of demands to avoid the ocean pollution problem from the dumping oil-containing water ballast, which in most cases would require using one-quarter to one-third of the tanks in the tankers only for ballast, not to transport oil, with a proportionate cost increase, it is just not realistic to think that we are going to hold the price of jet fuel or any other petroleum product constant over the next 15 to 20 years. That is why I suggest that this assumption of Boeing and DOT be critically examined, because the high fuel consumption of the SST makes the cost of jet fuel a fairly sensitive parameter in the analysis.

As for the size and risk of the investment, it does not seem particularly out of line with the resources able to be assembled by private enterprise for other purposes. The aforementioned Alaskan oil development is illustrative; the oil companies have spent, or plan to spend, at least \$0.5 billion for preliminary development, \$1 billion for the oil leases, \$1.5 billion for the pipeline, and \$1.5 billion for a tanker fleet, i.e., a total of at least \$4.5 billion compared with about one-third as much allegedly required for development of the SST. Obviously the oil companies also face risks, as the delay in the issuance of a pipeline permit demonstrates. What accounts for their willingness to mobilize the resources, and the unwillingness or inability of the SST proponents to do the same?

The answer, I submit, hinges on the expected return on investment. When it is of the order of 15 to 20 percent or more, private capital can be found, even for risky enterprises. When it is of the order of 6 percent, as would be the case for the SST even if the program should be successful, private capital is nowhere to be found. The SST proponents have, of course, proposed a solution which is ideal from their point of view. The Federal Government assumes 90 percent of the cost and risk of development, is repayed last, and receives less than the average rate of return on its investment, so that the contractors can receive 15 to 20 percent on theirs. From the point of view of the government and the public, the solution is less than ideal, because scarce resources are diverted to enterprises which are submarginal with respect to both economic and social factors.

The need for Government financing of the SST thus belies the assertion of greatly higher productivity. The SST runs counter, in fact, to the proven formula for success in the aviation industry: not only have successful new airplanes been faster, they have been considerably less expensive in cost per seat-mile.

Even using the statistics of Mr. Magruder when he testified—you remember that chart he had of costs per revenue passenger-mile, showing the lines for all the different airplanes—there was an enormous difference going from the propeller planes to the 707, and an enormous difference going from the 707 to the 747; there was barely any difference at all going from the 747 to the SST.

Except for the first few years, when he assumes that more seats would be filled on the SST, the lines were practically one on top of the other. And that was using the questionable assumptions that I have referred to before.

## EXPECTED MARKET FOR THE SST

As for the expected market for the SST, there are a number of faulty assumptions in the economic analyses of Boeing and DOT. The most important of these are in estimating the perceived value of travel time saved, the level of competitive (subsonic) jet fares, and changes in price of jet fuel. More reasonable assumptions lead to a market estimate of less than 200 planes, versus their estimate of about 500.

With respect to the balance of payments, other faulty assumptions render the analyses of Boeing and DOT invalid. These include the overestimate of the total market; an overestimate of the competitive threat of the Concorde, which has costs per seat-mile about twice that of the 747 and which will probably not be permitted in U.S. airports because of excessive noise; and neglect of the negative impact on balance of payments from extra travel abroad by Americans and extra fuel consumption. But, most important of all, the balance of payments is a macroeconomic problem, to be handled by macroeconomic policies such as fiscal and monetary policies and revaluations of currencies. Subsidizing particular industries for the purpose of increasing exports leads to distortions in the domestic economy and a misallocation of resources; the cure can be worse than the disease.

It is no surprise, considering the above, that when 16 of this country's leading economists, representing a wide range of political persuasions, were asked their opinion of the SST program, 15 stated that they believed it inadvisable that it should continue.

## PRIORITIES

Finally, we believe that it is time that we reallocate our country's resources for research and development, limited both in dollars and in the numbers of scientists and engineers, away from less important and toward more important objectives. The SST should not be the largest (apart from military and space programs) research and development enterprise of the Federal Government. We are spending only \$10 million in R. & D. in the Department of Justice to develop better methods of fighting crime, \$35 million in the Department of Housing and Urban Development for improved methods of building construction, \$60 million in the Post Office for developing better ways of handling the mail. Is the SST, for which \$290 million was requested for this same fiscal year, more important than any of these, much less than all of them combined? Is it more important than R. & D. for all other forms of transportation, for which \$200 million was requested?

We think not. That is why I appear before your committee, to ask that you lead the way in making this reallocation come about, to align Federal resources with a true Federal interest.

The SST debate is an historic turning-point in the way people think of, and manage, technology. Stopping the SST will become a dramatic example that man, acting through the political processes which he has invented to make judgments among conflicting and incommensurable values and alternatives, can control his relationships with the machines he creates.

We ask you to strike the SST appropriation from the Department of Transportation appropriations bill.

Mr. McFALL. Thank you, Mr. Moss, for your testimony. Yours is an excellent statement and analysis of all the arguments that we have been hearing against the SST, and which will be considered in the evaluation that we will be presenting to the Congress.

I am sure the Members of the House will find your excellent statement of value in judging the case when it is presented on the House floor.

Mr. Steed, have you any questions?

Mr. STEED. No questions.

Mr. McFALL. Mr. Minshall?

Mr. MINSHALL. No questions, Mr. Chairman.

Mr. McFALL. Mr. Edwards?

#### ROYALTY PAYMENTS TO THE GOVERNMENT

Mr. EDWARDS. I have only one question.

If I understood your statement correctly, you said, in effect, that the Government would be repaid last as the planes were sold after production was started. It is my understanding that we will be paid along as planes are sold until at the 300th plane we would receive our whole investment back. Is that incorrect?

Mr. Moss. In the contract between Boeing and the Department of Transportation, Boeing has the option of not paying any royalties for the first 100 planes sold, and beginning to pay royalties with the 101st plane.

There is another very important point associated with this, which was brought out by the representatives of the Council of Economic Advisers a year and a half ago when they were reviewing the SST program. They calculated that if Boeing was interested in maximizing its profit on the SST, it would set a higher selling price for each plane than would be the case if we were interested, for example, in repaying the Government investment through the royalties. They would sell fewer planes, but by making more money per plane they would make a higher total profit.

The way the contract is written, Boeing might come off very well by having a high selling price, selling no more than 150 or 200 planes, and giving the Government only a very small fraction of its investment back.

Mr. EDWARDS. Do you really believe that that is good business practice? Don't you really believe it is to Boeing's advantage to sell 500 planes or 600 planes if they can, rather than pushing the price up and selling only 150?

Mr. Moss. I think Boeing is probably interested in maximizing its profits for its shareholders. Most industrial corporations are so interested. I would not count on any corporation acting altruistically if it ran counter not only to its profits but possibly even to its survival as a corporation.

#### SALE OF SPARE PARTS

Mr. EDWARDS. Are there not also profits in spare parts, and this sort of thing, that go with the sale of more airplanes?

Mr. Moss. There are, and all of this would enter into the calculation, but I think the Council of Economic Advisers did have a valid point when they explained that the optimum strategy from Boeing's point of view was different from the optimum strategy from the Government's point of view, and there was nothing in the contract to hold Boeing to the optimum strategy from the Government's point of view.

Mr. EDWARDS. I want to go on record as saying there is nothing wrong with the profit motive, and I am not suggesting Boeing should not have a profit motive, but by the same token, all of the facts would indicate to me that Boeing's greatest profit and the greatest number of jobs for its employees and the best way to hold its team together for future airplane production, whether it be the SST or something else, would be to continue to produce that plane just as long as they can sell it.

So, I find it hard to understand your assumption there.

Mr. Moss. I think you have to consider the cost and the selling price, in that calculation. Boeing, for example, does not continue to employ workers that it no longer needs for its programs just to hold its team together and to wait for the next big job to come along; such action would adversely affect its profits.

Mr. EDWARDS. That is exactly what I am trying to say. Boeing, I would assume, being a prudent business concern, would try to set the price at a level that would bring in the most purchasers and allow them to produce the most planes and keep the team together the longest. That certainly would be my impression of what a prudent business concern would do.

Thank you, Mr. Chairman.

Mr. McFALL. Have you any questions, Mr. Conte?

#### POSSIBLE EFFECT ON MIGRATORY BIRDS

Mr. CONTE. Mr. Moss, on page 2 you state the supersonic flights could have an adverse effect on migratory birds. I am vitally interested in migratory birds, and this is the first time I have ever heard this. Have you any scientific evidence to back up your statement?

Mr. Moss. There is little or no evidence dealing with the effects of sonic booms on migratory birds. There is some evidence on the effect of booms on other animals and wildlife.

You probably have all heard the story of the minks that were eating their young after being exposed to the sonic boom.

Mr. CONTE. Minks have a long history of eating their young. I happen to know something about minks. I raised rabbits as a kid, and one of the big problems was that, when you had a litter, you had to be careful that the mother would not eat the young ones.

Mr. Moss. There does not seem to be any question that the sonic boom produces a startle effect on both humans and animals and birds. The question of how important this startle effect might be on migratory birdlife remains unanswered. I do not believe there is any data on that.

However, the proposed over-ocean flight of the SST would intersect some routes of migratory birds, and if there was an effect, it could have a significant impact on the ecological systems of which these birds are a part. I think that calls for further study.

## NOISE LEVEL

Mr. CONTE. I would like to get your estimate of what you feel the noise level of the SST should be. You say it should be less than 108.

Mr. MOSS. I think the recommendation of the National Academy of Sciences-National Academy of Engineering is reasonable; that by 1975, all airplanes, including SST's, should meet a standard of 10 EPNdB below the present level of a maximum of 108. The new maximum would be 98. The smaller planes would have a somewhat lower maximum, about 95 EPNdB.

Mr. CONTE. Thank you, Mr. Chairman.

Mr. McFALL. Thank you, Mr. Moss, very much.

STATEMENT OF DAVID R. BROWER, GARY A. SOUCIE,  
AND GEORGE ALDERSON

Mr. McFALL. Our next witness is David Brower, president, Friends of the Earth. Mr. Brower.

Mr. BROWER. Thank you, Mr. Chairman.

I would like to bring with me Gary A. Soucie, the conservation director of Friends of the Earth, and George Alderson, our legislative director.

Mr. McFALL. I am glad to welcome a fellow Californian before the committee, Mr. Brower. We shall be pleased to have your statement at this time.

Mr. BROWER. Thank you, Mr. Chairman, and thank you for the opportunity to appear before this committee and for the opportunity to present to you in this adversary affair some of the opponents' views where the public can listen to what we say, and the Congress, too.

One of the commandments is that you should not covet your neighbor's anything, I presume—wife, car, or anything else. I plead guilty to coveting our opponents' staff and numbers and budget. When I think of Mr. Magruder having 97 people and a fairly large budget with lots of support from industry, I wish we had something like that kind of support for presenting to the Congress what we think is almost as important a view. But we will get along as well as we can with our rather more limited resources in this respect.

Mr. CONTE. What you lack in size is made up in quality.

Mr. BROWER. I wish, too, that we had some of the training aids to use here, but we do not have those. I wish we had the funds to carry out some research that I think is needed. I am quite impressed with the eloquent implication of Mr. Magruder's need for \$27 million for research. I am also a little apprehensive that he does not think really the research is going to uncover any problems.

I am rather semantically impressed by the name of one of his divisions, the Data Management Division. I thought data were rather where you found them, and you didn't have to manage them. But that just shows part of my own bias.

He has presented the SST as sort of the economic life insurance policy for the United States. I think there are other things that our economic life depends upon. I think there is a little bit of overselling.

Just as a general observation, from what I have heard so far, possibly one of the threats to American aviation leadership lies in there

having been so many Boeing eggs in the SST basket when what we really need is output from Boeing that will be much more usable over the longer run for more people, something that has led to their success so far.

I hope that will emerge from this controversy.

In any event, we do not have the opportunity to present our side as elaborately, but possibly there could be something offered, Mr. Chairman.

I am reminded of the Grand Canyon controversy, which is the greatest battle I have been in up to now, where it seemed advisable to have an opportunity for counterrebuttal, at least for the record.

I remember with respect to Mr. Moss' statement before the Interior Committee, that the Interior Committee wanted to submit his figures, and some of the others that the Sierra Club was then presenting, to the Bureau of Reclamation, which is really rather an advocate of the Grand Canyon dams. We did secure at that time the opportunity to comment on the Bureau of Reclamation's comment.

I think it might be quite valuable here if Mr. Brown and others could comment on the comment, so it really is an adversary proceeding, with a presentation, answer, rebuttal, and counterrebuttal. I think that would help Congress get the information it needs a little bit better.

I could not help but notice in Mr. Magruder's statement a reference to the Mekong River dams. You may recall that. One of the reasons he said we needed an SST was to get a good balance of payments so we could afford to be good to other countries. There is something almost diagnostic of one of our major ailments in this very example. The Mekong River dams sound good, but I think they really will show only the harm that well-intentioned people can do.

You may know something about the general proposal, that there be a whole series of dams on the Mekong River, but the studies that have led to these are rather biased. The problems ecologists see, for example, are that these dams would require the movement of about 2 million people out of their present places where they have lived for centuries in some kind of balance with the earth, onto lateritic soils, subjecting them to disease vectors they have no natural immunity to, destroying their own balance of payments, putting the Mekong River's protein production of of action, destroying of of the major Asiatic flyways, and also probably threatening the recovery and continuing fertility of the Mekong River delta.

This kind of thing can happen because the figures that I have on the Mekong are that \$16 million were spent on engineering studies, \$30,000 spent on sociological studies, and only \$5,000 spent on ecological studies.

I would like to see those funds reversed. I think we might get better information in that way.

Let me go to my formal statement, with that little prelude.

I would like you to let my testimony begin with concern for the earth. There will be no America, nor will any other nation or people endure, on a dead planet. All nations, our own in the lead in an unhappy race, have been treating this planet as if we had a spare, and as if the living environment were our enemy. Each of us, as a human being, arrived on this earth to find it a miracle and a treasure, to find it

a source of all the beauty that we know, and we are now discovering ourselves in the midst of almost having squandered this treasure, losing in the bargain any chance ever to know it again. We have glorified man's acquisitiveness, his aggressiveness, his search for convenience and comfort and security and speed; we have not thought hard enough about his ability to love and revere life. Because criticism of what we thought was good enough has made us uneasy, we have stifled the creativity, the new thinking, the world needs without quite realizing that this was what we were doing. We thought that the formulas that have brought us to our present success—and to our present brink—were all that we needed to sustain us and to rescue us. A long-haired, bearded, antiestablishment individual who spoke of peace and brotherhood was once executed for his having spoken out. For genius in this same spirit, we have found ourselves meting out the same punishment.

There is a need for change. There is still barely time for change. With fair application of the youth and imagination that should lie within each of us until we die, we should be able to accommodate ourselves to this change and be delighted and pleased that it is coming to pass. This we need and this, if we strive for it, we can have: the New Renaissance is not a Republican idea or a Democratic idea, or even an American idea. Let us say that it is, and deserves to be, a human idea. Let it be informed by the insight of the late Adlai Stevenson in his last speech, one given in Geneva in July 1965. Let this be a universal pledge of allegiance to this planet and to its peoples:

We travel together, passengers on a little space ship, dependent upon its vulnerable reserves of air and soil, committed for our safety to its security and peace, preserved from annihilation only by the care, the work, and, I will say, the love we give our fragile craft. We cannot maintain it half fortunate, half miserable, half confident, half despairing, half free in a liberation of resources undreamed of until this day, half slave to the ancient enemies of man. No craft, no crew can travel safely with such vast contradictions. On their resolution depends the survival of us all.

The peril to this planet, this fragile craft we share, and to ourselves if of a magnitude that is enormous, a tremendous peril, one that we are only now beginning to perceive fully. Let me try to put the peril in an understandable scale, a scale something like that which was made available to the world through the Apollo missions and the intrepid voyagers into space. To them the earth was an oasis in the vast desert of space. The great French explorer, Jacques Yves Cousteau, who has explored another kind of space, the depths of the oceans, has given us a most appropriate perspective:

If we were to reduce the earth to the size of an egg, which is how it must have looked to our astronauts, the water of all the oceans would amount to no more than a drop of water on that egg's shell. The earth's atmosphere, if concentrated to the density of water and colored so that we might see it, would amount to only 1/250 of that drop of water. On that scale, the soil of the earth capable of producing crops and thus sustaining the food of almost all mankind, would hardly be visible to the naked eye. That drop, plus that fraction of a drop, plus that speck, are all we have, are what makes our planet unique, and our very numbers and appetites threaten it as it has never begun to be threatened before, at a speed that has never before been approached.

Let me explain that to you with a simple analogy. The earth isn't a mere egg, it is a sphere 25,000 miles around. If we think of those

miles as numbers on a great clock, measuring off the age of the earth itself, then those 25,000 miles, representing the 4 billion years geologists attribute to the earth, give us a distance-and-time scale of 1 mile for every 160,000 years. Think about that for a moment, and let your imagination travel around the earth with me on a route that passes through San Francisco as we leave Dulles headed east and return to it from the west. If you will do this, you will begin to sense how long the earth got along without men, and how suddenly, in his most recent period, man and his technology are exploding around it.

We take off from Dulles, then, on our 25,000-mile journey the day the earth begins. We travel about 6,000 miles (representing a billion years) before there is any life at all on the planet. Halfway around the earth (2 billion years) we note that life has become more complex, more diverse, more stable, and more beautiful—corresponding with a time the oldest rocks in the United States were laid down (those at the bottom of the Grand Canyon, in the Visenu Schist). As we approach San Francisco from the west, after 22,000 miles of travel, we note that desert shrimp, stone crabs, and cockroaches have been added to the life inventory—in a form that persists until this day. As we cross the Rockies, the age of reptiles begins, and as we near the Alleghenies it is over, but redwoods and pelicans have appeared on earth. Our craft lets down and we skim the earth just a mile before the runway—and man appears on the plane? While we land and roll toward the end of that 2-mile strip, man persists with no tools more drastic than a shaped stone. Our 25,000-mile trip is about to end, representing the time the earth has got by without man's interference.

Hardly a city block from the end of the runway, with only 400 feet yet to roll, in that 25,000-mile journey of the earth, man discovered agricultural techniques and applied them in Southeast Asia. The oldest living thing, a California Bristlecone Pine, began its life 150 feet from the end of the journey, and Christianity 65 feet from the end. The industrial revolution is represented by the last 6 feet, those two centuries in which man devised the tools with which to dismember the biological capital of the earth and use it up, whereas theretofore he had lived on the earth's organic income without destroying or otherwise spending capital. Less than a foot from the end of our trip man began to apply DDT and other chlorinated hydrocarbons in his war against competing forms of life—a war that the world's life-support systems had gone along very well without for all but 11 inches on our 25,000-mile journey.

Assume, then, that we are now at the end of that runway, wondering what kind of trip to take next. And realize this: We are now planning to make demands of certain kinds in the next 10 years—amounting to a further 4 inches of travel past the runway's end—that will equal all the demands we have made thus far. By this I mean that in the oil industry and in the electricity-generating industry, it is the common expectation that we must double our output in less than a decade—spend as much in the next 10 years, and produce as much, as we have in all our history so far.

We have been counting on some kind of magic that will let us stretch a finite earth, and keep doubling the demands we place upon it for things. I no longer believe we will discover such magic; we must instead take a hard new look at the coming years, on how to live within

the earth's income, and not continue to live beyond its means—and thus beyond our own.

On my way here from San Francisco, I picked up an item in the San Francisco Chronicle. On the front page it says, "Big Oil Slick Off South Africa," and this is really relevant to the SST problem. Let me read the article that came from Reuters in Cape Town.

Ships and helicopters yesterday poured solvent on an oil slick more than 5-miles long spread by the stricken tanker *Wafra*, trapped on a sandbank off the tip of South Africa.

Officials are afraid the 28,339 ton Liberian-flag ship, which so far has only spilled oil from its fuel bunkers, may break up and spew its cargo of 40,000 tons of crude oil into the ocean.

I was at an International Conference on Oceans in Malta, last June, where the statement was made that if a major oil spill took place off the African Continent there is not one individual in Africa who knows what to do about it, and this story proves it. Right now they are putting solvent on the oil. Is that what you do about an oil spill? I don't think so. Why don't we know? Because we don't have the right kind of studies.

In Sweden, 3 weeks ago, I was talking to one of their leading ecologists who said he was having great problems getting a \$30,000 research grant to tell him what the long-range effects would be of putting solvents or other detergents on oil, on the Baltic Sea. He could not get \$30,000, but he had no trouble getting a \$400,000 grant to investigate the machinery for putting detergent on the oil. It is again that imbalance. That becomes relevant because of the figures that you have been hearing from Mr. Moss—and Friends of the Earth supports fully what the Sierra Club says through Mr. Moss—on the extraordinary demand for fuel that the SST is going to bring about.

We can no longer afford to make that sort of demand upon our environment. We know right now, Congress knows, you have been reading the papers, the difficulty of finding out from the State Department about the imminent contracts between the Government of South Vietnam and the oil industry for offshore drilling there. We know about the offshore drilling and the spills all over the world. This is part of the SST's pollution, not just the noise, but the demand on an exhaustible and rapidly being exhausted fuel resource around the world. This is something we cannot afford, if we want to stay here.

Our key need, then, I repeat, is learning to live within the earth's income, the annual dividends available from the biological wealth the sun lets the planet and life create. Until now we can hope to be forgiven for knowing not what we did. Now we are beginning to know what we are doing to the earth, and are beginning to realize that we can never again undertake a project without asking what does it cost the earth?

This question must inform us as we study our energy needs, our transportation, our development of food and fiber, and preservation of open space, parks, wildlife, and wilderness, our approach to the population crisis, pollution, growth, the crisis in our appetite explosion that has us wanting more and more, and as we contemplate our international relations and the environmental route to peace, including peace within our own land. The only war we seek is a war

against the destruction of our only planet—not a Department of Conservation, but a government of, by, and for people awakened to the need of conserving the life-support system that enabled the world to work before man came, without which man cannot remain.

In this context, then, let us consider the proposed supersonic transports here and abroad—a proposed mode of travel that I find vigorous opposition to wherever I speak. I conduct a quiz with each audience and find only one man per thousand favoring SST. There is a sea of hands when I ask for those opposed.

The late Howard Zahniser, responsible more than anyone else for there being a national wilderness preservation system in the United States, once replied to a forester's derision of his support for wilderness, "I admire the ardor with which you attack my emotionalism," a parallel retort is suggested by the ardor with which Senator Barry M. Goldwater, in "The Big Lie and the SST" (New York Times, Dec. 16) attacks the truthfulness of organizations trying to spare the world from the SST. He was joined by other SST enthusiasts, some of them even more emotional than he.

Senator Goldwater is probably the most charming, most radical, and most consistently wrong person I have ever had the pleasure of debating. Still, anyone who likes to run the Grand Canyon in boats cannot be all wrong. Even so, in the first debate, which took place on the south rim of the Grand Canyon where he appeared unannounced, he tried to persuade the visiting press that a downstream dam would be good for the Grand Canyon, while an unpstream dam would be bad.

The next debate was in Washington at the National Press Club, and was still about the Grand Canyon. My appearance was a month after his. Asked after his talk if there was anything he would do differently if he could rerun his presidential campaign he replied, swearing quite eloquently, "Where do you want me to begin?" His humility brought down the house.

Since Friends of the Earth has a key role (Mr. Goldwater lists us first among those who trouble him) in the attempt to save the skies from the SST, may I suggest an inventory of timely admissions of error for the Senator to select from at his pleasure?

#### TIMELY ADMISSION

1. It is ungracious to accuse people of the big lie, and the application in this case misses the mark completely. We have barely enough time to try to get the truth around and no need to lie.

2. It is still too early to say as the Senator does that the scientists who did not like atomic bombs were wrong.

3. It is wrong to accuse Grand Canyon defenders of big lying when the words the Senator complains of are words he put in our mouths and we never spoke or thought. This is the when-did-you-stop-beating-the-lady gambit. Our side never said that Echo Park Dam would flood the dinosaur bones or suggested that Grand Canyon dams would be rim to rim. But the reclamation extremists like to say we said so and Senator Goldwater should not join them.

4. Dams proposed for Grand Canyon were not then, and are not now, as the Senator alleges, humanitarian. Great concrete piles cannot be. The dams were a device to spend something priceless in order to create

an illusion of revenues for moving the Columbia River water to Los Angeles to add to the Colorado River water already there.

5. Just because you are wrong once, you don't have to stay wrong. I think all of us, until we have a critical sober look, were once mesmerized by the prospect of the SST. Then almost all of us saw what an unacceptably expensive toy it would be, on seven counts. Our book, *The SST and Sonic Boom Handbook*, made this quite clear last February.

6. We have never said two prototypes would cause the damage Senator Goldwater lists, and he must have been unobservant indeed to construe our full-page ad, book, articles, and detailed, buttressed, and documented evidence that we ever in any way said two prototypes would do all this. But the fleets of SST's required to provide a theoretical payout would indeed bring environmental havoc. They would waste a fortune on a bad trip that could become addictive. Let that be the bumper sticker: *The SST is a Bad Trip*. The U.S. economy and leadership in civilian aviation will not derive benefits from a multibillion-dollar fix. They will get benefits from their doing useful things, so are trying to save Boeing and its customers and Senator Goldwater from themselves. There is not any overawing sense in doing useless or harmful things to make jobs.

We wish the Senator would join us. He can base all the admissions we recommend to him upon excellent research by good men, including most of his colleagues—men who are not trying to sell self-serving programs or products and who, like the rest of us, deserve to be given the benefit of the doubt, and to preserve eardrums too.

There are other admissions to make. The air is not getting any better. Fossil fuels are not becoming more abundant. We worsen one as we lessen the other and SST's do both supersonically. No one should take lightly the objective prediction that a fleet of 500 Boeing SST's could use up in 3 to 5 years the equivalent of our biggest-ever oil discovery at Prudhoe Bay, in Alaska. (This figure assumes that it takes 7 barrels of crude to make one barrel of jet fuel—a figure that may be pessimistic.) I do not want it used up that way in my air or the Senator's either. I cross the Atlantic often (too often) and do not need to arrive that much sooner than my baggage or, considering what jet lag does to minds, that much sooner than my judgment.

On my way to Europe this time, to the Raumbouillet meeting of Friends of the Earth organizations from several countries, I scrawled this note on my menu:

The Santa Maria could sail up one aisle and down the other in this 747, and I ask, "was this snip necessary?" Without being sure which ship I refer to.

Considering what the 747 hard sell has done to the airlines' balance sheets and to the economy of Boeing, Seattle, and Washington, and bearing in mind the open-space-in-the-sky phenomenon the 747's have been lately as they fly slightly filled on fewer schedules after earlier check-ins between fewer cities, more slowly and with more diluted service and longer restroom waits to longer baggage delays and uglier taxicab hassles at the far end, I ask for this further question: Now that runaway technology has built us a turkey, must it also build us an albatross? Live audiences are often kind enough to laugh at this litany and question, but it does not begin to sum up our mistake, Senator

Goldwater's, nearly so well as the title of the SST analysis by a Stanford professor, from Watts to Harlem in 2 hours.

I would like to believe that Senator Goldwater is secretly happier to have an unspoiled Grand Canyon even if it has meant doing without a temporary splurge of expensive kilowattage in Arizona. And I would like to bet that he, we, the United States, and the world can somehow muddle through without assaulting our degrading atmospheric sea with SST's, singly or in flocks.

We invite Senator Goldwater and other good people to sign this statement with us: Industry has an obligation to stop contributing to the delinquency of users, including the intended users of SST's and other forms of speed.

Mr. McFALL. Thank you very much.

Mr. BROWER. Mr. Chairman, we have in the audience, if you would care to question him on anything, the author of a book that we have published that I would like to submit for the committee's file. It is "Concorde: The Case Against Supersonic Transport" by Richard Wiggs, with a forward by Michael Foot, Member of Parliament. Friends of the Earth have published that in cooperation with Ballentine Books.

Mr. McFALL. We will be glad to have that for the file.

#### COMPETITION FROM THE CONCORDE

Mr. BOWER. I have a few notes here that may interest you, on the Concorde which is part of the competition that worries us, that come from some remarks by Mr. Wiggs, where he thinks that:

"The prospects for Concorde at the present time are poor. Representatives of a number of airlines holding 'options' on Concorde—there are no orders in existence, and the number of options has remained at 74 for some 3 years, in spite of the efforts of special sales staff—have publicly stated their doubts about the profitability of Concorde. Among these are:

Mr. Najeeb Halaby who said in an interview on BBC (London) TV on February 1, 1971, that Pan Am would not order Concorde until they were sure the aircraft could be operated profitably and also acceptably with regard to sonic bank, airport noise, pollution, and so forth."

"Mr. Robert Six, President of Continental Airlines has said: 'Concorde is technically a good aircraft but economically a poor one.'" That was Flight Magazine, London, February 11, 1971.

Then there was the London Observer story, which I think is being submitted to your record, that front-page lead story on the 21st of February:

"BOAC Can't afford the Concorde." This report is so important that a copy is attached. BOAC has stated that the report is "oversimplified," but has not denied its basic truth.

It should be pointed out that all of these gloomy prognostications (except the last) preceded the emergence of the proposed new airport noise regulations at New York Kennedy and elsewhere. Whether the present bill at New York succeeds or not, potential purchasers of Concorde or other SST's would have to reckon with the probability of such regulations being imposed in the future—and not only at New York Kennedy.

## PROHIBITION OF SUPERSONIC OVERFLYING

Potential purchasers of SST's would also have to reckon with existing and future restrictions on supersonic overflying. Several European nations have already announced their intention to prohibit supersonic flights across their territories: Sweden, Norway, Switzerland, the Netherlands, West Germany, and Ireland. Switzerland has recently enacted such a ban; Ireland has legislation in readiness to enact if it should be required.

A section of the Canadian Air Regulations provides that "no aircraft shall be flown in such a manner as to create a shock wave, the effect of which is likely to create a hazard to other aircraft or to persons or property on the ground."

He has quoted a few other remarks about that. Then also I think a pertinent remark here is what the lesson is on the Rolls Royce problems alluded to yesterday:

The Prime Minister, Mr. Heath, said on February 7 that there was a lesson to be drawn from the collapse of Rolls Royce. "It is of the utmost importance that this lesson should be learnt and acted upon by us all \* \* \*. Governments must rid themselves of the illusion that you can find the way to prosperity by pouring out the taxpayers' money in perpetual subsidies for uneconomic ventures."

Just to sum up, I think I would just like to say we have only one ocean, with coves having many names; we have a single sea of atmosphere, with no coves at all. We have one thin miracle of soil, alive and giving life. We have only one planet. We have no spare, and the SST is no way to treat that one planet for which there is no spare.

I have been fairly general in my testimony, because that is my overall interest here, but with me here, with a bit of supplementary material, are Gary Soucie and George Alderson, who have been in the thick of this battle and who have information that I think you should have, and I am sure that they are available here to aid in any counterrebuttal, if that should please the committee, that you are seeking. I would like Mr. Soucie to pick up here and get down to a couple of specific details.

## REMARKS OF MR. SOUCIE

MR. SOUCIE. This will be very brief, but it is something that I think the committee should have for its deliberation.

Three weeks ago, across town, the Society of Automotive Engineers and the Department of Transportation cosponsored a conference on aircraft and the environment which was largely a technical conference. Only the contributing papers have been published, and the summary papers will not be published until July. I was able to obtain from the chairman of one of the sessions his summary report, which I am going to submit for the record, but I think one thing should be read.

## REPORT OF PROFESSOR HEYWOOD

The chairman is Prof. John B. Heywood of MIT, and he was chairman of the technical session on air pollution distribution. His report begins:

"In our workshop about 50 participants took part; the level of discussion was technical and informed."

I might point out that in the section I am going to read, the major participants discussing SST contrails in the stratosphere, were Dr. Lester Machta of ESSA and Dr. Arnold Goldberg who is Boeing's chief scientist on the SST program.

The section on high altitude dispersal reads as follows:

"We briefly reviewed the evidence of increased cirrus cloudiness in the upper troposphere as a result of water vapor emissions from current subsonic jet activity. It was generally agreed that the data presented by Dr. Machta in the conference proceedings could be significant"—I am submitting for the record Dr. Machta's paper—"and there is a definite need for further high-altitude cloud observations and data analysis both near and remote from air routes.

"On the dispersal and possible effects of SST emissions in the stratosphere, consensus was more elusive. We first reviewed the question of the steady-state distribution of SST emissions in the stratosphere from a fleet of SST aircraft during the 1985-90 period.

"It was agreed that the actual concentrations of emitted species will be higher than the values calculated assuming uniform worldwide distribution of SST emissions throughout the stratosphere. The question is how much higher, and on this there is wide disagreement. Approximate calculations of steady-state water vapor concentrations, for example, using relatively simple models of the dispersive process, range from a factor of 1.5 times this worldwide average to a factor of 10 times this worldwide average as an upper bound for significant portions of the stratosphere. It appears that we now have the ability to carry out a detailed study of this large-scale dispersal problem more precisely. This task obviously should have high priority, especially as these concentrations are necessary inputs to any estimates of the importance of possible climatic effects.

"We did not consider any of these possible climatic effect specifically. But we did consider the criteria which should be used to evaluate whether any of these effects would or would not be significant. The point of view which came through most clearly was that each possible atmospheric effect can only be evaluated by resort to a detailed model of the actual process involved.

"It was brought out quite clearly in our technical discussions that the testing of two prototype SST's in the stratosphere is primarily for testing vehicle performance. Such prototype testing would give no direct information on possible large-scale atmospheric effects of SST exhausts though it could give more precise data on engine emissions at stratospheric flight conditions. It was agreed that 100 hours of prototype flights in the stratosphere would have no significant atmospheric effects.

"Obviously this whole area of SST emissions and their effects in the stratosphere is in need of more field data and much more detailed analysis. The additional information required to resolve some of these open questions can only come from carefully developed, comprehensive, and vigorously pursued research programs. The detailed goals of such programs have yet to be worked out, but their planning and execution must be such as to insure the complete credibility of their results. At present our disagreements show we cannot yet give definite answers to many of the questions which are now being raised."

(The report follows:)

SUMMARY REPORT OF THE WORKSHOP ON AIR POLLUTION DISTRIBUTION

(Prof. John B. Heywood, Massachusetts Institute of Technology)

AIR POLLUTION DISTRIBUTION

In our workshop about 50 participants took part; the level of discussion was technical and informed. Two critical problem areas were discussed in some detail. These were the dispersal of aircraft exhaust emissions in the vicinity of airports, that is, the process that links emissions and ambient concentrations, and the dispersal of exhaust trails in the upper atmosphere both from subsonic and supersonic transports. I am going to summarize the consensus, or lack of consensus, on each of these topics.

*1. The airport problem*

At the present time there is still uncertainty as to the precise contribution of aircraft to pollution levels in the airport and the surrounding areas. Measurements available to date, which are not that extensive, show that in some parts of the airport, pollution levels are often as high as in central urban areas; in some parts of the airport; e.g., parts of the airport perimeter, mean values may be much lower. There was, however, a general consensus in our workshop that emissions and ambient levels ought to go down.

One important technique which needs to be developed and used in a rational control plan for aircraft emissions is diffusion modeling of the airport with its many different emission sources—aircraft, ground vehicles, heating plant, et cetera. It was felt that present modeling techniques are only accurate in predicting absolute values of ambient concentrations to within factors of 2 to 5. This uncertainty has many sources—inaccurate emission data, inadequate modeling of the local meteorology, and topography.

However, the relative change in ambient concentrations as emissions vary, for example, can be assessed much more accurately. The problems we now face and which modeling can usefully evaluate are effects of changes in aircraft emissions, effects of changes in operational procedures at airports, and effects of changes in aircraft activity. The rollback technique (e.g., halve the emissions halve the ambient pollutant concentrations) is not really useful for the airport problem because emissions during different parts of aircraft activity are substantially different, and because both ground traffic and aircraft are significant sources on the airport, but in different areas. Diffusion modeling is the only way to unscramble these interwoven sources. For example, if carbon monoxide emissions during taxi are halved on some engines, how else can the effect on ambient concentrations be estimated?

The validation of these models with field measurements was felt to be a very important immediate task. It seemed prudent to tackle first simpler situations such as dispersion of the aircraft trail from a single or few landing-takeoff cycles. Then the initial disagreement which usually exists between model predictions and field measurements can more easily be resolved. While the FAA has plans for a combined modeling and field measurement study at Dulles and Washington National Airports, a check on the accuracy of modeling these simpler processes at the same time seems necessary. A similar check on dispersal from ground traffic ought also to be done by the appropriate agency.

There are additional aspects to these dispersion problems than just a more careful application of diffusion theory can resolve. The interaction of the wing-tip vortices with the trail, effects of increased turbulence due to aircraft activity, interaction of one trail with another are examples of problems that may be important but are not at all well understood. Research should be initiated in these areas.

These comments underline the need for well-planned, long-range research on these problems. Had this been done in the past, we might be more ready to use diffusion modeling right now when it is needed, to evaluate the effects of emission reductions.

The contribution of aircraft in comparison to contributions from ground vehicles on airports needs to be further delineated. Since ground vehicle emissions will hopefully decrease the aircraft's contribution in comparison is important. This delineation can be done with a combination of modeling and field measurement studies. Measurements of several pollutants simultaneously at several

sites around the airport and its surroundings will be required. Since this requires many sets of instruments, it will be expensive. Similarly attempts should be made to separate the effects of emissions from the airport from those from the surrounding community.

These field studies ought to consider odor measurements of some kind, or attempt to correlate odors with other pollutant measures like hydrocarbons. The odor problem, a primary source of airport pollution complaints, has been much neglected in the past. No systematic study yet exists.

Special efforts are needed to investigate the sudden peaks in pollutant concentrations caused by aircraft exhaust trails passing a receptor. The problem is analogous to the powerplant plume touching the ground at specific locations. So there is a need in the field measurement programs to use fast-response instruments (a response time of a few seconds is required). There is a need, therefore, for some instrument development, particularly to monitor particulate concentrations. Diffusion models also need formulating which predict these high momentary peak concentrations and where in the airport or surrounding area they are likely to occur.

There was a consensus that modeling can play an important role in attacking these problems. Exhaustive field tests which succeed in determining relative contributions at one airport, from the different operations and sources on the airport, do not allow us to sort out the problem at another airport unless an accurate and reliable dispersion model exists. Measurements at Washington National do not tell us what we need to know at J. F. K.

## *2. High Altitude-Dispersal of Jet Exhaust Trails*

We briefly reviewed the evidence of increased cirrus cloudiness in the upper troposphere as a result of water vapor emissions from current subsonic jet activity. It was generally agreed that the data presented by Dr. Machta in the conference proceedings could be significant, and there is a definite need for further high-altitude cloud observations and data analysis both near and remote from air routes.

On the dispersal and possible effects of SST emissions in the stratosphere, consensus was more elusive. We first reviewed the question of the steady-state distribution of SST emissions in the stratosphere from a fleet of SST aircraft during the 1985-90 period.

It was agreed that the actual concentrations of emitted species will be higher than the values calculated assuming uniform worldwide distribution of SST emissions throughout the stratosphere. The question is how much higher, and on this there is wide disagreement. Approximate calculations of steady-state water vapor concentrations, for example, using relatively simple models of the dispersive process, range from a factor of 1.5 times this worldwide average to a factor of 10 times this worldwide average as an upper bound for significant portions of the stratosphere. It appears that we now have the ability to carry out a detailed study of this large-scale dispersal problem more precisely. This task obviously should have high priority, especially as these concentrations are necessary inputs to any estimates of the importance of possible climatic effects.

We did not consider any of these possible climatic effects specifically. But we did consider the criteria which should be used to evaluate whether any of these effects would or would not be significant. The point of view which came through most clearly was that each possible atmospheric effect can only be evaluated by resort to a detailed model of the actual process involved.

It was brought out quite clearly in our technical discussions that the testing of two prototype SST's in the stratosphere is primarily for testing vehicle performance. Such prototype testing would give no direct information on possible large-scale atmospheric effects of SST exhausts though it could give more precise data on engine emissions at stratospheric flight conditions. It was agreed that 100 hours of prototype flights in the stratosphere would have no significant atmospheric effects.

Obviously this whole area of SST emissions and their effects in the stratosphere is in need of more field data and much more detailed analysis. The additional information required to resolve some of these open questions can only come from carefully developed, comprehensive, and vigorously pursued research programs. The detailed goals of such programs have yet to be worked out, but their planning and execution must be such as to insure the complete credibility of their results. At present our disagreements show we cannot yet give definite answers to many of the questions which are now being raised.

WATER VAPOR POLLUTION OF THE UPPER ATMOSPHERE BY AIRCRAFT<sup>1</sup>

(Lester Machta, Air Resources Labs., National Oceanic and Atmospheric Administration)

Aside from the unused ingested air, the prime emissions from a jet engine are the products of combustion; carbon dioxide and water vapor. So long as hydrocarbons constitute the fuel, there is no means of avoiding these pollutants. For each pound of fuel consumed about three times as many pounds of carbon dioxide and 1¼ times as many pounds of water vapor must exit the engine. These two products comprise more than 95 percent of those made by the engine and about which new engine technology can do little.

This article will soon dispense with CO<sub>2</sub> from aviation as a weather/climate problem and devote its space to water vapor. It will not treat the environmental problems of CO, NO<sub>x</sub>, SO<sub>x</sub>, soot or particles, or unburned hydrocarbons. Future technology may be able to minimize these less abundant pollutants so that an evaluation of their environmental insult while currently of interest, may subsequently become academic.

## RESIDENCE TIMES

The atmospheric persistence of substance is frequently expressed by its mean residence time or lifetime. By analogy to first order chemical kinetics, the loss of the substance is proportional to its amount in a reservoir; the reciprocal of the proportionality constant is the mean residence time. Or put more simply, it is the time for a reservoir to reduce to 1/e (37 percent) of its original value. In a steady state condition (that is, a uniform, continuous source), the reservoir holds one mean life's worth of the substance.

Atmospheric carbon dioxide has been estimated to have a mean residence time in the troposphere ranging from 3 to 30 years before being taken up by the oceans and biosphere (1). 5 years seems to be the best value to this author.

Water vapor is lost to the atmosphere by precipitation, rain, snow, etc., mainly in the first few kilometers of the troposphere. It follows therefore that the mean lifetime of a water vapor molecule depends on its proximity to the layer in which precipitation elements form. Water vapor evaporating from the ocean surface, the main source of moisture, has about a 10-day mean life. This is deduced from the average atmospheric water vapor content, a little over three quarters of an inch spread over the earth, and the mean global precipitation, about 32 inches per year.

But of more concern is the lifetime of a water vapor molecule added by a jet aircraft to the upper troposphere; at say 35,000 feet. Using radioactive debris injected in roughly this altitude as a tracer (including tritiated water vapor from some of the U.S. Pacific nuclear tests), we estimate a mean residence time of about 30 days. It would be the author's judgment that the true value lies between 15 and 45 days in order to take into account variable weather conditions and the imperfect analogy to nuclear test products.

TABLE 1.—PRODUCTION OF CARBON DIOXIDE AND WATER VAPOR BY AVIATION ACTIVITIES

Period:	[10 <sup>11</sup> pounds/year]							
	Total U.S. commercial fuel consumption		Estimated world commercial fuel consumption		World fuel consumption including estimate for military aircraft		Stratospheric flights	
	CO <sub>2</sub>	H <sub>2</sub> O	CO <sub>2</sub>	H <sub>2</sub> O	CO <sub>2</sub>	H <sub>2</sub> O	CO <sub>2</sub>	H <sub>2</sub> O
1967.....	2.64	1.43	5.27	2.85	7.4	4.0	.....	.....
1985 to 1990.....	.....	.....	.....	.....	118	110	5	2

<sup>1</sup> Tropospheric or near tropopause altitudes only.

<sup>1</sup> Abstract: The two combustion products which future technology will be unable to eliminate from present day jet engines are carbon dioxide and water vapor. The potential climatic change effects of carbon dioxide are considered to be a small part of a larger CO<sub>2</sub> problem. Water vapor added to the troposphere forms contrails. The paper will assess the nonconclusive evidence of increased cirrus cloudiness at certain locations. Finally the potential climatic effects of added water vapor in the stratosphere on the radiation budget, the small decrease in ozone, and polar night cloudiness is evaluated in the light of future commercial aviation injections of water vapor.

Finally what about stratospheric injections by high-flying subsonic and supersonic aircraft? Again the analogy to the residence times from radioactivity is appropriate. The average value for gases is probably about 2 years for injections at altitudes of 60,000 to 70,000 feet and somewhat shorter for altitudes of 50,000–58,000 feet. Particles may have a shorter residence time than gases.

#### PRESENT AND FUTURE EMISSIONS

Table 1 lists the last available and the 1985–90 estimates of carbon dioxide and water vapor from aviation activities.

The estimates for SST operations which provide the bulk of the pollution for the stratospheric flights in 1985–90 assume 500 aircraft flying 7 hours each day; two-thirds use GE-4 engines and one-third the equivalent of two GE-4 engines. Each GE-4 engine produces 104,000 lbs. of CO<sub>2</sub> and 44,000 lbs. of H<sub>2</sub>O per hour. The 1985–90 non SST injections assume a sixfold increase in subsonic revenue passenger-miles over 1967 but with a 50-percent reduction in fuel consumption per passenger-mile.

#### CARBON DIOXIDE

Using the above information and a mean residence time of 5 years atmospheric carbon dioxide from all aircraft yields an annual growth of atmospheric CO<sub>2</sub> equal to about 0.15 parts per million (p.p.m.) in 1985–90. A projected 4-percent growth in the use of all fossil fuels makes the atmospheric input about 4 p.p.m. per year in 1989. Further, even 5 year's worth of aviation created CO<sub>2</sub> adds less than 1 p.p.m. Thus, aviation in the future will contribute less than 5 percent of the total growth in CO<sub>2</sub>. If the increase in atmospheric CO<sub>2</sub> becomes a climatic problem, only a small part can be attributed to aviation. The contribution of CO<sub>2</sub> from aircraft flying in the stratosphere is less than a third of those flying in the troposphere.

#### WATER VAPOR IN THE TROPOSPHERE

Aircraft emit water vapor both at low levels during landing and takeoff and at cruise altitudes. At low levels the aviation source competes with a very much larger natural source from evaporation (8x10<sup>17</sup> lbs./year). Except for rare, but locally important places, such as with very cold temperatures, the low level source of moisture will be dismissed.

In the free air, as contrails will attest, a potential problem may arise. While contrails represent visible evidence of artificially formed clouds, their persistence rather than temporary presence is the more crucial aspect. Persistent contrails can spread out to form thin sheets of cirrus clouds. But as meteorologists often point out, natural cirrus clouds may have formed anyhow a short time later. It may also be noted that the atmospheric disturbance by the airplane rather than the added moisture may have initiated the contrail.

First, let us examine the sensitivity of two layers of the troposphere to added moisture. Modern propeller-driven commercial aircraft cruise at about 24,000 feet while commercial jet aircraft cruise at about 35,000 feet. Present weather observations on radiosonde balloons cannot measure the atmospheric moisture above about 30,000 feet. Thus to compare the vulnerability of the two atmospheric layers (24,000 and 35,000 feet) it is necessary to use special frostpoint observations such as obtained by Mr. H. J. Mastenbrook of the Naval Research Laboratory. His data (2) collected between 1965–68 near Washington, D.C. during days with few or no clouds has been summarized for our purposes in table 2.

It is evident that much less moisture is needed (by a factor of 10) at jet aircraft altitudes than at propeller altitudes to saturate the air. The above numbers represent mean values for clear weather. There are many periods when smaller amounts of moisture are needed for saturation.

TABLE 2.—WATER VAPOR POLLUTION OF UPPER ATMOSPHERE BY AIRCRAFT

Type of aircraft	Altitude, feet	Moisture needed to saturate air-gH <sub>2</sub> O/kg. air	Observed relative humidity (percent)
Propeller.....	24,000	1.0	~25
Jet.....	35,000	0.09	~25

The humidity mixing ratio or the mass of water per unit mass of air tends to remain conservative during mixing of unsaturated air. The humidity mixing ratio is a direct function of temperature and an inverse property of air pressure. The temperature normally decreases up to the tropopause and then remains about constant with height; pressure, of course, decreases with height. On the average, the result is an increase of the saturated humidity mixing ratio above the tropopause. The saturated humidity mixing ratio represents the amount of moisture that can be contained in a mass of air before it forms liquid or solid particles. Present-day jet aircraft flying at 33,000 to 39,000 feet insert their moisture in that layer of the atmosphere in which the added water vapor most likely will form artificial clouds or enhance existing clouds.

The deficit of 0.09 gram per kilogram in table 2 requires more moisture for saturation than can be released by a single aircraft into a reasonable size cloud (as opposed to a small contrail.). A single 4-engine jet aircraft releasing 47,200 pounds per hour of water vapor and flying at a speed of 550 miles per hour will increase the average mixing ratio by only 0.00018 gram per kilogram when its water is evenly diluted in a cross-section area of 500 feet deep and 10,000 feet wide. To saturate the above volume of air requires a humidity mixing ratio which is already over 99 percent saturated.

Ideally, meteorologists might be able to predict the increase in cloudiness by measuring the frequency with which certain saturation deficits are encountered. Unfortunately humidity sensors cannot detect the small deficits. This is particularly true at the cold temperatures of the upper troposphere where the humidity element in the present routine radiosonde observations fails to operate.

Could the water vapor from future enlarged subsonic aircraft produce a cirrus veil over large areas of the earth? It appears very unlikely that a large volume of the atmosphere will be saturated from the foreseeable fleet of aircraft.

#### OBSERVED CHANGES IN HIGH TROPOSPHERIC CLOUDINESS

The author and his colleague, Mr. T. Carpenter of NOAA, have examined the records of cloud observations at Denver and Salt Lake City to detect changes associated with the onset of commercial subsonic jet aircraft operations. The work, as of this writing, is still in progress and while suggestive of a correlation between jets and high clouds, is far from conclusive. Two stations, whose weather records were on magnetic tapes, Denver and Salt Lake City, were chosen for the following reasons: (1) Few low or middle clouds permit more frequent observations of high clouds; (2) the two stations are on or near major air lanes; if any changes in high cloudiness were likely, they would show up at these stations. The second reason, being near air lanes, suggests that even if changes are proven for Denver and Salt Lake City, they may not occur more generally. But it may be noted that there are places in the United States over which even more numerous flights occur than Denver and Salt Lake City.

The observations for the following analysis, weather observer cloud reports at the two airport stations, are notoriously difficult to make quantitatively. This defect, it is hoped, may be overcome by averaging many observations and by subjecting the results to many independent checks. Secondly, the relationship between commercial jet aircraft and increased high cloudiness, if true, depends exclusively on coincidence in time. There may be trends in high clouds due to other causes such as changes in circulation patterns. Finally, even if a convincing correlation between clouds and aircraft by this analysis is demonstrated, one cannot distinguish between added moisture or simply the atmospheric disturbance by the aircraft as the cause of the enhanced cloudiness.

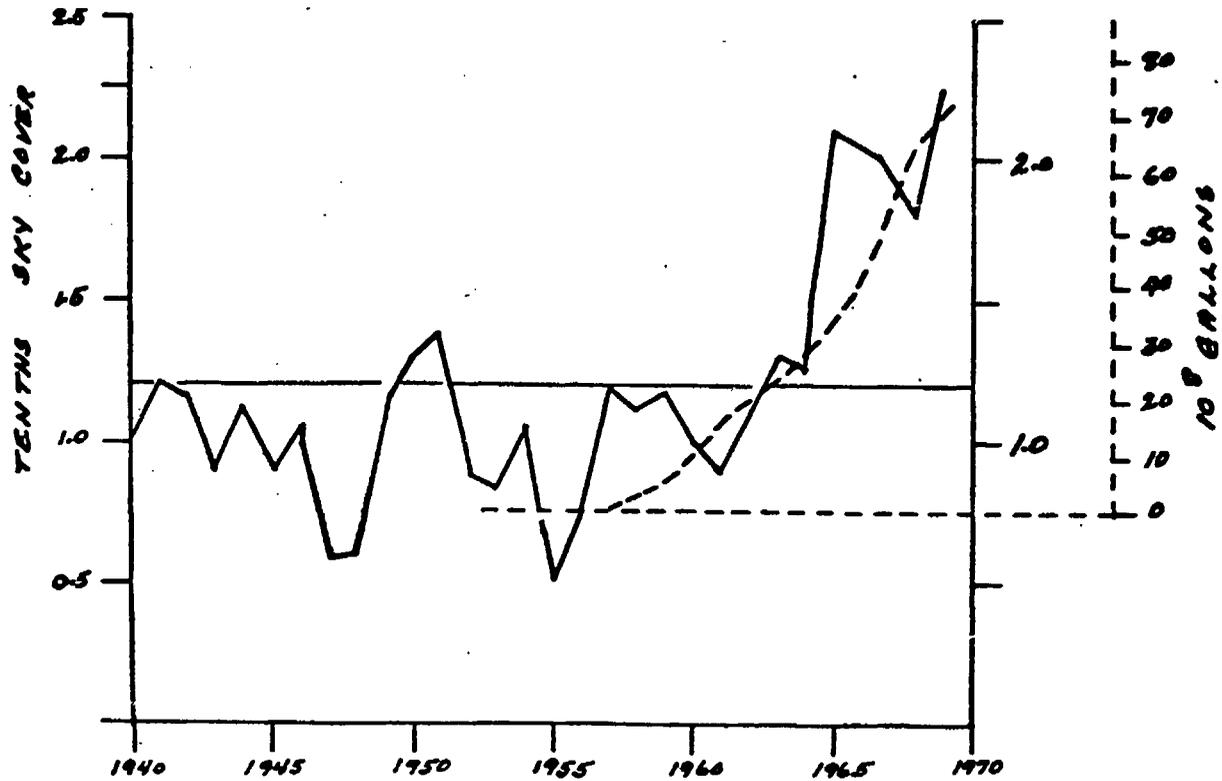


Fig. 1 - Annual amount of high cloudiness at Denver, Colorado, with no low or middle clouds. Data obtained from three hourly Weather Bureau airways observations. The dashed curve represents the annual domestic commercial jet fuel consumption for the United States which is assumed to be proportional to the number of flights in the vicinity of Denver

Figure 1 shows the average annual high cloudiness at Denver plotted against year beginning in 1940. From 1940 to 1947 observations were made at a military base, Lowry Field, thereafter at Stapleton Field, the commercial airfield serving Denver. Figure 2 shows the same high cloud history at Salt Lake City but beginning in 1948. In both cases only the 3 hourly observations with no reported low or middle clouds were used to determine the annual averages. On figure 2 the gross consumption of jet fuel has also been plotted; the gross fuel consumption probably reflects the relative frequency of jet flights over the two stations.

The two graphs, figures 1 and 2, show an increase in high cloudiness after the onset of commercial jet operations in about 1958; the growth at Denver is more marked than at Salt Lake City. Thus, this correlation suggests that commercial jet activity may indeed have increased the amount of high clouds. However, the conclusion should be tempered by other analyses of the cloud data. These are:

(1) At both Denver and Salt Lake City, the relationship for those observations with one- or two-tenths of low and middle clouds with commercial jet aircraft activity is as good as, or better than, that shown in figures 1 and 2.

(2) The observations of high clouds, with no low or middle cloudiness, were analyzed for Denver by the time of the day: daylight hours, dark hours, and sunrise and sunset hours. It is likely that the sunrise and sunset hours provide the most reliable high cloud observations. All three sets of data parallel one another although the post-1958 growth is not quite as distinct for the more reliable sunset and sunrise hours as for the mean shown in figure 2.

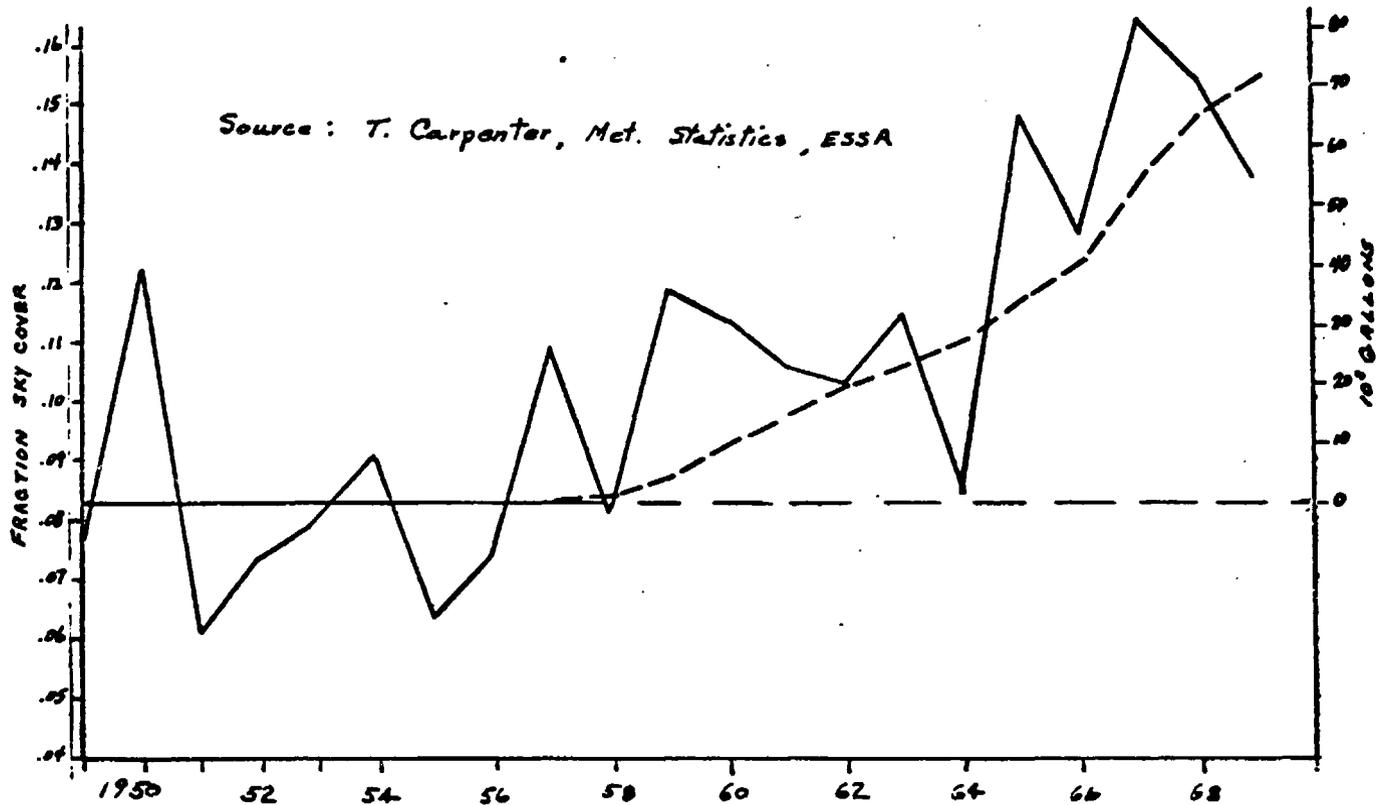


Fig. 2 - Annual amount of high cloudiness at Salt Lake City, Utah, with no low or middle clouds. Data obtained from three hourly Weather Bureau airways observations. The dashed curve represents the annual domestic commercial jet fuel consumption for the United States, which is assumed to be proportional to the number of flights in the vicinity of Salt Lake City

(3) The trends in the annual mean cloudiness of all three layers (low, middle, and high) are similar in each of the four seasons.

(4) The history of middle clouds, in the absence of low cloudiness, has been analyzed in the same fashion as shown for figures 1 and 2. Middle cloudiness at Salt Lake City shows no trend of significance; if anything there is a very slight downward trend until about 1960. But the middle cloudiness at Denver exhibits a disturbing, marked decrease from about 1944 to 1958 and remains about constant thereafter. This decrease in middle cloudiness argues that one can observe marked long-term changes without any apparent explanation. The immediate implication is that the upward trend between 1958 and 1969 might be due to some similar cause such as circulation and observational procedural changes. The most probable change in observation practice as the cause of the increase of high clouds after 1958 does not appear to be borne out by the relative changes in middle and high clouds. Aircraft pilots can advise weather observers about the cloud heights. For this reason, one might presume that the upward trend in high clouds might coincide with a decrease in middle clouds as the pilots tell the observer the type of cloud. At both stations, there was no apparent positive or negative correlation between the trends of middle and high clouds after 1958; the mean middle cloudiness remained about constant with time. Finally the low value of middle clouds after 1958 could offer more opportunity for observing high clouds. But one might also have more frequent clear skies, which would decrease the mean amount of high clouds; the greater opportunity to see high cloudiness need not increase its mean annual value.

(5) There have been no significant trends in low cloudiness.

With one significant exception, the auxiliary analyses do not contradict the connection between growth of cirrus cloudiness after 1958 at either Denver or Salt Lake City with jet aircraft. The analyses cannot more specifically assign the cause to increased jet aircraft activity. The one disturbing finding is the sharp decrease of middle cloudiness between 1944 and 1958. As noted this unexplained decrease raised the serious doubts as to the justification for attributing the post-1958 rise in cirrus cloudiness to aviation activities. Finally, one must repeat that the increase after 1958 is ascribed to aviation activity only by its coincidence in time and the visual evidence of contrails behind aircraft.

Assuming that the cirrus increase is due to subsonic jet aircraft, one may expect a continued increase in such cloudiness with time. Future projections call for a sixfold increase in passenger-miles by the period 1985-90 but improved technology may result in an aircraft efficiency such that the amount of moisture will increase by only threefold.

It is believed that the case for aviation causing an increase in cirrus cloudiness at Denver and Salt Lake City is sufficient to justify further studies. These should be aimed at proving or disproving the hypothesis, and if true, to determine the geographical extent of the increased cirrus clouds. Lastly, if the growth is due to aircraft, one must describe the optical and other properties of the artificial clouds to permit an assessment of the influence of the clouds on the weather and climate.

#### CIRRUS CLOUDINESS AND THE RADIATION BALANCE

Added cirrus cloudiness which may be produced by aviation activities can alter both radiation balance within the atmosphere and reduce the total radiant received from the sun by the earth and its atmosphere.

Kuhn (3) has measured and computed the radiation budget both with cirrus clouds and with clear skies. The net result of adding cirrus clouds is a cooling of the lower atmosphere during the day. Manabe (4) computed a net warming of the ground level air temperature by assuming different radiative properties of the cirrus clouds; the true effect will depend on the actual cloud characteristics. Hosler (5) claims to have found a decrease in solar energy because of cirrus cloudiness from aircraft in western Pennsylvania. At night, the lower atmosphere will warm slightly with cirrus cloudiness because the clouds will reduce outgoing long wave radiation.

The earth's albedo or the fraction of the solar energy reflected back to space is sensitive to atmospheric cloudiness. At present it is estimated that the albedo of cirrus clouds lies between .44 and .64 for overcast skies (6). Increases in high cloudiness due to aviation could therefore lead to an enhanced albedo. The result would be a decrease in the average atmospheric temperature; small changes in albedo produce significant reduction in the global temperature. The latter represents an equilibrium state between incoming solar radiation, controlled by the

earth's albedo, and outgoing long wave radiation. The suggested increases in cirrus cloudiness are too limited in area to deduce any significant global effects at this time.

#### CIRCUS CLOUDS AND ICE CRYSTALS

It is known that ice crystals from cirrus clouds can fall into lower altitude undercooled water clouds (droplets at temperatures colder than 0° C) thereby creating unstable conditions which may lead to precipitation. The possibility of producing new or larger cirrus clouds from aviation activities thus might alter the distribution of precipitation. Unfortunately, there is, at present, insufficient knowledge to predict the magnitude or significance of artificially induced precipitation even with knowledge of changes in cloudiness.

#### SUPERSONIC AIRCRAFT—STRATOSPHERIC WATER VAPOR

The water vapor in the stratosphere, according to our best evidence is given by a humidity mixing ratio of about 3 parts per million (ppm). Given a production rate of water vapor, a mean residence in the stratosphere of 2 years, and the mass of the stratosphere ( $7.7 \times 10^{20}$  grams), one may readily calculate the average humidity mixing ratio due to SST activities as 0.2 ppm.

#### OBSERVED VARIABILITY OF WATER VAPOR

Predicted changes due to SST operations should be put in perspective with those due to natural causes. Unfortunately the amount of information on natural variability of water vapor in the stratosphere is extremely limited and confused by errors of measurement. The vertical distribution shows decreasing values of humidity mixing ratios from the tropopause to about 50-60,000 feet, above which the value is constant. Mastenbrook of NRL has summarized his measurements since 1964 (7) which have been plotted in figure 3 for a single altitude range, 63-68,000 feet. All sampled altitudes above about 60,000 feet show the same upward trend.

The annual growth, if interpreted as being uniform throughout the 7 year period amounts to about 0.15 ppm/yr. Could this increase be due to aviation activities in the stratosphere? If the whole stratosphere is increasing by 0.15 ppm/yr, the annual increment of moisture is about  $2.5 \times 10^{11}$  lbs. of water per year which is about the same as produced by all aircraft in 1967. If the source of the moisture for the stratosphere were near the latitude of Washington, D.C., the observed increase in moisture might be tenfold greater than the global average (see next paragraph); this assumption demands  $0.25 \times 10^{11}$  lbs. of water added each year. The assumption of uniformity clearly exceeds the capability of the aviation industry to account for the increase in stratospheric moisture. The assumption of non-uniformity demands that over 5 percent of the moisture from aircraft be inserted within the stratosphere and this is deemed unreasonable. Thus, the observed stratospheric water vapor increase demands greater amounts of moisture than can be reasonably expected from aircraft flying in the stratosphere. On the other hand  $2.5 \times 10^{11}$  lbs/yr, the larger growth of stratospheric moisture, is less than one-millionth of the natural annual evaporation rate. Thus, very small increases in the evaporation could easily add moisture to the troposphere in large enough amounts so that when transported aloft might account for the moisture increase in the stratosphere. It is not being claimed that the trend in figure 3 is, in fact, due to enhanced evaporation (or any other natural process) but rather that very small changes in natural processes can easily produce the observed stratospheric moisture increase.



## DISTRIBUTION OF SST WATER VAPOR

Flights by SST aircraft will not occur uniformly in the stratosphere; rather most of the flights will occur in the north temperate latitude. Thus, it would be expected that the concentration of water vapor or any other pollutant emitted by the SST flights will have a higher concentration generally in the latitude band of the more numerous flights. While one may attempt to quantitatively predict the average distribution with latitude based on mixing theory, the required diffusion coefficients have been derived by fitting the theory to past tracers added to the stratosphere. We can use the tracers themselves. Figure 4 shows an example of the distribution of radioactivity from a nuclear test at 40° north in western China 7 months after the event. The cross section is derived from aircraft measurements in the Western Hemisphere over a 6-day period. All the data available for the isoline analysis appears at the position of the dots and triangles on the chart. The average concentration for the entire stratosphere (both hemispheres) is about 33 picocuries per standard cubic meter of air, the units given on the chart. The "500" isoline represents a concentration 15 times greater than the mean stratospheric concentration. Later in time the distribution becomes more uniform (a factor of about four between the peak and the average concentration 12 months after the time of the event); prior to 7 months the peak to average ratio exceeds 15. The concept of a mean residence time which allows 2 years worth of material to accumulate in the lower stratosphere implies stratospheric uniformity and this is clearly not the case. Thus, there is difficulty in assigning a factor for nonuniformity. For purposes of being quantitative, the peak concentration in the north temperate latitude is assumed tenfold greater than the world average but this is admittedly very uncertain.

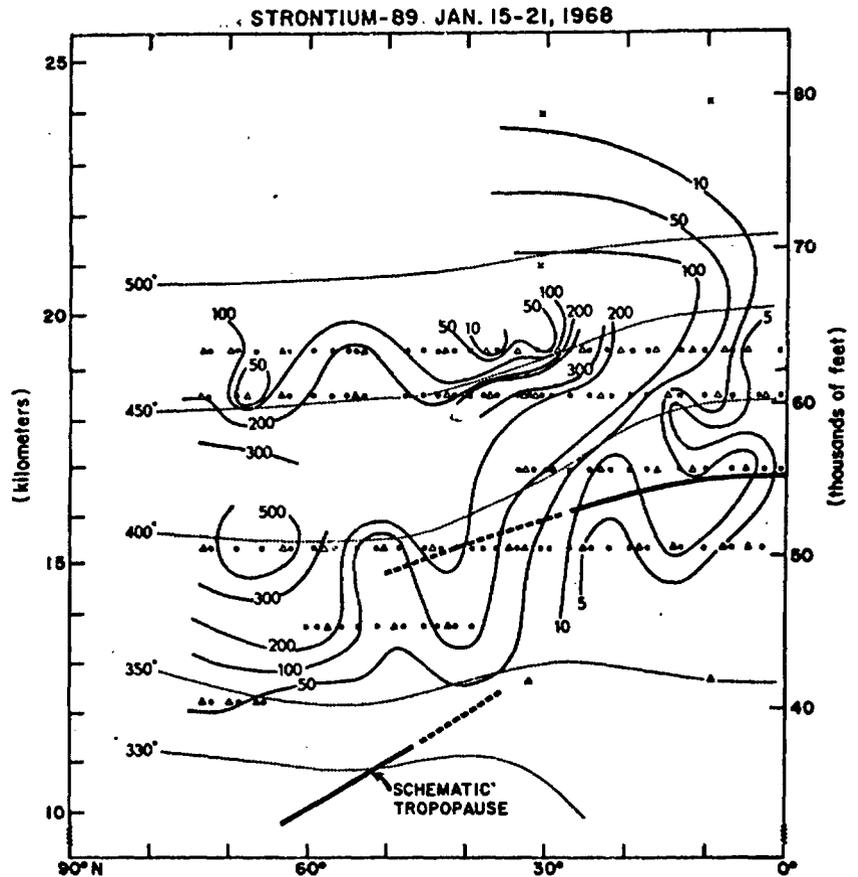


Fig. 4 - Cross section of Strontium-89 from the nuclear event at 40°N seven months after the injection on June 17, 1967. Solid isolines are labeled in units of picocuries per standard cubic meter. Dotted lines are isolines of equal potential temperature. Radioactivity observations have been made only at points, triangles, and crosses. If the radioactivity were uniform through the stratosphere of both hemispheres it would average 33 picocuries per standard cubic meter

Since the increase in the stratospheric average moisture has been estimated as 0.2 p.p.m. due to the operation of the fleet of SST aircraft, the peak concentration increase might be about 2 p.p.m. and the future peak (added to the present concentrations of 3 p.p.m.) might be about 5 p.p.m.

One may note that while the source of the pollution is 40° north in figure 4, the highest concentration 7 months later is found north of 60° north. This poleward shift of the maximum concentration follows from the spherical nature of the earth and has been noted often in bomb debris distributions. This poleward drift will have some bearing on the formation of water clouds in the stratosphere (to be discussed later).

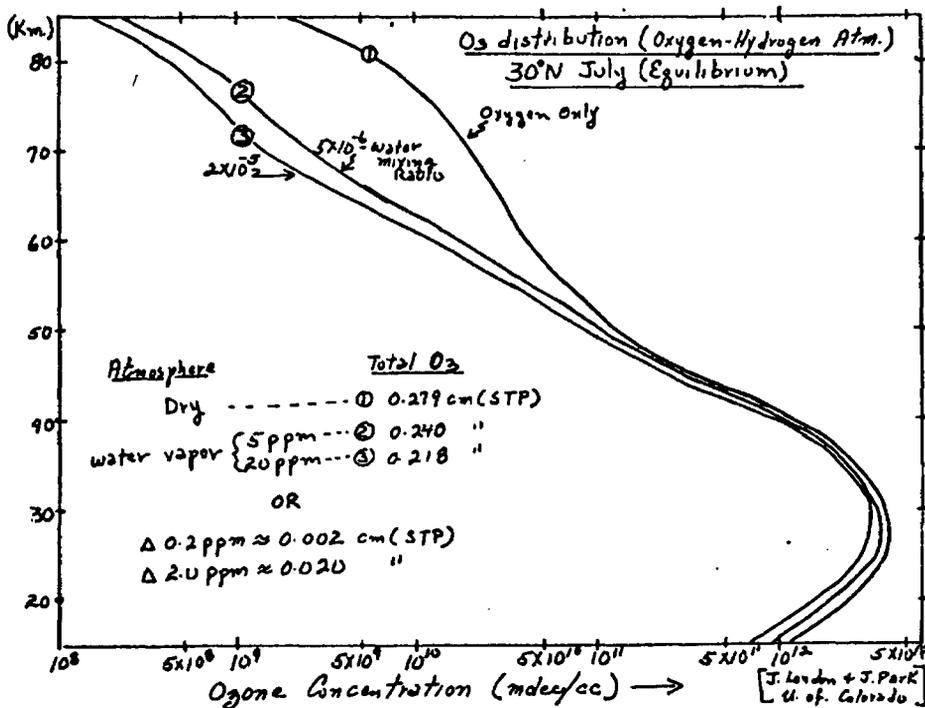


Fig. 5 - Equilibrium vertical distribution of ozone for three assumed atmospheres according to London and Park. The inset provides the changes in total ozone for two changes in water vapor which might occur from a fleet of SST aircraft

#### WATER VAPOR AND OZONE

In 1964, Hampson (8), argued that the equilibrium ozone concentration in the atmosphere would be lower for a wet rather than a dry stratosphere. This possibility has led to a speculation of lower ozone concentrations when the moisture of the SST adds to that occurring naturally. In turn, the lower ozone may increase the amount of ultraviolet radiation received at the ground with consequent deleterious effects on man and other forms of life.

London and Park (9), using the best information on photochemical reaction rates, have calculated equilibrium ozone concentrations for atmospheres without moisture and with various amounts of water vapor. The distributions for three such cases appear in figure 5. The calculations leading to figure 5 include no air motions. The main changes in ozone due to the presence of water lie above about 50 km. The inset indicates the change in the total ozone column (which controls the penetration of ultraviolet energy) to the change in moisture. The response of the ozone column to moisture obtained by London and Park is smaller (by a factor of about 3) than that reported by Harrison (10).

Figure 6 illustrates the day-to-day variability of total atmospheric ozone at Caribou, Maine, one of the stations measuring total ozone in the United States. It is evident that the global increase of 0.2 p.p.m. moisture predicted as a consequence of a fleet of SST aircraft leads to an ozone change which is negligibly small in comparison to the natural day-to-day variability of ozone. Figure 7 shows the yearly march of ozone at several U.S. total ozone stations. From it one may note that the change in ozone due to the SST moisture is much smaller than the place to place variability; it is also exceeded by the seasonal variability, which is not shown.

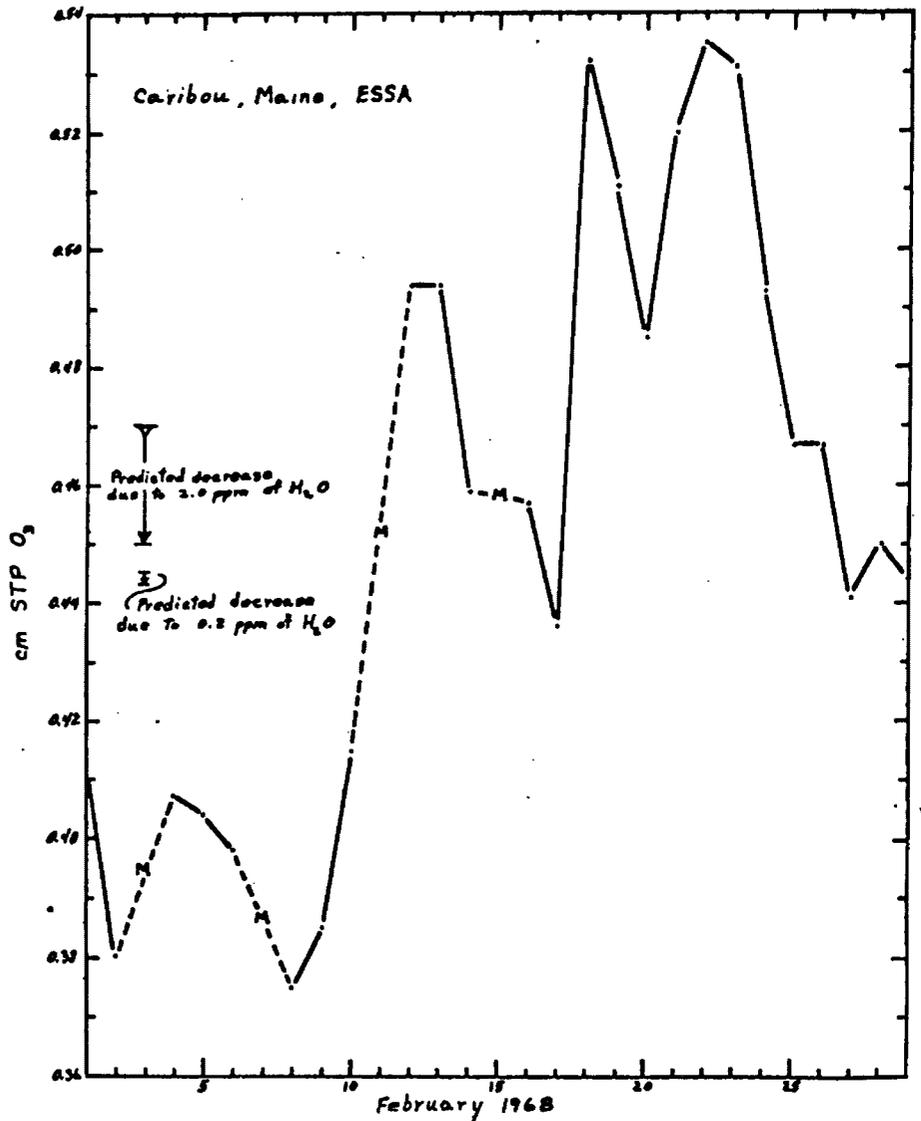


Fig. 6 - Daily observations of total ozone at Caribou, Maine, in February 1968, compared with predicted ozone changes due to water vapor from a fleet of SST aircraft

Finally, figure 8 (provided by Professor London) argues that the changes in the amount of ultraviolet and near ultraviolet radiation due to changes in the moisture is small in contrast to the difference between places. Thus, to the extent that present theory gives the correct order of magnitude of the ozone changes due to added moisture from a fleet of SST aircraft, it does not appear likely that there will be significant changes in the amount of ultraviolet radiation received at the ground.

Harrison (10) has also examined the temperature changes that might accompany the change in ozone and finds these to be relatively small.

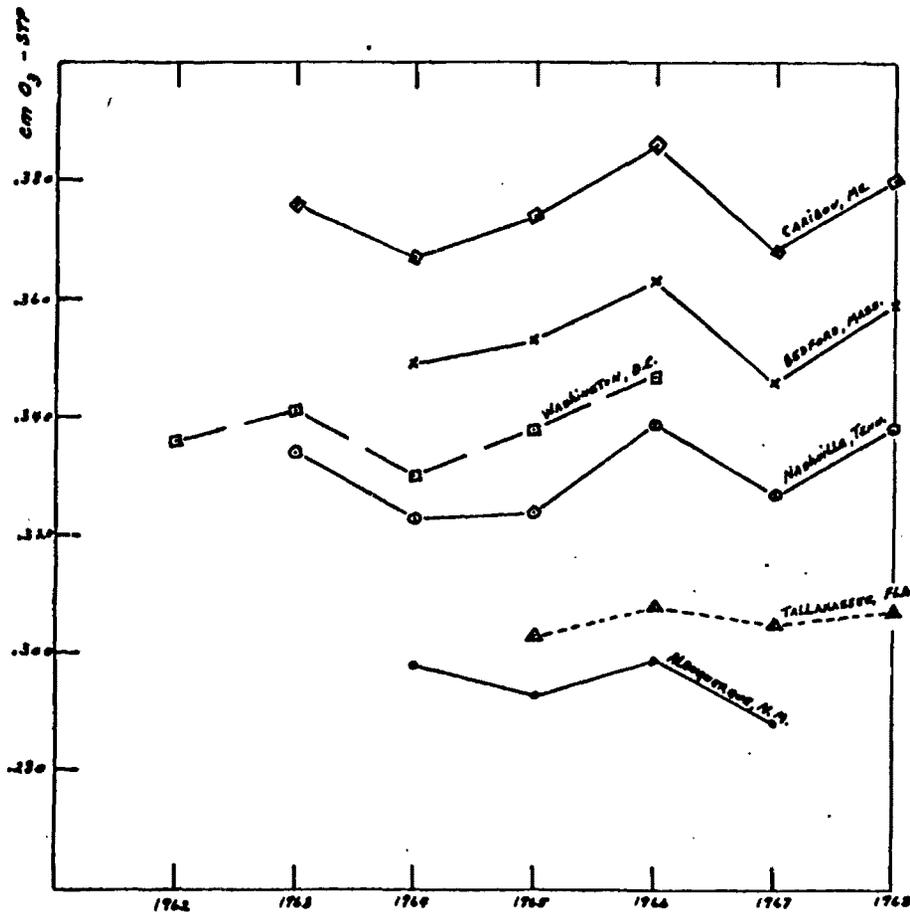


Fig. 7 - Annual total ozone observations at six United States Dobson spectrophotometer stations of the NOAA network. Note that there are no systematic changes in total ozone during the period of record

In conclusion, there are no predictable effects at ground level due to the effect of added moisture on the ozone concentrations which approach the normal variability in the atmosphere. All of the conclusions must be tempered by uncertainties in the data used for the photochemical calculations.

#### WATER VAPOR AND STRATOSPHERIC CLOUDINESS

Most of the stratosphere has relative humidities of 10 percent or less. This dryness permits no persistent contrails and, insofar as this writer is aware, none have ever been reported in the stratosphere. However, there are parts of the stratosphere not far removed from SST flight altitudes at which the air is much closer to saturation than the stratospheric average. These are near the winter poles and the region just over the equatorial tropopause. The latter region has not been considered in this analysis for the formation of artificial clouds by aircraft emissions because it coincides with upward motion from the troposphere where adequate moisture is present. But the polar night areas can potentially increase their cloudiness with additional water vapor.

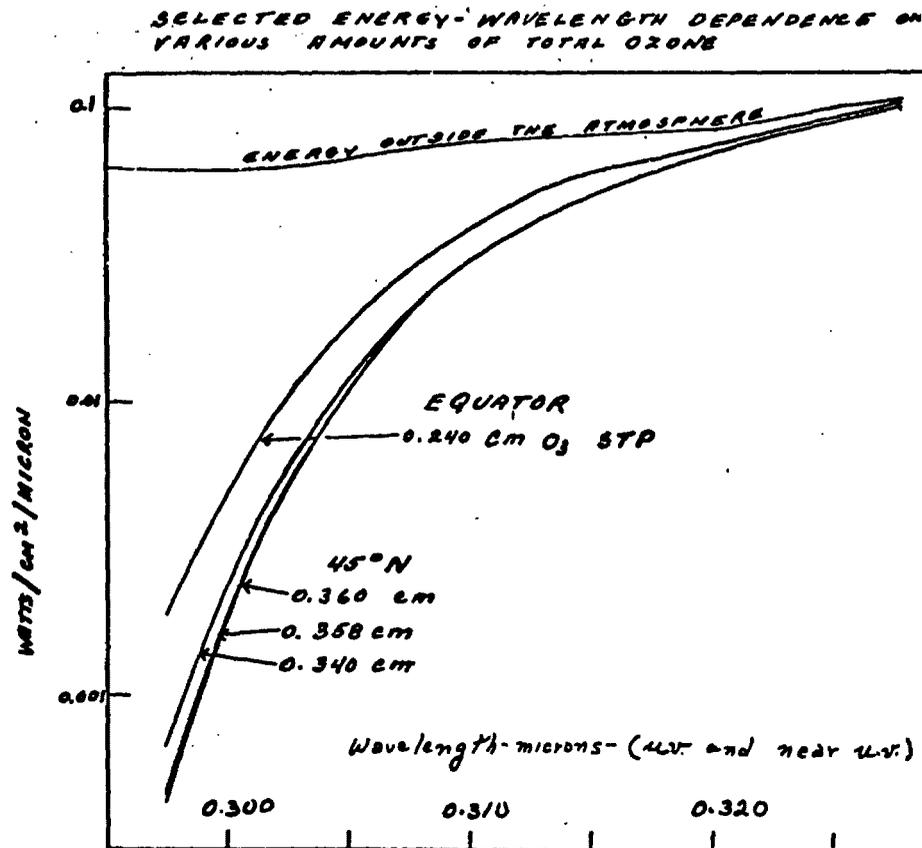


Fig. 8 - Theoretical transmissions of near ultraviolet radiation through atmospheres with varying amount total ozone

High clouds do form in the polar winter; perhaps more often and more widespread than have been reported since it is dark and low cloudiness is common where they would be expected. Thus, recently, widespread overcast skies have been detected over Antarctica in the winter stratosphere; mother-of-pearl clouds have been observed over Norway for the past 100 years (11). They occur at about 70-80,000 feet or slightly above the SST cruise altitude but such clouds may be formed even below the SST cruise altitudes. Our attention will focus on the north polar area since moisture from SST operations will be very small in the Southern Hemisphere. On the other hand, as noted in figure 4, even if the major flight paths lie south of 60° N., the humidity mixing ratio in north polar regions may significantly exceed the average stratospheric concentration of 3.2 ppm in parts of the stratosphere.

Mother-of-pearl clouds are observed in Norway mainly during foehn conditions. It is during this weather that skies are sufficiently clear to see high clouds. Strangely, no mother-of-pearl clouds were reported between 1892 and 1925 in Norway. But since then they have been reported one to two times each winter month. The area of the polar basin with the coldest stratospheric temperatures lies north of Iceland and near Greenland. Here is where such clouds probably occur more frequently than now observed and where added moisture in the stratosphere can increase the cloudiness. This is the area in which persistent contrails might occur if aircraft flew over this area.

Should there be an increase in stratospheric cloudiness, there will be an enhanced absorption of long wave radiation. By warming the cloud elements, "feed back" heat tends to evaporate the newly formed clouds. The net result of

interference with the radiation balance by introducing additional clouds in the stratosphere is unknown. Even if there were a change in climate it is not known whether it would be either beneficial or detrimental.

There are two reasons why the possibility of forming clouds in the polar stratosphere may be greater in 1985-90 than at the present time. First, the lower stratosphere may be cooler in the future than it now is because of the presence of more carbon dioxide from all sources of fossil fuel combustion. The "greenhouse" effect from such added carbon dioxide warms the lower atmosphere but cools the upper atmosphere. Second, as seen in Figure 3, there appears to be an upward trend in stratospheric water vapor with time. Should this continue it will itself tend to increase polar night clouds in the stratosphere but the presence of added water from SST aircraft can further enhance cloudiness.

#### STRATOSPHERIC WATER VAPOR AND THE RADIATION BALANCE

Water vapor in the stratosphere plays an important role in maintaining the existing stratospheric thermal structure along with ozone and carbon dioxide. One can obtain a crude estimate of the change in temperature which might accompany larger amounts of moisture expected from the fleet of SST aircraft. Manabe and Wetherald (12) have made such calculations from which one may estimate that the global average increase of moisture from 3 to 3.2 p.p.m. will raise the ground level temperature by  $0.04^{\circ}$  C. The north temperate zone where moisture increases may be larger than 0.2 p.p.m. could have larger warming effects but since the calculations do not allow for any but a simple vertical adjustment, the likely circulation which accompanies larger temperature changes make it impossible to assign numerical values to the temperature changes in restricted regions with the present atmospheric models.

The computations of temperature changes also indicate that there will be larger decreases in temperature in the stratosphere than warming at the earth's surface by perhaps a factor of two or three.

The sense of the temperature changes due to increased moisture in the stratosphere because of SST operations is the same as, but appreciably smaller than, that due to carbon dioxide from the burning of fossil fuels from all sources.

The global radiative effects due to water vapor in the stratosphere from SST emissions are small (that is less than  $0.1^{\circ}$  C.) and smaller than those expected from the future amounts of carbon dioxide in the atmosphere. Only perhaps in the stratosphere might the temperature changes from the added water vapor be significant. The consequences of such changes on the weather near the ground are unknown.

#### ANALYSIS AND CONCLUSION

It is often easy to compute changes in concentration of gases or particles in the atmosphere but virtually impossible to predict the weather or climatic effects of such modifications. In some cases, one can provide the sign of the temperature change. Many meteorologists feel that there are feedbacks within the atmosphere which will minimize the potential consequences of man's activities.

Although still not proven, the evidence points to the production of artificial cirrus cloudiness by the present subsonic aircraft. If true, and if the amount of clouds increases with expanded aircraft operations, the potential consequences must be examined most closely. The earth's albedo or reflecting power is controlled in large part by clouds and any systematic large scale change in cloudiness can reduce the amount of solar energy available to the earth-atmosphere.

Speculations on future SST water vapor injections are on far weaker grounds than the evidence for clouds from subsonic aircraft. The areas in which such cloudiness will increase are limited and outside the sunlight part of the globe. Further, it is virtually impossible at this time to either guess even the order of magnitude of the increase in cloudiness or the climatic consequences if any were to form.

An examination of the possible ozone depletion suggests that it will be much smaller than the natural variability of ozone. Two points deserve note. First, there are still many uncertainties in the computations of photochemical reactions so that the conclusion must not be regarded as final. And second, the biological consequences of exposing all living things to even a small increase of ultraviolet radiation lies outside the scope of this paper.

In man's quest for a better environment, scientists and engineers should examine all sources of pollution including those originating well above the ground and include the potentialities for weather/climate modification.

## REFERENCES

1. R. Nydal, "Further Investigation on the Transfer of Radiocarbon in Nature". *Journal of Geophysical Research* 73, 3617-3636, 1968.
2. H. J. Mastenbrook, "Water Vapor Observations at Low, Middle, and High Latitudes During 1964 and 1965", NRL Rep. 6447, Sept. 1966.
3. H. J. Mastenbrook and D. R. Purdy, "Vertical Distribution of Water Vapor Over Washington, D.C. During 1966 and 1967", NRL Report 6891, May 1969.
4. P. M. Kuhn, "Inadvertent Modification of Weather and Climate", ESSA Tech. Rep. ERL 185-APCL 15, Sept. 1970.
5. S. Manabe, "Cloudiness and Radiative Convective Equilibrium" in *Global Effects of Environmental Pollution*, 156-157, D. Reidel, Dodrecht, Holland, 1970.
6. C. L. Hosler, private communication, 1970.
7. R. J. List, ed. "Smithsonian Meteorological Tables," Publication 4014, Sixth Rev. Ed., City of Washington, 1951.
8. H. J. Mastenbrook, "The Variability of Water Vapor in the Stratosphere," submitted to *J. Atmos. Sci.*, 1970.
9. J. Hampson, "Photochemical Behavior of the Ozone Layer," *Carde T. N. 1627/64*, Valcartier, Quebec, September 1964.
10. J. London and J. Park, private communication, 1970.
11. H. Harrison, "Stratospheric Ozone With Added Water Vapor: Influence of High-Altitude Aircraft," *Science* 170, 734-736, 1970.
12. C. Stormer, "Mother-of-Pearl Clouds," *Weather*, 3, 13-18, 1948.
13. S. Manabe and R. T. Wetherald, "Thermal Equilibrium of the Atmosphere With a Given Distribution of Relative Humidity," *Journ. Atmos. Sci.* 24, 241-259, 1967.

## DOT/SAE CONFERENCE

Mr. BROWER. Mr. Alderson.

Mr. EDWARDS. Mr. Chairman, may I inquire just one moment on what the gentleman just read?

Mr. McFALL. Yes.

Mr. EDWARDS. If I understood what you said, you were reading a summary prepared by a person, based on work of two or more other persons?

Mr. SOUCIE. This was a 3-day conference held February 8 through 10 in Washington, D.C., cosponsored by the Department of Transportation and the Society of Automotive Engineers. I was not only a participant, but I also ran one of the sessions. There were approximately 600 participants during the 3 days, most of them very technical people, because most of the sessions were technical. The format of the conference was rather cumbersome, but there were a number of papers submitted in advance of the conference; and then there were summary papers presented; and then there were technical discussion sessions, such as the one I have just referred to.

In other words, all the people interested in this case in the distribution of air pollution by jet aircraft came together in an afternoon session, an unstructured session, where the people who had submitted contributing papers sat as a panel. All those interested personally, and Dr. Heywood said those interested numbered 50, came and had a discussion; and this report is a report of something like 3½ hours of technical debate on this subject. Part of the session, the part I read, was on the contribution of contrails in the upper atmosphere, both by subsonic and supersonic aircraft.

I was present at that debate, and most of the debate over the SST's contribution, which this summarizes, was by the two gentlemen I

named: Dr. Lester Machta of ESSA and Dr. Goldberg of Boeing. There were many more people including myself who rather jumped into the argument to stir things up.

Mr. EDWARDS. What you said really is not unlike what Mr. Ruckelshaus said the other day.

Mr. SOUCIE. That is true, it is not unlike what Mr. Ruckelshaus said. In fact, I think Mr. Ruckelshaus' testimony about the nature of the program is the most candid and honest presentation of that program we have had to date.

Mr. BROWER. Except our own.

Mr. SOUCIE. Yes; but on the other hand, you will notice that Dr. Heywood points out that these studies haven't begun. In the first place, nobody can tell you, and this committee has not been told, what those studies will be. It is an assurance on the part of the Department of Transportation that these studies will be conducted and they will allegedly be finished by the summer of 1973.

Second, it is obvious—and this point was raised, I think, when Mr. Ruckelshaus was here—that these studies have got to be done to insure the credibility of the results; and this was a point of some concern that in a field which the world experts disagree on so violently, whether or not a research program conducted by the Office of Supersonic Transport Development can be generally credible. This is a really serious problem because the greatest experts in the world in this field disagree violently.

#### REMARKS OF MR. ALDERSON

Mr. ALDERSON. Mr. Chairman, I only have a brief item to submit. I have been serving as coordinator of the Coalition Against the SST, and we appreciate the fairness of the committee in welcoming testimony in opposition to the program. One of the types of testimony that has not been presented during these hearings is the testimony of economists. In the absence of economists, we have tried to get some opinion from them to submit. Last fall the statements of the 16 economists, which Mr. Yates put into the record on the first day of the hearings, were compiled. Miss Dunlap submitted a letter from Dr. Friedman earlier this morning.

#### QUOTE FROM STATEMENT OF PROFESSOR ARROW

At this point, we submit an additional statement from Prof. Kenneth J. Arrow, professor of economics at Harvard University, which Dr. Arrow prepared for inclusion in the record of this hearing. This is a new statement which he had not made before, and he wanted to make this contribution to the deliberations. I won't read it. I will submit it, except that I would like to read about one page of it, which gets to the heart of some of the matters that have been under discussion.

Dr. Arrow raises the probability that the cost estimates will have been too low for the prototype program. He says:

Further, these risks are insidious. Suppose it is accepted that the Government proceed this time. If 1 year and \$400 million later, it turns out that development costs are reestimated at \$1.6 billion dollars instead of the present \$1.3 billion dollars, Congress will be tempted to consider it more worthwhile to

rescue the money already spent than to cut off the project at a still more advanced state. Eventually, there will be the alternatives that the Government either forget its royalties or the aircraft companies go under because the airlines cannot pay the price with royalties included. This is no imaginary experience. Many irrigation projects have already done the equivalent. Perhaps the worst possibility of all is that the airlines having accepted the SST and finding them impossible will demand that subsonic fares be raised to minimize competition. Thus the less affluent passengers will be taxed to pay for errors of forecasting.

No one can say that these eventualities will come to pass, but no one can say that they will not. Cost and demand estimates are too unreliable to say otherwise. Indeed, if they were more reliable the aircraft companies would not be coming hat in hand to this Congress. The benefits to the economy or to society as a whole is negative in view of the nuisances created. The benefits to individuals are at best small and concentrated in an already wealthy group and the risks of large losses to be paid by taxpayers or by subsonic airline passengers are very considerable. Congress will do well to halt this burgeoning monstrosity at this relatively early stage.

That concludes Mr. Arrow's statement and I have copies which will be submitted.

STATEMENT OF PROFESSOR ARROW SUBMITTED FOR THE RECORD

Mr. McFALL. We shall include Professor Arrow's statement in the record at this point.

(The information follows:)

STATEMENT OF PROFESSOR KENNETH J. ARROW, PROFESSOR OF ECONOMICS,  
HARVARD UNIVERSITY

The supersonic transport (SST) so strongly advocated by the Federal Aviation Administration, represents a very large investment of resources by the Federal government and a much larger investment subsequently by airlines and by producers, if the intentions of the plan are to be carried out. The question must seriously be raised, what justifies such expenditures? In particular, the scope of this project bears little or no relation to the usual aims of Government expenditure, which are the realization of those social goals, such as education or national defense, which in the nature of the case cannot be achieved by private action. But what social goal is being achieved here? Only that a certain relatively few people will be able to save a few hours in travel. There is indeed a case, strongly grounded in both our civic and religious morality for assisting even a few individuals who are peculiarly incapable of helping themselves. But that can hardly be argued here; it is precisely the more successful and better off, those whose earning power is greatest as the FAA's analysis makes clear, to whom the benefits accrue.

The Federal Government is then sharing in the risks of an enterprise whose returns are purely private and enjoyed only by the affluent. There is no objection whatsoever to the provisions of such an enterprise; but ordinarily we assume that the private sector will be fully motivated by profit considerations to carry it out. It is well to be clear; there is only one reason why the Government's support is sought or that any meaningful case can be made for the Government's support; mainly, that the magnitude and riskness of the development costs are beyond the capacity of the private sector. The only other economic arguments that have been advanced relate to the creation of jobs and to the improvement of the balance of payments. It may be stated flatly that neither of these has much merit. The first has none at all. The total level of employment in the economy is set by a combination of Government expenditures and of private demand, as influenced by taxes and monetary policy. The money spent on SST development and production could be spent in other directions by the Government, or through lower interest rates and lower taxes, made available to the private sector for its own uses. By the same token, the proposition that the Government will receive taxes from the production and use of the SST is fallacious; the Government will receive an equal amount of taxes from whatever economic activity would take its place.

With regard to the balance of payments question, it is ridiculous to suppose that foreign governments are going to permit their airlines to buy huge volumes of expensive aircraft from the United States without making some corresponding cut in imports in some other direction. Their limited dollar reserves would force them to such a step. The excellent analysis of this point by the Institute for Defense Analyses,<sup>1</sup> acting as consultant for the Federal Aviation Administration is in no way refuted by the feeble comments of that agency which amount to simple denial.<sup>2</sup>

Not only does the SST achieve no goals other than private ones, but as is well known, it creates social nuisances in the form of sonic boom and noise. I will yield to others in analysis of the environmental aspects; for the purposes of economic analysis, I will assume that the environmental objections have been taken account of in the form of prohibition of supersonic flight over land areas.

There remains then just one question: Are the likely returns in the form of net benefits to individuals greater than the costs incurred, both, of course, properly discounted back to the present. It is well to be clear about the meaning of net social benefit, or the consumers' surplus, to use the technical term of economists. The only possible beneficiaries are, of course, those who use the SST; that is, those who are willing to pay the SST's surcharge over the subsonic flight for the same route. The surcharge is that needed to pay for the extra cost of the SST relative to subsonic planes. This cost represents resources drawn from the rest of the economy and should be paid. If an individual is just barely willing to pay the surcharge, he has no net gain, no consumer's surplus. The gain is only the excess of the surcharge he would be willing to pay over that he would be required to pay.

There is, of course, no way of knowing what that figure is. But some idea can be obtained by examination of the FAA's report (as cited in footnote 2). The likely surcharge seems to be about 30 percent. Then a rough graphical interpolation in their figure VII-10 (p. VII-22) suggests that the social gain is about 6 percent of total present international air travel expenditures if all of the FAA's assumptions are satisfied. That is, the average benefit to international air travelers is the same as that of a fare reduction of 6 percent across the board. The latter reduction would, however, be much more equitable since according to the FAA's assumptions, it is only a relatively few high income recipients who would gain. Undoubtedly a rationalization of the international air transport fares, bringing them more into line with costs, would yield a greater total benefit.

But it is hard to accept that the FAA assumptions are all valid. The FAA has assumed that individuals value their time at 1.5 times their earning rate and would choose the SST if the saving in time so valued is more than the surcharge. The Institute for Defense Analyses argued on the basis of cogent evidence that it was more nearly accurate than individuals valued their time in flight at their earnings rate. In this case the consumers' surplus just about disappears. Indeed, the prevalence of chartered flights suggests that tourists are in many cases willing to take considerable delays to save money. These could hardly be likely prospects for SST surcharge payers.

Most important of all are the uncertainties in costs. All statements about development and subsequent production costs for an airplane with an unprecedented fuselage technology must be guesses. In contexts such as these, cost estimates have a strong tendency to be too low. The F-111 is only the latest in a series of examples from military research and development where, with every reasonable effort, the tendency to underestimate costs has been apparent.<sup>3</sup> Fifty percent overruns are more usual than not, and 100-percent overruns are not uncommon. At such levels, the SST would change from a project which barely pays for itself to an unmitigated financial and economic disaster.

Further, these risks are insidious. Suppose it is accepted that the Government proceed this time. If 1 year and \$400 million later, it turns out that development costs are reestimated at \$1.6 billion instead of the present \$1.3 billion. Congress will be tempted to consider it more worthwhile to rescue the money already spent than to cut off the project at a still more advanced state. Eventually, there will be the alternatives that the Government either forget its royalties or the aircraft companies go under because the airlines cannot pay the price with royalties included. This is no imaginary experience. Many irrigation projects have already done the equivalent. Perhaps the worst possibility of

<sup>1</sup> N. J. Asher, et al. *Demand Analysis for Air Travel by Supersonic Transport*, Vol. I, Institute for Defense Analyses, Dec. 1966.

<sup>2</sup> *Economic Feasibility Report, United States Supersonic Transport*, Federal Aviation Administration, April 1967, Section VIII.

all is that the airlines having accepted the SST's and finding them unprofitable will demand that subsonic fares be raised to minimize competition. Thus the less affluent passengers will be taxed to pay for errors of forecasting.

No one can say that these eventualities will come to pass; but no one can say that they will not. Cost-and-demand estimates are too unreliable to say otherwise. Indeed, if they were more reliable the aircraft companies would not be coming hat in hand to this Congress. The benefit to the economy or to society as a whole is negative in view of the nuisances created. The benefits to individuals are at best small and concentrated in an already wealthy group and the risks of large losses to be paid by taxpayers or by subsonic airline passengers are very considerable. Congress will do well to halt this burgeoning monstrosity at this relatively early stage.

STATEMENT BY MR. WIGGS SUBMITTED FOR THE RECORD

Mr. BROWER. I have one more request. Could I submit for the record this brief statement by Mr. Richard Wiggs on his analysis of the Concorde?

Mr. McFALL. That will be accepted for the record.  
(The information follows:)

---

\* See for example R. Summers "Cost Estimates as Predictors of Actual Costs", Table 11, page 152 in T. Marschak, T. K. Glennan, Jr., and R. Summers, *Strategy for R & D*, N.Y.: Springer 1967.

Statement upon

- 1) The interdependence of the U.S. SST project and the Concorde
- 2) The poor prospects for the Concorde

Statement submitted to the House Appropriations Committee,  
Washington by Richard Wiggs (from London) March 2, 1971<sup>1</sup>

One of the main arguments of the supporters of the U.S. SST project is the proposition that "The question is not will supersonic transports be built. It is who will build them." In the U.K. one of the main arguments in favor of the Concorde SST is the assertion that "If we don't do it the Americans will." I submit that both these statements are false. It is difficult to understand how anyone who understands the situation can seriously advance these claims. If the U.S. SST project is cancelled, this will be because the U.S. has come to the conclusion that supersonic transport is environmentally unacceptable and economically unprofitable. These two factors are closely related since environmental unacceptability clearly reduces operability and potential sales. The U.S. has already stated its intention to ban supersonic overflying; and in some 13 States legislation has already been introduced which aims to reduce levels of noise at airports--the noise levels proposed being such that no SST at

---

<sup>1</sup>My status in this matter: I am the author of a new book on SST problems: "Concorde: the case against supersonic transport" published in London on February 19, 1971; and I have been working full-time on these problems for 3 1/2 years on behalf of The Anti-Concorde Project. This organisation was founded in the U.K. in late 1966 by a group consisting mostly of professional people--professors, doctors, lawyers, lecturers, teachers, writers, farmers, housewives, etc., to oppose the development of all SSTs. The group's growth has been rapid. We have co-operated closely with groups having similar aims in the U.S. and elsewhere, with substantial results.

present envisaged could possibly comply with them without sacrificing much of its payload, much of its range, or both.

Another series of objections to supersonic transport centers upon the possible ill-effects that might result from their polluting of the upper atmosphere.

If the U.S. decides that SSTs are environmentally unacceptable, and decides therefore not to proceed with its SST project, this will remove all impediments to

1. the enactment in the U.S. of a ban on supersonic overflying
2. the enactment of the proposed regulations for reducing noise at airports.

It is moreover possible that the President's Council for Environmental Quality may decide that in the absence of information about the possible results of SST pollution of the upper atmosphere, SST operations to and from the U.S. should not be permitted.

Of these propositions, (1) would drastically cut potential sales of Concorde; and (2) --or a decision against supersonic transport by the C.E.Q.--would so reduce the operability and therefore the sales of Concorde that it could not be put into commercial production.

In the U.K. recently the supporters of Concorde have been greatly agitated by the proposed new noise regulations at New York, with which Concorde could not possibly comply. The former Minister of Technology in the U.K., Mr. Anthony Wedgewood Benn--whose parliamentary constituency happens to be at Bristol, the home of the British half of Concorde--hurried to New York to campaign against the proposed noise limits and to demand concessions for the Concorde.

Mr. Benn's agitation is understandable, since it is agreed in the U.K.

that the barring of New York against it would kill the Concorde. Less easily understandable or excusable is the effort made by this Socialist former minister to persuade the New York authorities to allow the imposition upon millions of New York citizens of noise at intensities known to be injurious to health, for the benefit of the few people who would travel by Concorde-- and for the benefit of its manufacturers, who have known ever since they began the development of this machine that it would be far noisier at airports than any other aircraft in commercial use.

The agitation of Mr. Benn and of other supporters of the Concorde confirm that the removal of the U.S.A. from the field of potential supersonic operations would be fatal to the Concorde. And if the U.S., for reasons including environmental considerations, decided against SST development it is inconceivable that the U.S. would permit the despoliation of its environment by SSTs from overseas.

It is also clear that environmental pollution tends not to respect political boundaries. The problems attending supersonic transport, like so many other pollution problems, are of international size. We who in Europe have been opposing supersonic transport are now looking to the U.S. in the hope that in this (as in so many other ways) you will take the lead.

#### Interdependence

The interdependence of the Concorde and the U.S. SST works both ways. Just as the advocates of the U.S. SST have raised the spectre of U.S. airlines being forced to buy European SSTs and of U.S. citizens being forced to fly in them, so, in the U.K., opposition to the Concorde has continually been met by the cry: "If we don't do it the Americans will." And, just as the withdrawal of the U.S. from SST development will inevitably bring

about the end of the Concorde, so the cancellation of the Concorde, for whatever reason, will be very detrimental to advocacy for a U.S. SST. This follows both because of the removal of "the challenge of Concorde" and because the reasons for the collapse of Concorde would be the environmental unacceptability and the economic unattractiveness of supersonic transport operations.

The prospects for Concorde

The prospects for Concorde at the present time are poor. Representatives of a number of airlines holding "options" on Concordes (there are no orders in existence, and the number of options has remained at 74 for some three years, in spite of the efforts of special sales staff) have publicly stated their doubts about the profitability of Concorde. Among these are:

- Mr. Najeeb Halaby who said in an interview on BBC (London) TV on February 1, 1971 that Pan Am would not order Concordes until they were sure the aircraft could be operated profitably and also acceptably with regard to sonic bang, airport noise, pollution, etc.
- Mr. F. C. Wiser of TWA, who, in London, July 1969, said "It will be extremely difficult for any airline to make supersonic planes pay, because of their increased running costs and smaller size."
- General Elwood R. Quesada, of American Airlines, told the Joint Economic Subcommittee on Economy in Government: "A lot of people say the airlines wish the plane (the supersonic transport) would go away. I'm one of them." (Washington Post, 8 May 1970). General Quesada also invented a new term for the SSTs, including the Concorde:

they would be "non-compensatory." This means, as The Economist (London, 16 May 1970) pointed out, "non-profit-making."

- The Times (London, 13 October 1970) reported: The coolest note yet heard from British Overseas Airways Corporation on Concorde was sounded by Mr. Ross Stainton, Deputy Managing Director, in his Presidential Address to the Institute of Transport last night. 'To the airlines, it represents a tempting engineering development, but a heavy demand on limited investment funds with as yet no certainty of increased return,' he said. 'Magnificent as Concorde is as a technical achievement a rational assessment of cost and benefit has yet to be made.'
- Mr. Robert Six, President of Continental Airlines has said: "Concorde is technically a good aircraft but economically a poor one." (Flight, London, 11 Feb. 1971).
- Flight has also reported recently that some airlines are internally debating whether passengers on Concorde would pay the 100% fare surcharge that would apparently be necessary.
- The Observer (London) reported in its front-page lead story on 21 February 1971: "BOAC CAN'T AFFORD THE CONCORDE." This report is so important that a copy is attached. BOAC has stated that the report is "oversimplified," but has not denied its basic truth.

It should be pointed out that all of these gloomy prognostications (except the last) preceded the emergence of the proposed new airport noise regulations at New York Kennedy and elsewhere. Whether the present Bill at New York succeeds or not, potential purchasers of Concordes or other SSTs would have to reckon with the probability of such regulations being

imposed in the future--and not only at New York Kennedy.

Prohibition of supersonic overflying

Potential purchasers of SSTs would also have to reckon with existing and future restrictions on supersonic overflying. Several European nations have already announced their intention to prohibit supersonic flights across their territories: Sweden, Norway, Switzerland, The Netherlands, West Germany, and Ireland. Switzerland has recently enacted such a ban; Ireland has legislation in readiness to enact if it should be required.

A section of the Canadian Air Regulations provides that "no aircraft shall be flown in such a manner as to create a shock wave, the effect of which is likely to create a hazard to other aircraft or to persons or property on the ground."

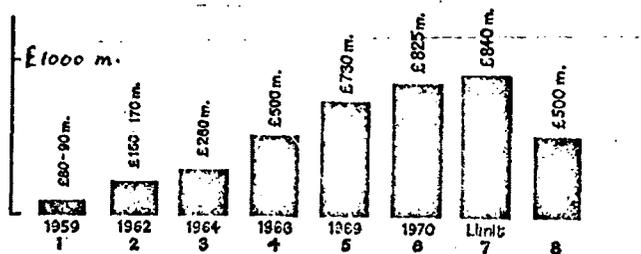
That the passage of Concorde SSTs does create hazards to persons and property on the ground has been abundantly proved by the several supersonic flights by Concord prototype "002" on its test route over parts of the U.K. These have produced many hundreds of claims for damage to property and many hundreds of complaints. Both the present U.K. government and its predecessor have announced their intention to produce proposals for banning supersonic overflying.

Prohibition of supersonic overflying over many territories will greatly reduce the operability of SSTs. Such prohibitions will also obviously lead to the concentration of potential supersonic routes over areas where such prohibitions have not been enacted; the inhabitants of such areas could be expected to react to this by demanding that the flights over them be stopped--and the operability of the SSTs would be further reduced.

### The Cost of Concorde

The cost escalation of the Concorde project should be carefully examined in the U.S. before any further commitment to SST development is undertaken. The 1962 estimate of R. & D. costs was £150 to £170 millions. By 1970 this had risen to £825 millions--and th's is far from being the final figure.

The Cost of Concorde



(1 to 6) Progressive estimates of the cost of research and development for Concorde.

(1) Estimate for the Supersonic Transport Aircraft Committee (1959).

(2) Estimate at the time of the Anglo-French Concorde Agreement (1962).

(3 to 6) Subsequent revised estimates. The 1969 estimate *excludes* the cost of establishing the production line and a reserve for "contingencies" -- both included in some previous estimates. (Production line financing now estimated at £200m.)<sup>1</sup> The research and development costs are now admitted to be largely or entirely irrecoverable.

(7) The cost limit proposed by the Minister of Technology in May 1969.

(8) The amount already spent (late 1970).

At each stage, from 1964 onwards, all suggestions that the Concorde be cancelled have been met with the proposition that "we've spent so much, we can't stop now." Once the prototypes were flying, the further cry was raised: "It works. It's a marvel of technology. It's flying--we can't stop now." All this should be a warning to those who are tempted by the proposal to build two prototypes of the U.S. SST "to resolve the environmental questions," etc.

Environmental effects resolved by prototypes?

In so far as the environmental effects of SST operation can be resolved by two prototypes, they have been resolved by the Concorde prototypes. The Concorde's sonic booms are very far above the limit of human tolerance, and they cause frequent and sometimes severe damage. There are serious doubts whether frequent routine supersonic operations could be tolerated by people on ships. The possibility exists that resonance effects from sonic booms would result in breakage of plateglass windows on ships--e.g. on the sundecks of liners--at great danger to passengers and crews. The Concorde's sonic booms have broken plateglass windows in shops and plateglass mirrors in bedrooms; as the advocates of SST frequently claim, <sup>overpressures</sup> the ~~operations~~ involved are unlikely to be sufficient to cause such damage. The damage is the result of resonance and related effects.

The prospects of SST

The evidence available from U.S. investigations, and from experience with the Concorde, indicates conclusively that commercial supersonic transport--at least with the machines presently being developed or planned--would entail environmental ill-effects (sonic boom, airport noise) far beyond the limits of tolerability. (The possible ill-effects of commercial supersonic transport operation in the stratosphere cannot be resolved by prototype operation).

It is also clear that the Concorde is a potential loss-maker for airlines: its payload is very small, its operating costs are very high, its fuel consumption per passenger mile is 2 1/2 times that of subsonics; Concorde would be very difficult to integrate with subsonics in traffic

control and airport operation (its makers assume it would be given priority at airports); if re-routing were required, to take account of sonic boom restrictions, possibly new route-control systems would be needed.

Extravagant claims about the profitability of both the Concorde and the U.S. SST are made by their supporters, but there is no hard evidence to back up these claims. They are no more than publicity-promotion material.

It is abundantly clear that the Concord project is not a national asset to the U.K. and France--it is a national liability of immense size. Even if it were "successful" in the sense that fleets were sold to airlines, the loss to the U.K. and France, in public money, is unlikely to be less than £1,000 millions--\$2 1/2 billions. The previous U.K. government tried in 1964 to disburden itself of this loss-making project. It remains to be seen how the present U.K. government will make out. The Prime Minister, Mr. Heath, said on February 7 that there was a lesson to be drawn from the collapse of Rolls Royce. "It is of the utmost importance that this lesson should be learnt and acted upon by us all. . . . Governments must rid themselves of the illusion that you can find the way to prosperity by pouring out the taxpayers' money in perpetual subsidies for uneconomic ventures."

I respectfully suggest that if the U.S. can avoid involving itself in the similar but even larger set of problems inherent in your SST project--and the way is thus left clear for the U.S. to take the lead in safeguarding our environment from the harmful effects of SST, then the whole concept of civil supersonic transport will do what General Quesada wanted--it will "go away." General Quesada's wish is assuredly shared not only by many other airline representatives, but also by countless people in the U.S., in Europe, and throughout the world, who care about the quality of human life and about the quality of the environment in which we live and upon which we all so completely depend.

[From the Observer, London, England]

**AIRLINE BOMBHELL FOR THE GOVERNMENT—BOAC CAN'T AFFORD THE CONCORDE**

(By Andrew Wilson, our air correspondent)

BOAC, with a key position among 16 airlines holding options to buy the Anglo-French Concorde, has told the Government that it sees no way of operating the supersonic airliner economically.

The corporation's verdict is bound to affect the Government's imminent decision on the £1,000 million project, whose cancellation would cause an industrial crisis more serious than the collapse of Rolls-Royce.

BOAC's finding was known to Mr. Frederick Corfield, Minister of Aviation Supply, before he flew to Paris for talks with his French opposite number, M. Chamant, last Thursday.

In Paris, M. Chamant is believed to have given Mr. Corfield the results of a study by the French national airline, Air France. This showed that French sums on the Concorde have come out even worse than BOAC's. Both airlines calculate that it will cost twice as much to operate per seat mile as the subsonic Boeing 747.

BOAC's figures are based on a detailed analysis of 9 months' subsonic and supersonic flight tests by the two Concorde prototypes; of direct and indirect operating costs; and of the expected demand for supersonic travel in 1974-80, the likely first 6 years of Concorde's operation.

The flight results were encouraging. As first reported in the Observer on January 24, they demonstrated that the Concorde is capable of flying from Paris to New York with its promised payload of 25,000 lbs., equivalent to 125 passengers and their luggage.

But these technical results are only a small part of the whole picture.

It was when BOAC and Air France began to calculate the running costs and overheads—fuel, crew pay, maintenance, and so on—that the alarming disparity between the Concorde and the jumbos began to emerge.

No only is Concorde a loss-maker in the sense that BOAC would earn more money by flying subsonic jumbos; it is also expected to cut earnings in subsonic services by interfering with traffic frequencies.

According to those who have analyzed its performance, operating losses are expected even with the most favorable seating and fare structure—a two-class aircraft in which both first- and economy-class passengers would pay a surcharge of between 20 and 30 percent.

**DOUBTS AMONG CUSTOMERS**

In practice this arrangement might be difficult to apply because subsonic members of the International Air Transport Association would veto any Concorde economy fare that threatened to steal their first-class business traffic.

Already potential customers for Concorde are experiencing grave doubts about securing enough passengers to justify services before 1980—a reflection, in part, of the general fall in traffic growth estimates since the balmy mid-1960's when BOAC, like Air France and Pan-American, increased its options from six Concorde to eight.

For BOAC only two non-Atlantic routes are now thought capable of supporting a daily service; London-Johannesburg, which carries an exceptionally high proportion of first-class passengers, and London-Moscow-Toyko, which might be operated in conjunction with Russia's Aeroflot flying the supersonic Tu-144.

Anything less frequent than a daily service is considered to be out of the question because nobody will wait for the next day's Concorde when a subsonic flight is available immediately.

For this reason London-Sydney (flown via Colombo to avoid sonic boom problems) appears to have been dropped from the list of possible Concorde routes, though Australia's Qantas might still be interested in buying Concorde "at a reasonable price" for its Pacific operations.

For BOAC the diminished market means that even if the Government subsidized its operation of the Concorde, only four or five aircraft would be needed, instead of the original eight.

A similar reduction could be expected in the requirements of other customers—a move which is bound to be reflected in the selling price of Concorde, with spiralling effects.

The price quoted in draft contracts sent to BOAC, Air France and Quantas earlier this month is believed to be \$28 million (just under £12 million). But this was almost certainly based on the hope of breaking even with a production run of between 50 and 100 aircraft.

If, as seems likely, the hoped-for sales figure drops from 74 aircraft (the present number of options) to about 30, the figure indicated by BOAC's market researches, the price would have to be substantially increased, perhaps by 60 per cent.

Such an increase would almost certainly put the plane out of the market.

According to the communique issued after last week's Paris meeting, the decision of the British and French Governments on Concorde's future will be taken when Mr. Corfield meets M. Chamant again at the end of next month.

Before then three things can happen:

(1) The French Government could order Air France to buy Concorde, in the belief (which remains to be tested), that BOAC and American airlines would feel bound to follow suit.

(2) An American airline could place the first order, despite American airlines' increasing economic difficulties and a proposal by Pan American for a 5-year trial period before introducing full-scale operations.

(3) The British Government could offer BOAC a subsidy to fly the plane, although the corporation dislikes this solution and argues, very reasonably, that it would hardly improve the plane's prospects.

Uneconomic though Concorde may be, none of these developments can yet be excluded. The Government, in particular, is thought to be scared stiff at the prospect of cancelling Concorde on which more than half the £825 million which is the officially estimated development cost has already been spent.

Anticipating trouble, BOAC has been careful throughout to say that it would like to fly the Concorde "if possible." It is determined, however, that responsibility for a decision on the plane should be put where it clearly belongs—on the shoulders of the Ministers, and especially the Chancellor of the Exchequer.

#### SUPERSONIC FLIGHTS OVER LAND

Mr. MoFALL. Thank you, Mr. Brower.

Mr. CONTE. I have a few questions for Mr. Soucie. I realize the hour is late.

Mr. Soucie, we have heard many assurances here from SST proponents that the SST will never fly over land supersonically. I know that your coalition has made many statements about this. How do you feel about it?

Mr. SOUCIE. I think that other witnesses have already pointed out that it is probably uneconomic to expect the airlines to operate these very expensive aircraft over limited routes, and there will therefore be numerous economic and political pressures to change. We don't, today, have any kind of regulation.

We have had procrastination for 4 or 5 years, assurances after assurances after assurances that it will not happen, and yet no law has passed, even though Senator Magnuson, who says that he is not opposed to such a law, has had bills before his committee for 2 years which he has never allowed to have a hearing. The President says that he will not. Mr. Magruder, in part of the statement he did not read the other day, says that the Department of Transportation's position is that if it is the will of Congress, that DOT does not oppose such a law. We don't even have a Federal aviation regulation, fraught with all of its difficulties, which Mr. Moss alluded to.

Then the other thing that strikes me here is the similarity of this situation, this assurance after assurance, and no performance, with some other DOT assurances we are getting on the quieter engine, which assure us they will have by time of production, and then this

research program, which is touted as being the answer to all of our problems though we don't have the program outlined nor a starting date, which you, Mr. Conte, inquired into the other day, and got no satisfactory answer, I thought.

#### IMPACT OF PROTOTYPES ON THE STRATOSPHERE

Mr. CONTE. We have heard a lot of witnesses on the other side who say that the two prototypes will not harm the environment, and I am inclined to do more questioning on that this afternoon, if we ever get there. How do you feel about these flights into the stratosphere? Do you feel they will harm the environment, cause pollution?

Mr. SOUCIE. From all of the evidence that we have been able to get there is no indication whatsoever that the flight of two aircraft for a limited number of times will have any significant effect on the stratosphere.

Mr. CONTE. Will not?

Mr. SOUCIE. Will not; that is right. We have not ever said they would. Then you may wonder why we oppose the appropriation for two prototype airplanes that will not harm the environment.

It has been demonstrated by Mr. Ruckelshaus' testimony, by the statement by Mr. Heywood that I just submitted, by the rather reluctant admission by Mr. Magruder and others, that the two prototypes are unnecessary to getting the answers to the biggest imponderable of all, which is the effect of the SST's on the atmosphere, because in fact this research program—

#### IMPACT OF A FLEET OF SST'S

Mr. CONTE. Do you feel it will have an effect on the climate?

Mr. SOUCIE. I do feel that a fleet of 500 will, but that two will not, but the two won't give us any answers either. In other words, I have discussed this with Dr. Goldberg of Boeing. I have discussed it with Mr. Lockett, Chief of the Technical Operations Division of the SST program, and have been told that this ill-defined research program in the upper atmosphere will be conducted primarily by balloons, by the flight of the RB-57-F, by the use of lidar and other ground-based telemetry equipment and possibly piggyback missions with the U-2, SR-71, YF-11, and other aircraft.

The thing that is worrisome here is that if you examine the sales rhetoric of the SST proponents, even though they tell Congress they are only asking Congress to approve these two harmless necessary prototypes, the sales rhetoric necessitates the sale of 500 airplanes. Otherwise the Government cannot get back its money and make a profit. There wouldn't be any renaissance of jobs in the aerospace industry, there will be no national prestige for the United States, there will be no contribution to the balance of payments, there will be no maintenance of the leadership of the aerospace industry. So the SST proponents are already committed to the 500 airplanes.

In fact, we assume from our best information, and Mr. Yates has brought this out over and over again, that there will not be private capital available. Under Secretary Beggs last year admitted that this was a distinct possibility for the financing of the construction of these production planes. In the absence of private capital, the argu-

ments which we have heard time and again during this hearing alone, that since we have gone this far, we should finish what we have done, if we finish the prototype program, and then private capital is not available, the pressure for the Congress to keep putting up money will be even greater than it is now.

Then if we assume, on the other hand, the Boeing-DOT line, that private capital will become available, in fact assume everything that they say, it is still a troublesome venture, because here is what you have to assume.

You have to assume that this DOT research program, which has to be finished by the summer of 1973, because that is when the production decision must be made, will have answered all these really imponderables about the upper atmosphere. It is somewhat unlikely that this kind of rushed research, which isn't even underway at the moment, can produce the answers. At any rate it will be DOT who decides whether or not the answers are acceptable.

Secondly, as Secretary Volpe pointed out the other morning, the marketplace will make the decision whether to go ahead, because if private capital is available, as Mr. Magruder has assured us it is from the Bank of America, Chase Manhattan, and National City, then Congress cannot participate in the decision whether to go ahead because suddenly it is no longer a Government matter. It is now a typical aerospace industry decision, with the airlines, deciding whether to go ahead.

What is happening now is that Congress is really, quite possibly if we accept Boeing and DOT arguments, right now in its last position to make a decision. Right now is the last handle Congress will have on the whole SST program.

#### BASIS FOR CONCLUSION

Mr. CONTE. You keep mentioning that you feel that flights of 500, 400, or 300 SST's will have an effect on the climate. Will you get something together and put it in the record to show us how you arrive at this conclusion?

Mr. SOUCIE. Yes, sir; I will be glad to.  
(The information follows:)

## FRIENDS OF THE EARTH

917 15TH STREET, N.W., WASHINGTON, D. C. 20005  
(202) 638-2525

DAVID BROWER, *President*  
GARY A. SOUCIE, *Executive Director*

March 7, 1971

Hon. John J. McFall, Chairman  
Subcommittee on Transportation  
House Appropriations Committee  
Washington, D.C.

Dear Mr. Chairman:

This is in response to Mr. Conte's query during the hearings on Wednesday. He asked me to submit for the record a comment on why the SST fleet's emissions in the upper atmosphere would pose a hazard.

So very little is known about the physics and the chemistry of the upper atmosphere that you can arrive at almost any conclusion about the likely effect of an SST fleet on the stratosphere, depending upon the assumptions you make, the experts whose work you use for your calculations, and the degree of your self-interest in the SST program.

Our ignorance of the upper atmosphere is so appalling that expert predictions about the effect of 500 SSTs range all the way from assurances of no effect, postulated by scientists working for or as consultants to Boeing and DOT, all the way to the near certainty of climatic damage. Writing in the January issue of *Scientific American*, Professor Reginald E. Newell of MIT, a recognized expert in atmospheric science and theories of climatic change, said that a fleet of 500 SSTs flying at 70,000 feet will produce "a significant increase in the water-vapor content at higher levels" which "would be expected to produce increased cloudiness and therefore a change in the albedo, or reflectivity of the earth."

The risks of proceeding with the SST program are great: increased incidence of skin cancer, disruption of the earth's climatic patterns, and the ultimate risk described last year by one of the President's own environmental advisors, Dr. Gordon J. F. MacDonald of the Council on Environmental Quality, that if sufficient ozone were stripped from the atmosphere, it "would effectively wipe out life, except in the oceans."

Considering the depth and breadth of our ignorance and the gravity of the risks, we cannot afford to plunge ahead with a prototype program that is not necessary for the research we need and which adds to the already seductive momentum of the program. Proponents of the SST assure us that it is unlikely any of these adverse effects will occur. Similarly, it is unlikely in Russian roulette that the single cartridge will be in the chamber when you pull the trigger, but no rational man would point that revolver at his own head, even with the odds 6 to 1 in his favor.

Sincerely,

  
Gary A. Soucie  
Conservation Director

Mr. CONTE. I want to congratulate you on a very fine statement.

Mr. BROWER. Thank you.

Mr. MOFALL. Mr. Edwards.

#### ECONOMICS OF THE SST

Mr. EDWARDS. I was earlier inquiring about the statement that you made and where it came from. First, I should like to say I think you have made a beautiful statement. There is very little in there I would even try to disagree with. I think your description of how we all got here and what we have got to preserve—I am sure all of us are as concerned about this old earth as you are. I wonder if you have any belief as to whether the SST will be economical?

Mr. BROWER. My own belief is that it won't. I am here making a judgment as a man who has a habitat up in an airplane. I almost spend more time up in the air than on the ground I am afraid. It is exactly the kind of thing I am not interested in at all. It is not going to do me a bit of good nor the people I know.

Mr. EDWARDS. If it is not economical, do you believe that the airlines will buy it anyway?

Mr. BROWER. I have seen things sold by supersalesmanship that should not have been sold, and I think that there is an enormous bit of pressure being put from all sides here on grounds that I don't think are good grounds, U.S. supremacy, chauvinistic grounds and others, that can lead to bad decisions on the airlines' part.

If you compare ships, the 747 has all sorts of advantages over the SST. I gave you this little litany of what I think is not too good about the 747. I have been on quite a few flights now, and I don't think it is all that good when the airlines were sold it, and everyone who has bought it is in serious trouble. I think Gary Soucie, who has followed this very closely, who came to us from the Sierra Club to Friends of the Earth some time ago, from Swissair, who has been a very close follower of what goes on in the air, has a comment.

Mr. SOUCIE. One of the problems is that equipment procurement and other policies of the airlines is governed by the Judas' goat principle which is: as soon as the first guy has one, everybody else feels he has to have one. I think the biggest farcical demonstration of this was in the 1950's where we had the great sandwich war among the airlines. IATA had determined that in economy class you could only serve sandwiches. Then SAS, a three-government airline including Denmark, made a real production number, out of the Danish sandwich, so SAS started serving these elaborate things called sandwiches, which PanAm and TWA thought was unfair, because it is a little more elegant than a ham and swiss on rye. Then the airlines of the world were competing as to who could put out the biggest lavish sandwich. This caused all of the airlines to troop off to Paris for a crisis meeting and finally they wrote the rules you could serve TV dinners in economy class. We had the same thing in the mid-1960's with in-flight entertainment. As soon as TWA elected to start showing films, then all of the airlines started worrying about their necessity for showing films and many bolted into it. United equipped nearly all of its flights for in-flight entertainment and then started yanking them out because it wasn't economical.

Mr. EDWARDS. You are talking about frills. I am talking about business judgment on the part of Chase Manhattan or some of the major banks of this country, and other big industries, if prototypes are shown to not be economical, that it costs too much to fly, that there is no way to make a buck out of it. Do you still believe that the airlines are going to buy this plane, and that the banks and others are going to permit it?

Mr. SOUCIE. Yes, sir, within reason, and here is why. At the time the 747 was being offered for sale, the director general of IATA, Knut Hammarskjold, said that he was alarmed at the numbers of 747's being ordered by the world's airlines, because IATA, which is the world association of carriers, simply couldn't find the passengers for all that capacity. They didn't see where it was going to come from, but unfortunately each airline makes its own decision, and feels that if it has the capacity, if it has the greatest sales force, et cetera, it can bite off a bigger share of the market. No single airline could afford to make the decision to be cautious and reasonable, so you had a situation of overpurchase of the 747 at a bad time, which is not to criticize the 747. I haven't flown as many times as Dave, so I am not as down on the plane, but I think that it is obvious that more airlines bought 747's, and more 747's, than they can profitably operate.

I was talking to an executive for one of the trunk carriers in the United States a couple of weeks ago. He told me about one of their airline's planes arriving that very day in New York from Los Angeles with six passengers aboard. Now some airlines have cancelled their 747 orders, and some are now beginning to cancel their DC-10 orders unfortunately, but in fact many more airliners were ordered than the airlines could reasonably hope to fill.

Mr. BROWER. It is sort of the long-distance running analogy that occurred to me last night. In a mile race you often get the "rabbit," the guy who goes out there to draw the opposition out, to spend them too soon. This happens. Somebody goes out and runs fast and someone tries to keep up and they are both put out of the action. I am concerned that the U.S. Government in its aviation program says it is prepared to go the distance and not just blow it, in this sudden flare of enthusiasm and high-pressure salesmanship.

#### ABILITY TO BAN THE SST

Mr. EDWARDS. Let me ask what may be the \$64 question. Various people in this country have different degrees of faith in their Government, in this Congress, and in the Executive branch. But, assume that the ecological studies show that this would really be a detriment to the ecology, to have a fleet of 500 SST's. Do you believe that this Government would nevertheless allow the SST to land in this country, or to fly over this country, or in and about this country?

Mr. BROWER. I would hope not, but I don't have too much faith, after having seen what came out of the Department of the Interior on the 102 report on the trans-Alaska pipeline, where somehow, in spite of all the ecological effects, they said, "Go ahead and build it". Fortunately Secretary Morton apparently isn't going to be made the scapegoat of this kind of thinking. But the pressures that come to bear in Government can't be sustained unless the public itself is

awakened to them and realizes it has a role and can sound off and be heard. The decisions can be very bad decisions. That trans-Alaska pipeline is just a gem of one of the reasons we fear what will happen.

Mr. CONTE. Will you yield?

Mr. EDWARDS. Sure.

Mr. CONTE. I shouldn't get into this because those Danish sandwiches are getting more tempting by the minute, but in all fairness, Dave, I think that Secretary Volpe has done a fantastic job to protect the environment. He stopped the jetport in the Everglades. He stopped that road down in New Orleans that goes through that historical center.

Mr. SOUCIE. Franconia Notch.

Mr. CONTE. Yes, Franconia Notch. A lot of good things have come out of that Department since he has been there. I don't want to sound prejudiced because he is from Massachusetts and a friend of mine, but I think he has done a great job protecting the environment, cutting down on noise from airplanes. In all fairness regarding the supersonic boom, I feel there definitely should be a law, but he has repeated here—of course he is not going to be here forever—he has repeated time and time again this thing wouldn't fly supersonically over land.

Mr. BROWER. I don't even want to fly supersonically over the ocean. I don't think we need that speed. That question you ask, we don't know. You have probably heard this record of the humpback whale, Roger Payne's great contribution. Here we apparently have whales able to communicate over thousands and thousands of miles of ocean. We ought to get the whale vote and the porpoise vote on this and a few other things before we assert ourselves as the lord of the universe, after the record we have of screwing it up. I don't think we have the right. I don't want to go banging the ocean that many times a day.

I was down at the southern tip of Cumberland Island with John McPhee going around at sunset one night. We got a sonic boom, and from my old infantry experience I hit the dirt right away. I don't like noise like that. I suppose I looked pale as I got up. The rest of us kind of scattered and hit the dirt. I have seen mules scatter in a sonic boom. Then I looked at the horizon in the sunset. As far as the eyes could reach clouds of birds were rising up, having been shook up by that same boom. Here we have this prospect of bang, bang, bang. For what? For no good purpose. I don't need that speed. Speed does not measure progress. It measures the absolute opposite of it. We are on a strange addiction. It is just wrong, that is all. Do I show my prejudices?

Mr. CONTE. Yes. Very good. I am with you.

Mr. EDWARDS. I think everybody is entitled to a reasonable bias. I will now conclude with this. The thing is that we have really no control ultimately on what is going to fly over the ocean. We can say what can't land in this country, and we can go to international councils and make our argument based on what we might learn from these prototypes or from the research that we will do on the ecological questions, but in the final analysis we don't have any control over what the Russians or the British or the French or anybody else, if you will, is going to do. That is all I have. Thank you, Mr. Chairman.

Mr. McFALL. Thank you, gentlemen. We will start again at 1:30.

## AFTERNOON SESSION

Mr. McFALL. The committee will come to order and we will hear testimony from Mr. Duane Yorke.

## STATEMENT OF DUANE YORKE

Mr. YORKE. Mr. Chairman, I am Duane Yorke residing at 112 Clover Drive, Massapequa Park, N.Y. My interest in this subject is that of a professional engineering executive concerned about the responsible assessment of new technology. This concern is essentially in what I believe to be the spirit of H.R. 17046, the Technology Assessment Act of 1970 sponsored by Representative Emilio Q. Daddario, Democrat from Connecticut. Unfortunately, it appears that circumstances have precluded the implementation of this resolution in sufficient time to provide this subcommittee with the capability suggested in the act. I am, therefore, coming forward voluntarily to help provide some such services at the pleasure of the subcommittee in regard to the supersonic transport question.

Before going any further, I would like to clarify my understanding of the question before the subcommittee. I believe that the question is restricted at this point to only a yes or no vote on the continuation of funding from April 1, 1971, through June 30, 1971 for the SST prototype program as defined by the already existing contracts.

By the time that this statement is read, it appears probable that a large and unknown amount of new SST information may be before the subcommittee or the public, much of it perhaps, fascinating but nevertheless irrelevant to the question before the subcommittee. Rather than contributing to this information pollution by way of a lengthy statement covering all possibilities at this time, I believe that it would be in the subcommittee's interest to explore with me, by questioning only those areas of most concern.

With regard to my position on the question before the subcommittee, based upon information available to me as of February 26, 1971, I believe the best interests of the public would be served by a no vote because of the following principal reasons:

1. A lapse from a good productive research and design program into an unresponsive prototype situation no longer in the control of the principals appears to be near at hand.

2. There is no conclusive proof that a no vote really damages anything or anyone irretrievably.

3. It may produce a new, more expedient, and less costly route to a really good SST.

4. For the sake of gaining more perspective on aerospace priorities it is desirable to stimulate thinking.

5. Precedents with other programs and indeed with the SST itself indicate that requirements and guarantees in technical contracts are virtually meaningless.

6. A major segment of the aerospace industry does not believe in the SST.

This statement, as previously noted, has been purposely kept very brief. Further written amplification of the above remarks in the time

available for preparation has also proved to be impractical. In a spirit of constructive cooperation, I am willing to answer any questions about the above statements to the best of my abilities.

YORKE LETTER TO MAGRUDER

Mr. McFALL. Thank you, Mr. Yorke. You noted that you were opposed to the continuation of the SST on February 26, 1971. On September 21, 1970, you wrote a letter to Mr. Magruder which I will quote in part to you:

Perhaps you need some more help in consolidating the SST story? I have been arguing for supersonic cruise airplanes since 1957. Although most of work has been on military applications, Ray Bisplinghoff and John Swihart are familiar with my talents and enthusiasm. I would be interested in either a full-time or consulting arrangement, should you consider it desirable.

Why did you change your mind since September 21?

Mr. YORKE. I don't believe I have changed my mind, Mr. Chairman. The statement which I just read I think very carefully delineates that I am replying to the question of the yes or no vote on this particular issue before the subcommittee. Now, before we go any further into this discussion I would like to make it clear that the preceding speakers on the negative side of the question, that I have no direct affiliation with that group of speakers whatsoever. This is a completely separate situation and a different set of reasons to support the negative proposition before the subcommittee.

Mr. McFALL. I don't understand. You are against the SST now. In September last year you were apparently enthusiastically for it. What caused that change of mind?

Mr. YORKE. Well, there is a very serious problem, I think, between alienation of the public against three letters of the alphabet, SST, and what constitutes the question really before this committee.

Mr. McFALL. What do you consider the question before this committee?

Mr. YORKE. I believe it is contained in the statement that I read, that it is a yes or no vote on a continuation of an existing contract for a given, very short, essentially 90-day period of time, and the dollars, as I understand it, involved in this particular extension are rather small to some of the other figures that have been quoted in the last few days.

Mr. McFALL. Any questions on this side?

Mr. YATES. No. Thank you very much.

Mr. McFALL. Thank you very much, Mr. Yorke. We certainly appreciate having your testimony.

Mr. YORKE. I thank the chairman very kindly.

Mr. McFALL. We are very glad to have with us our colleague, the Honorable Clarence Brown, a U.S. Representative from Ohio. Mr. Brown, we would be very glad to have your testimony whenever you are ready to begin.

STATEMENT OF HON. CLARENCE BROWN

Mr. BROWN. Mr. Chairman and members of the committee:

Why should the United States complete the development of two prototype airplanes of the supersonic transport? I believe there are

three good reasons: economic, environmental, and social. And I shall discuss each in brief factual detail.

There has been an unfortunate tendency on the part of the opponents of completion of the American SST prototypes to use demagogic "scare" charges and to continue to use such attacks even after they are outdated or disproved. I have had the opportunity to debate the question of completing the SST funding with such opponents and have been shocked to hear them use the report of an ad hoc task force of Cabinet officials which President Nixon named when he first became President. The opponents of the SST indicate that this first cursory study by the administration indicated SST development was deferrable—but they do not indicate that the predicate of the study was that there would be no British-French Concorde or no Russian TU-144. I should like to submit with my testimony today an article on the Concorde which appeared in the February 8, 1971, issue of Aviation Week and Space Technology and a copy of an advertisement from the December 28, 1970, issue of the same publication advertising the Russian TU-144 on display and ready to be sold soon.

Distortion of facts by SST opponents has become common. When the Joint Economic Committee did its study last year on the SST, the chairman of the subcommittee making the study wrote Under Secretary of Transportation James Beggs and the members of his 1969 Administrative Ad Hoc Study Committee on the SST and asked for 1970 updated comments on their 1969 viewpoints. The responses favoring the SST and based on more accurate information than was available in 1969 were ignored by the committee's initial report.

Specifically, the chairman wrote to Dr. Lee DuBridge, the President's science adviser, urging him to be sure and respond by May 1 so that his views could be included in the joint committee's final report. Dr. DuBridge did reply on April 22, 1970, and his rather lengthy letter concluded with this comment, and I quote.

Mr. McFALL. Mr. Brown, you have an insert, don't you, in your prepared text?

Mr. BROWN. Yes, I do. We have copies of it, I believe. You should have it.

Mr. YATES. We have it.

Mr. BROWN. I am sorry. I thought you had it, Mr. Yates.

Mr. McFALL. Go right ahead.

#### DUBRIDGE LETTER OF APRIL 22, 1970

Mr. BROWN. Dr. DuBridge did reply on April 22, 1970, and his rather lengthy letter concluded with this comment, and I quote:

Thus, on the whole I would strongly recommend that your committee endorse the President's proposal that the United States proceed with the SST project.

But the committee report chose to ignore those views and proceeded to report on page 15, and I quote:

The Director of the Office of Science and Technology concluded that "the Government should not be subsidizing a device which is neither commercially attractive, necessary, nor has public acceptance".

## COMMENTS FROM OTHER GOVERNMENT AGENCIES

The Joint Economic Committee's August 1970 report also distorts the views of the Under Secretary of the Treasury for Monetary Affairs in this same way by quoting from his 1969 statement which assumed no commercially available foreign SST and then further distorted his views by quoting from his 1970 letter. Ignored by the Joint Economic Committee report is the conclusion of the Under Secretary's 1970 letter, which says:

I am, therefore, not in a position to provide you with an up-to-date assessment of the commercial prospects for this plane; nor have I personally kept in touch with recent efforts to solve the various environmental problems raised by the SST aircraft.

The opponents of the SST do not consider significant the fact that on December 7, 1970, every department of the Federal Government which could be remotely considered appropriate for commentary reported favorably on the development of the two SST prototypes and that the President's Council on Environmental Quality has recommended that the prototypes be completed so that the studies they will make possible may be undertaken.

## STATEMENT BY CHAIRMAN, NAS SUBGROUP ON WEATHER AND CLIMATE MODIFICATION

Now, there is another insert at this point, Mr. Yates and gentlemen:

In a televised debate just the other night, an opponent of the SST charged that a National Academy of Science report, supposedly representing the views of many eminent scientists, had concluded that SSTs would cause skin cancer. Apparently Dr. James E. MacDonald, a senior physicist at the Institute of Atmospheric Physics of the University of Arizona and an authority on unidentified flying objects, also repeated this charge before this committee yesterday. I asked that the matter be checked out through the National Academy of Science and the following is the reply received late yesterday:

## TELEGRAM

WILLIAM MAGRUDER,  
*Director, SST Development.*

In response to your inquiry with respect to reports that the National Academy of Sciences has issued a statement that the SST could increase the incidence of skin cancer.

I want to advise you that the NAS has not issued such a statement. I am chairman of the NAS review subgroup on weather and climate modification which is presently updating its 1966 report. The review subgroup is analyzing a number of tentative conclusions and will publish this report after these conclusions have been subjected to the normal NAS procedure of a thorough scientific review to insure their validity.

DR. THOMAS MALONE,  
*Chairman, National Academy of Science.*

The fact is that a number of Americans have been misled about the nature of the competition the American aerospace industry faces from the French-British and Russian developments—and some of it has been purposeful. I also am submitting to the committee a copy of a

transcript of a wireless interview I had on August 19, 1970, with John Hosken of the British Broadcasting Corp. immediately following the issuance of a report on its hearings on Federal transportation policy and the SST by the Joint Economic Committee. In that interview Hosken asked, "On Concorde itself, why was no firsthand evidence sought from the Anglo-French technicians. It seems to me to be a very grave loss here." He goes on to observe, "But I understand the committee only took evidence on Concorde firsthand from a British journalist; it strikes me as being a rather slap-happy way of coming to such a damning conclusion."

A full text of the interview is available. The fact of the matter is, Mr. Chairman, a lot of the conclusions damning the SST have been arrived at in a slap-happy manner. But the perpetuation of such conclusions on the part of public officials and responsible journalists is inexcusable and is a grave disservice to American national interests. For instance, the criticisms of takeoff and landing noise of the SST by Dr. Richard Garwin are based on outdated information, but it is still liberally quoted while the recent reports of Dr. Leo Beranek of the recognized firm of acoustical experts, Bolt, Beranek & Neuman are ignored.

Similarly, the opponents of the completion of the SST prototypes are fond of quoting from the study of a work group on climatic effects of the SST at the Massachusetts Institute of Technology 1970 Summer Study of Critical Environmental Problem meeting at Williamstown, Mass.; but they overlook a followup statement by Dr. Will Kellogg, Associate Director of the National Center for Atmospheric Research and chairman of that work group, which says, "I am very much disturbed over recent gross exaggerations and scientific misstatements regarding the SST's potentially harmful effects upon the atmosphere and man's environment. Last August a group of top scientists at the MIT Summer Study stated that there are indeed environmental uncertainties, caused in no little part by gaps in available information, which require additional research in order that they may be resolved. I pointed out at that time and want to strongly reaffirm that there is no environmental reason however to delay construction of the two prototype U.S. SST's.

"It is my profound hope that the U.S. Congress will not be misled by these exaggerations or by scientific misstatements."

The full text of Dr. Kellogg's remarks are also available.

And within the past couple of weeks there was a page 1 story in the Washington press quoting a story in the London Observer to the effect that neither the British Overseas Aircraft Corp. nor Air France felt the Concorde could be operated economically. The next day a story appeared in which BOAC denied the earlier report, but this followup appeared on page 9.

Such has been the effort to mislead this Congress by those who would see us discard the project which has already received \$860 million in Federal funds and \$140 million from prime contractors (Boeing and General Electric), subcontractors, and 26 airline companies in the United States. In addition to this billion dollars of investment which would be lost if the project is not completed, another \$100 million would be needed to terminate the Federal obligation in orderly fashion. So we are talking about a total of \$1.1 billion if we quit now

as opposed to current total estimated costs of \$1.68 billion to complete the prototype phase. The Government's share of this completion total would run \$1.3 billion; the prime and subcontractors will have put in an estimated \$300 million; and the airlines will have an estimated \$80 million invested.

Thus, you should really be thinking today about \$340 million of Federal funds—the difference between \$1,300 million of Federal funding to complete the prototypes and the Federal cost of at least \$960 million to terminate the project as of March 31, 1971. Total liability could run as high as \$1,100 million, of course, if we stop now.

The precedents are clear for spending this kind of money on the development of the Nation's transportation resources and technology. Just as the U.S. airlines have enjoyed Federal subsidies for development, so the commercial aircraft industry itself has been the recipient of airplane technology from development of military aircraft for both wartime and peacetime uses. Subsonic commercial jets like the Boeing 707 and the DC-8 were made possible by the federally funded research which developed the Air Force's B-47 and B-52. The DC-3, the first plane to make commercial air travel economical and convenient, was originally developed as a military project for World War II use. And, of course, the very titanium technology which will make it possible for the American SST to be bigger, stronger, and faster than foreign SST's made of aluminum, was originally developed for U.S. military planes now flying supersonically at altitudes even higher than the prospective cruising range of the commercial SST.

It should be unnecessary for me to list examples of the historic commitment of our U.S. Government to the development of faster, more convenient, and safer transportation. Such Federal funding or subsidization includes the early post roads and canal systems which leaped the Appalachian Mountains, the railroads which opened the American West, the Panama Canal which linked two oceans, and the incomparable Interstate Highway System on which \$36 billion has been spent to reduce the cost of delivery of consumer products to every corner of our Nation. American bargelines have their rights-of-way built and maintained by Federal funds, and our oceanic merchant marine fleet has been the recipient of shipbuilding subsidies for years to maintain some small measure of competition with the flag vessels of other nations. As a matter of fact, during the same period of time our Federal Government has been spending a potentially recoverable \$860 million on the development of two SST prototypes, it has invested over \$2 billion on oceanic shipbuilding in an effort to try to restore the U.S. fleet to the competitive position it once held.

Similarly, more Federal funds—over \$1 billion in all—have been spent in the last decade trying to maintain and develop urban mass transit in the United States, and \$3.1 billion in Federal funds have been committed to this effort over the next 5 years. Even such a highly specialized problem as vertical and short takeoff and landing for the benefit of military and domestic commercial airplanes has been the recipient of over half a billion dollars of Federal funds in recent years.

But the SST project is different from all these in that the Federal Government will receive all of its direct investment back in royalties by the time an estimated 300 planes have been sold, and it will receive

an extra billion dollars in royalties if 500 of the projected 500 to 800 sales materialize by 1990.

The SST project is also different in that we are not trying to develop a new transportation industry—as we once were with intercontinental railroads—or revive one that has collapsed—as we are with the merchant marine or urban mass transit. In our investment in the development of SST prototypes, we are merely continuing the development of an industry which is one of the great contributors to the Nation's economic well-being.

The aerospace industry, one of our Nation's most technology-intensive, supplies 85 percent of the world's markets for new aircraft equipment and parts and thereby contributes to a favorable balance of U.S. trade, an amount which has varied between \$1 and \$2½ billion annually during the past decade. It is to such technology-intensive industries that America must look in future years for a preservation of our balance of trade, according to recent testimony by Commerce Secretary Maurice Stans, before the Joint Economic Committee on which I serve. In 1970 our trade balances were negative by \$6.1 billion in raw materials. We were only enjoying a \$1.5 billion favorable trade balance in agricultural products. But in the technology-intensive industries, our favorable trade balance in 1970 was \$9.6 billion—enough to offset the other categories by \$2.7 billion. The significance of the over \$2 billion favorable balance, contributed by the current competitive advantage enjoyed in world markets by our aerospace industry, therefore, cannot be overstated. It is from these favorable balances that we will get or hold onto some of the resources, with which we can pay for the social and ecological programs which we will need in the years ahead.

The most modest estimate of the advantage we will derive from the availability of an American SST in world trade is \$22 billion between now and 1990, with a possibility that this could go as high as \$45 billion. Conversely, it is clear that if we lose the advantage we now enjoy in world markets, we could lose as much in the next 20 years as we stand to gain.

There is a tendency on the part of all customers to purchase from the supplier who can offer them a "family" of products, and this capability will shift to the British, French and to the Russians, if America eschews the opportunity to maintain its present competitive advantage by deciding not to build an SST. The European manufacturers are offering shuttle aircraft, the short-range jet and air buses in addition to the SST. Each meets a certain market need from the standpoint of economics. The SST is designed to serve the developing transoceanic travel market, which is expected to triple by 1985 from its present level of 100 billion revenue passenger miles per year.

While the economics of the Concorde and the TU-144 are still shrouded in some secrecy, the projected figures for the American SST indicate that it will be able to make something more than two transoceanic trips while a subsonic Boeing 747 or jumbo jet, carrying about the same payload, covers the same distance. In other words, one trip over for the 747 or subsonic jet while the SST is making a trip over, a trip back, and then starting back over again.

Thus, even though the SST may cost more to own and operate, it can still be more economical at carrying passengers than current

jets. It will, in fact, cost more to buy; but it will require less labor to care for passengers on flights of less than 3 hours to Europe than is required to serve passengers on flights taking more than 7 hours on subsonic jets. With such economic advantages in view, the SST is expected to pay itself out in 5 years at a projected 1970 cost of about \$40 million per plane—essentially the average payback time as planes now in subsonic service (including the 747, which costs \$22 million per plane).

If you extrapolate those figures to 1978 when the American SST will become available the figures will be about \$51 million for the American SST and about \$28 million for the 747 based on the same rates of price increase.

The assumption has been that the smaller seating capacity (125 vs. 300), and somewhat slower (1,400 mph vs. 1,800 mph) European SST's, will be in service commercially between 1972 and 1974, and our SST will not be available before 1978. Such time frames could permit the European SST's to develop enough sales to recover their development costs, and be retired without economic loss to airlines using them before American SST's, with a better product, win the market which is expected to develop in the 1980's and afterward. The British, French have estimated the total market through 1990 at somewhere between 1,200 and 1,600 SST sales worldwide. Such figures are based on projected increases in transoceanic traffic volume and relate to planeload capacity and flight speed. Another way to look at this, is to compare the number of planes it would take to carry the passenger miles in a certain year, if new planes had not been developed. For example, all of 1971's traffic could be carried in 786 flying 747's, but the same revenue passenger miles would have required 2,188 707-100's or 8,378 Constellations or 47,416 DC-3's. By 1980, the estimate is that 500 SST's can replace 819 747's or 6,700 707's, or 145,000 DC-3's, which would be required to carry the same traffic estimated in that year.

#### ECOLOGICAL REASONS

If the impact of these figures is not impressive with reference to the economics of the future of aviation, they should certainly be impressive from the ecological standpoint. The prospect of 145,000 DC-3's polluting the lower atmosphere 10 years from now, versus 500 SST's, gives some impact to the argument that the SST has the lowest pollution rate per passenger mile, of any modern mode of transportation. One SST carrying 298 passengers at 1,780 miles per hour, will spew out less unconsumed fuel pollutants, than three automobiles traveling at 60 miles per hour.

Another comparable estimate is that the whole SST fleet will emit less water vapor in the stratosphere daily than the average thunderstorm and there are between 3,000 and 6,000 thunderstorms in the world each day. Contrails also do not form at SST altitudes—as established by the fact that present military aircraft have been able to do reconnaissance unobserved from those heights for years.

To dismiss ecological concerns in a new area about which so little is known, would be as irresponsible as the use of Sunday-supplement "scare tactics" about the possible dangers to the environment from supersonic flight. Certain early concerns about SST's and the ecology

have been disproved by research in our space program, and by research activities undertaken within the SST budget itself. The completion of the two prototypes will make possible further research in all areas of ecological concern. With an estimated \$82 million of the Federal expenditure on the SST project dedicated to research into environmental considerations, and in the face of the current American concern about the environment, I feel certain that all environmental hazards will be resolved before any possible harm could be done. Two independent advisory committees have been established by the Department of Transportation, to assure the availability of the best scientific advice and counsel in the country on noise and environmental research. The membership includes such people as Dr. Harold Rossi, professor of radiology physics at Columbia University.

To the suggestion that SST's will deplete ozone in the stratosphere and thus affect ultraviolet radiation at the earth's surface, as an example, the Environmental Science Services Administration and its consultants and the MIT study group have concluded that any variation that might occur would be barely detectable and would be small compared to the daily variations found between two places on earth such as Washington and Albuquerque. These effects, along with the "greenhouse" concerns about emissions of dust, gases, and water vapor, all will be fully investigated before 1978, when production of SST's for sale and flight is now scheduled. Should we consider flight by any SST's harmful to the world environment, we should certainly want to undertake international negotiation on this score from a thorough grounding in scientific research and facts. (As a matter of fact, the question of landing rights for SST's is a matter negotiated between governments and our hand, in this regard, no matter what our position, will be strengthened by facts developed by valid research.) But such investigation as has been made by recognized authorities has so far indicated nothing that would call for a termination of the project to build two U.S. SST prototypes.

A noise level of the American SST at the measuring points 1 mile from landing, three and a half miles from takeoff and 0.35 mile from the side line path of the plane which would be comparable to, or less than, currently flying subsonic jets is considered achievable by Dr. Beranek and his SST Community Noise Advisory Committee. Because larger intakes in the SST engine reduce the shrill whine, the takeoff and landing EPNdB levels for the SST are currently below the 108 level of subsonic jets. And because the SST is expected to land more sharply and takeoff more steeply, this sound is expected to be audible on the ground for a shorter period of time. A year ago the side line EPNdB figure was assumed to be 124 for the SST. But it is now clear that 118 has been reached and 108 is attainable, according to the experts on Dr. Beranek's team.

As to sonic booms, the SST will not be permitted to fly at supersonic speeds over land masses according to an enunciated regulation of the Federal Aviation Administration. Such regulations have the force of law, but should anyone in or out of Congress feel the need to enact permanent legislation to reemphasize such a regulation, I shall be happy to join them even though I feel it is unnecessary. The fact is that American military aircraft have been flying supersonically over various populated parts of the world for years and the number

and degree of damage objections have been minimal. And perhaps it is worth noting that almost all claims have been lodged as a result of preannounced tests. It has been reported to me that prior to such announced tests of the Concorde in England recently, approximately 300 complaints of damage from supersonic boom were lodged before the plane had taken off for the tests.

#### EMPLOYMENT

The impact of the SST has been mostly from the headlines to date—except for the effect of the dollars expended. Estimates are that 14,000 Americans are directly employed in the program to make the two experimental American models and that this represents some 40,000 other jobs in collateral employment. The production employment estimate is 50,000 jobs directly and 150,000 indirectly. I would not defend the development of a supersonic transport as a “make-work” project. But similarly I find it difficult to understand the logic that wants to terminate this potentially constructive project and the economic benefits which can flow from it and yet would substitute for it some kind of nonproductive job retraining or Federal dole for those out of work in the aerospace industry. The ultimate social benefits to be derived from productive labor would always seem to exceed those derived from nonproductive labor. A dole or retraining program would be a consumer of tax dollars which must be generated from some other productive enterprise. But estimates on the taxes to be derived from a commercially salable U.S. SST run in excess of \$6 billion during the decade of the 1980's. While this distinction may appear to be only economic, its social ramifications cannot be overlooked.

Similarly the social ramifications of a method of closing the distance gap in the world should not be ignored. The history of mankind is filled with efforts to shorten the distance between nations and cultures. After Marco Polo returned from China, the European effort to find shorter trade routes to the Indies resulted in Vasco DaGama's voyage around Africa and the discovery of America by Columbus. But the development of geographic routes soon gave way to the mechanical methods of increasing speed to shorten distance. The clipper ships gave way to steam and the ship itself has given way to air transportation within our lifetime. As a friend of mine who works for a domestic airline commented succinctly the other day, “No one ever comes up to my counter and asks how he can take the long way to get there.” Everyone wants to save time in travel whether that time is to be used for pleasure or more serious pursuits. And 6 million Americans who travel abroad by air now and the estimated 25 million who will be traveling by air internationally in 1985, will not all be “jet set pleasure seekers.” Twenty-six percent of those who go to Europe and 50 percent of those who fly the Pacific are traveling on business today, attempting to sell American production abroad and create American jobs. As that time is cut to one-third by supersonic planes, the amount of travel will be encouraged. Business with Europe will then be conducted with the same travel speed with which it can be conducted between Boston and St. Louis and the barriers between people and nations will be lowered yet a little more. As the underdeveloped countries are devel-

oped, the economic differences which threaten world peace will also be reduced as the intercourse of trade expands. Fatigue studies have indicated that the average passenger on a plane recognizes a perceptible deterioration in his comfort after 3 hours on a plane. Who can say that happier intercontinental relationships between America and Europe will not be beneficially impacted by that small fact alone?

But whatever our judgment on the SST, it should be made on the basis of facts and not unprovable claims and suspicions. Those of us who favor the SST have attempted to be diligent with both the facts and the logic which flows from facts. I think the facts are persuasive as to the merits of our position. I recognize valid doubts and feel that these doubts must be answered as the program develops. But none of those doubts is substantial enough to justify abrupt termination of this program now.

I must also concede to a certain emotional bias in favor of improving air travel. The men who gave it its first lift off the ground are from the area of the congressional district I have the honor to represent in Congress. They have done much to lighten the burden of mankind by making it possible for him to spend less time traveling to and fro and more time in productive efforts in the various locations where those efforts are to be undertaken. The contribution is not unlike the discovery of the wheel, the domestication of the horse or the development of the steam engine. But within a week before the Wright brothers flew for the first time at Kitty Hawk, no less an eminent source of fact and logic than the New York Times editorially advised Samuel Langley, one of their competitors, to turn his talents to "more useful employment." I don't know what Samuel Langley did, but I am glad such advice was not pursued by the Wright brothers and I would hope it would not be followed by the Appropriations Committee or the Congress.

(The information submitted by Mr. Clarence Brown follows:)

**STATEMENT BY DR. WILL KELLOGG, CHAIRMAN, WORK GROUP OF CLIMATIC EFFECTS**

I am very much disturbed over recent gross exaggerations and scientific misstatements regarding the SST's potentially harmful effects upon the atmosphere and man's environment. Last August a group of top scientists at the MIT summer study stated that there are indeed environmental uncertainties, caused in no little part by gaps in available information, which require additional research in order that they may be resolved. I pointed out at that time and want to strongly reaffirm that there is no environmental reason however to delay construction of the two prototype U.S. SST's.

It is my profound hope that the U.S. Congress will not be misled by these exaggerations or by scientific misstatements. Dr. Ed David's statement last Sunday which Dr. Walter Roberts and I strongly endorse, says it well: "let's not suppress technological advances but through research, development, and experimentation make sure that those advances are obtained without undesired side effects." I strongly support a vigorous environmental research program in parallel with prototype SST construction. Don't downgrade the ability of American scientists and engineers to apply their genius to the successful resolution of uncertainty.

Dr. Will Kellogg is a widely known atmospheric scientist. He is Associate Director of the National Center for Atmospheric Research in Boulder, Colo. Last August, Dr. Kellogg chaired a working group which examined the SST's possible effects upon the environment, during the summer study of critical environmental problems sponsored by MIT at Williamstown, Mass. Dr. Roberts, referred to in Dr. Kellogg's statement, is Director, National Center for Atmospheric Research.

TRANSCRIBED FROM A RECORDING BY RADIO DIRECTION TELEDIPHONE UNIT

JOHN HOSKEN—CONGRESSMAN BROWN

(Transmission: August 19, 1970)

HOSKEN. Congressman, why did this report concern itself with Concorde at all.

BROWN. Because the question of how many sales of any SST around the world would be made will affect whether or not the American Government will be repaid for whatever investment it might make in the development of an SST to compete with the Concorde.

HOSKEN. They said categorically that the Concorde is going to be a commercial flop; now how much damage can this report do to Concorde.

BROWN. Well I assume that it could damage the acceptance of Concorde in the British and French Governments but my guess is that it will not dissuade them from the development of the Concorde because even on this side of the Atlantic the U.S. airline companies, all of them, have indicated their interest in some kind of supersonic transport plane. Now the issue really is whether or not for us, for the American Congress, whether or not funds from American taxes should be used by the American Government to develop an American plane competitive with the Concorde.

HOSKEN. How much notice is going to be taken of this report in any case in America. I understand that Senator \* \* \* Chairman \* \* \* is \* \* \* had a big bias before he really started and that two members took no part in the report and that you wrote a rebuttal. So what \* \* \*

BROWN. Well, I think Senator \* \* \* views are \* \* \* were there before the hearings were ever held and before the report was ever written. The fact of the matter is the logic and the facts—the facts and report are controversial and the logic is not altogether sound. However, there will be great attention given to the report because while this committee has no legislative jurisdiction it is a prestigious advisory committee with reference to Federal economic investment of tax money. Now my difference simply with the Senator is that I think that a supersonic transport will soon be flying in the world. I feel that the United States should make every effort to see that it is a more efficient American-made SST, that it will solve the environmental problems which the SST has been accused of having. To abandon the field, that is for Americans to abandon the field of foreign competition as Senator \* \* \* report suggests will be an assured economic loss for American taxpayers who have already invested a good deal of money in the study of an American SST and a much greater environmental risk because if the Concorde flies, whatever it does to the environment of the world will certainly also be done to the American environment.

HOSKEN. On Concorde itself, why was no firsthand evidence sought from the Anglo-French technicians. It seems to me to be a very grave loss here.

BROWN. Well I think it should have been, definitely, although I am not sure in view of the fact that this is a highly competitive circumstance that they would have wanted to advise a committee of the American Congress about what progress had been made in—in the development of the Concorde because perhaps they were just \* \* \* to see the Americans abandon their interest in building their own SST.

HOSKEN. But I understand the committee only took evidence on Concorde firsthand from a British journalist; it strikes me as being a rather slap-happy way of coming to such a damning conclusion.

BROWN. I think that's quite correct and I think that if one knows the viewpoint of the British journalist involved one would have to conclude that the testimony was almost assuredly going to be against any SST.

Mr. McFALL. I want to thank you very much, Mr. Brown, for your very concise summary of the arguments in this important matter before the committee.

Are there any questions?

Mr. YATES. I have some.

Mr. McFALL. Mr. Yates.

#### SCARE TACTICS

Mr. YATES. Mr. Brown, what do you mean by a scare tactic? As an opponent of the SST, are you referring to me when you said opponents were guilty of scare tactics?

Mr. BROWN. I think that many of the opponents, Mr. Yates, not necessarily you, not necessarily any individual who is opposed to the SST, have been guilty of using scare tactics. I think the skin cancer argument, the argument that was presented earlier in opposition to the SST that somebody who flew at 65,000 feet would have their blood boil, and that sort of thing is pretty irresponsible, yes, sir, I do.

Mr. YATES. Those are the examples you have in mind?

Mr. BROWN. Those are the examples I gave in my testimony.

Mr. YATES. Is it a scare tactic to raise a question of possible environmental pollution?

Mr. BROWN. Oh, indeed not, and I said that in my testimony.

#### BOAC AND AIR FRANCE COMMENTS ON THE CONCORDE

Mr. YATES. OK. You also said in your testimony on page 4:

"And within the past couple of weeks there was a page 1 story in the Washington press quoting a story in the London Observer to the effect that neither the British Overseas Aircraft Corporation nor Air France felt the Concorde could be operated economically. The next day a story appeared in which BOAC denied the earlier report, but this followup appeared on page 9.

"Such has been the effort to mislead this Congress by those who would see us discard the project \* \* \*"

Now, I have both stories here. You tell me whether the second story is a denial of the first. Here is the story on page 1 in the Post and here is the story that appeared the next day. This is the story that appeared in the Post:

The British Overseas Airways Corporation (BOAC) has told the British Government that BOAC sees no way of operating the Anglo-French supersonic airliner Concorde economically.

The BOAC verdict is bound to affect the Government's imminent decision on the \$2.4 billion project, cancellation of which would cause an industrial crisis in Britain more serious than the collapse of Rolls-Royce earlier this month.

BOAC's finding was known to Frederick Corfield, England's minister of aviation supplies, before he flew to Paris for talks with his French opposite number last Thursday.

In Paris, French transport minister Jean Chamant is believed to have given Corfield the results of a study by the French national airline, Air France, which showed that the French valuation of the Concorde has come out even worse than BOAC's. Both airlines calculate that it will cost twice as much to operate per seat mile as the subsonic Boeing 747.

(BOAC declined to confirm or deny the Observer report officially, but a spokesman said, "All we can say is that BOAC continues to want to operate the Concorde, and in conjunction with the manufacturers and the government we are looking for the best ways of doing so.")

And then it goes into a long dissertation on it.

This is what the so-called denial says. You will note that the statement was that——

BOAC sees no way of operating the Anglo-French supersonic airliner Concorde economically.

The denial said:

The British Overseas Airways Corporation yesterday denied weekend press reports that it had told the government it did not want to buy the Concorde supersonic airliner because it could not afford to use it.

There is nothing in this article, the first article, that said that the BOAC did not want to buy the airliner. All the first article said was

that the costs of operating the Concorde were roughly 100 percent higher than operating the 747. There is nothing in this denial to negate that report.

Mr. BROWN. If you will read the line again, Mr. Yates, I think you have answered yourself.

Mr. YATES. All right. It says:

\* \* \* denied weekend press reports that it had told the government it did not want to buy the Concorde supersonic airliner because it could not afford to use it.

The next paragraph repeats the earlier statement:

We continue to want to buy and fly the Concorde \* \* \* and we are looking for the best ways of doing so.

There is no denial in this article of the contention of BOAC that the costs of operating the Concorde would be twice as much as operating the 747. There is no denial in that article of that fact.

#### ECONOMICS OF THE CONCORDE

Mr. BROWN. Mr. Yates, I am not in a position to suggest whether or not the price will be double the 747 or somewhat more, or just what modification you want to put on that. Let me read to you, if I may, from a brochure on the Concorde given me just the other day by a Member of the British Parliament in which the economics of the Concorde are discussed. Apparently this article would indicate that the assumption all along has been that the Concorde would be a premium priced method of transportation by comparison to the 747. Now, I want to go on and say that that does not necessarily speak to the circumstances with reference to an American SST. But to quote from this brochure:

Nevertheless, if Concorde were operated alongside the subsonic airlines at the same level of fares it would make a substantial operating profit. The magnetic appeal of halved flight times would guarantee Concorde extremely high load factors probably near 100 percent, that would more than offset the higher operating costs. This favorable Concorde result would, however, be obtained at the expense of the subsonic aircraft in which the carriers have made a very large capital investment. Airlines will, therefore, plan supersonic services as part of an integrated fleet operation. Passenger traffic by air is at present classified on the basis of cabinet amenity standards. First class passengers pay the considerable fare premium of 30 to 80 percent over the economic fare for a little more leg and elbow room and rather better catering, but in terms of speed, the commodity that civil aviation is really in business to sell, they gain no advantage over economy class passengers. The front end of the cabin arrives at the same time as the rear.

Once the Concorde enters service there will be a new situation and new opportunities. There will be two different but complementary types of aircraft for long-haul passenger services and it will be possible to classify air traffic by the more rational yardstick of speed. Concorde travel as a superior product will command a higher fare price. For the first time a premium on the fare will get the passenger to his destination quicker, in fact in half the time.

That apparently is one of the basic assumptions involved in the Concorde. It is not, I think, necessarily a basic assumption with reference to the American SST, because the American SST is both faster and will carry a larger payload.

Mr. YATES. How does this last response of yours relate to the point that made in stating, and repeating, an undenied statement by a BOAC official who said that the operating costs for the Concorde would be twice as much the the 747?

Mr. BROWN. Well, it indicates the assumption I think, Mr. Yates—I don't want to read it again—that there would be higher operating costs for the Concorde than for the 747.

Mr. YATES. All right, we agree then.

Mr. BROWN. And the assumption that there might be a premium fare on the Concorde. That does not necessarily relate, let me repeat, to the American SST, which would be larger in terms of payload—125 on the Concorde to 298 on the American SST—or to the speed factor, which would be 1,800 miles per hour versus 1,400 miles per hour on the Concorde.

On that basis it would occur to me that the American SST will be more economical to operate than the British-French Concorde or the Russian TU-144, which has essentially the same characteristics and configuration as the Concorde.

Mr. YATES. That may very well be but that did not relate to the question of the Concorde vis-a-vis the 747, did it?

Mr. BROWN. Yes, I think it did.

Mr. BROWN. I trusted it did.

Mr. YATES. I thought you were making the point that the SST will be more economical than the Concorde.

Mr. BROWN. Precisely I was. I don't want somebody to read my response with reference to the Concorde as a reference to an American SST as it would relate to the 747.

Mr. YATES. Oh, no, that wasn't in my mind at all.

Mr. BROWN. All right.

Mr. YATES. All I was trying to do was to limit my questioning to the point that you make in your statement that there had been an effort to mislead the Congress by pointing out what appeared in the first article and not pointing out what appeared in the second article. The point I am making is the second article does not deny what the first article said.

Mr. BROWN. I would still characterize it is an effort to mislead the Congress on whether or not the Concorde will be purchased by BOAC and whether or not an American SST will be an economic product to operate:

#### COST OVERRUNS

Mr. YATES. OK. Your statement indicated the historical subsidization of transportation by this Government of various forms. Would you favor the SST program if there were as much an overrun of the SST as there was of the C-5A?

Mr. BROWN. Can you tell me how much the overrun on the C-5A was, sir?

Mr. YATES. To the best of the knowledge that Congress has received, the overrun was in excess of \$1 billion.

Mr. BROWN. On the basis of what initial investment?

Mr. YATES. On the basis of the contract investment that had been entered by and between the Government.

Mr. BROWN. How much? Do you know the percentage? Could you give me a percentage, please?

Mr. YATES. What difference does it make?

Mr. BROWN. Well, you have made an assumption and asked me to make a judgment on the basis of the assumption. I would like to know what the assumption is if I could find out.

Mr. YATES. Are you not willing to accept the fact that there were overruns on the C-5A?

Mr. BROWN. Yes, sir, but don't you think that a valid response to your question would relate to how much the overrun might be? In other words, if the item is 1 percent more costly than estimated I might be very much for it. If it is 300 percent more costly I might be very much against it. If you will give me the basis of the assumption I will be glad to answer your question.

Mr. YATES. Suppose there were an overrun of 100 percent on the SST. Would you favor going ahead with the program, nevertheless?

Mr. BROWN. It would certainly raise serious questions in my mind. I don't assume at this point that the overrun will be 100 percent.

Mr. YATES. Would you favor it if it were 50 percent?

Mr. BROWN. No, sir; I don't think the overrun will be any place close to that, if there is an overrun at all.

Mr. YATES. Are we talking about an overrun—yes, it is my question.

Mr. BROWN. Yes, sir, it is your question.

Mr. YATES. We are talking so far the prototype program has produced an overrun of \$76 million, presumably as a result of the action by the Congress and the Bureau of the Budget last year in cutting back on the money that had been requested for the program, but don't you agree that it has been the history of development airplanes, by the military certainly at least—I am not aware what it was in the civil field—in the military, hasn't almost every development program for an airplane recently produced substantial overruns?

Mr. BROWN. I don't know whether that is true or not. No, sir. Let me just say that should there be an overrun, the commitment of the Federal Government drops from 90 percent to 75 percent, as I am sure you are aware. After the breaking point, we go from a 90-10 contract arrangement to a 75-25 contract arrangement; and presumably industry would be as interested or relatively interested in whether or not there is an overrun on the SST—more interested in whether or not there is an overrun on the SST—than they might be in a military contract wherein the Federal Government bears the total cost of the development.

#### GOVERNMENT FINANCING AFTER PROTOTYPE CONSTRUCTION

Mr. YATES. Mr. Brown, would you favor Government financing of the program after construction of the prototype?

Mr. BROWN. Well, I think that is an invalid question at this point. We are talking about the development of the prototypes, and I indicated in my statement that what I would like to do is see the prototypes finished so that we can evaluate the environmental concerns and other factors involved.

Mr. YATES. Is that the extent of your interest in the program at this time? You want to see the prototypes finished?

Mr. BROWN. Yes, sir. That is the only question at issue, is it not?

Mr. YATES. No; I think there is much more than that at issue here. I think there is an issue as to whether or not we go ahead with the

program according to the testimony that has come before us; whether we go ahead with a program that will produce 150,000 jobs, according to the testimony of Mr. Magruder; whether we go ahead with a program that he says will produce a balance of payments of \$22 billion; whether we go ahead with a program that will maintain America first in the aerospace industry throughout the world, according to Mr. Magruder; and that is not implicit necessarily in the construction of the two prototypes.

Mr. BROWN. No, but the reverse of that is that if you stop now you have killed the program off; and it is going to be too late for you to get back in at some extended future date because the market will be gone. So really what I am suggesting is that \$340 million that it will apparently require to complete this program is a pretty gosh awful good gamble compared to the prospect of losing \$22 billion in balance-of-payments benefits, \$1 billion return on the Federal investment plus the initial investment of \$1.3 billion, plus the tax advantage of \$6.5 billion, plus those 14,000 to 40,000 jobs in the prototype phase, plus the 50,000 to 150,000 jobs in the production phase.

That is what is at stake. And, quite frankly, just on the basis of the environmental concerns, I would finish the prototype program, because if you are going to tell the other nations of the world who have SST's that they cannot land them here because they are dangerous, I would assume that responsibility in the world would require us to say to them, "You should not fly them." And if we are going to say that, I would like to see us well grounded in scientific fact that can be developed from the development of the prototype airplane.

Mr. YATES. You are aware of the testimony of Mr. Ruckelshaus to the effect that completion of the prototypes was not necessary to receive that scientific information?

Mr. BROWN. I think that the thrust of the testimony which I have read from Mr. Ruckelshaus and others is that there will be benefits derived from the experimental flying of the prototypes which will contribute information as to whether or not there will be environmental danger from the flying of a fleet of SST's.

Mr. YATES. Well, it was my understanding of the testimony of Mr. Ruckelshaus and of Mr. Greenfield, his assistant, that they didn't have to fly the prototypes in order to obtain information about possible pollution of the stratosphere. The only question, they said, was an economic one. They said it wasn't necessary, in their judgment, for obtaining that information.

Mr. BROWN. You had the information of his full testimony and whatever questions and answers the committee had. As I understand his testimony, it was that there was no environmental danger from the completion of the prototypes and that the question hinged on a matter of economics.

Mr. YATES. That is what he said. He said that, and that there was no need to finish the prototypes in order to obtain the information that was needed.

Thank you, Mr. Chairman.

Mr. McFALL. Mr. Conte.

## SUPERSONIC FLIGHTS OVERLAND

Mr. CONTE. The only point I want to make, and I made it yesterday with Dr. McDonald regarding unidentified flying objects which he felt caused the brownout on the east coast, is this. I had to weigh all of his testimony in view of that. Now you come up with a doozy here on page 12, and I mean a doozy, that you are not worried about supersonic airplanes flying supersonically over land areas; you say they have been doing it for years all around the world.

That could be your opinion, but I don't want any part of it.

Mr. BROWN. I have indicated to you that I don't want any part of it either, and I have said I would be glad to support—

Mr. CONTE. Just a minute. When I am through you can talk as long as you want. I have seen supersonic planes fly over our area in Massachusetts, military planes. I have seen hundreds of thousands of chickens run into the corner and suffocate. I have seen what it has done to livestock and everything else. I don't want any part of it. I quote from your testimony :

\*\*\* I shall be happy to join them even though I feel it is unnecessary. The fact is that American military aircraft have been flying supersonically over various populated parts of the world for years, and the number and degree of damage objections have been minimal.

Mr. BROWN. Yes, sir.

Mr. CONTE. This is all I have to say.

Mr. BROWN. May I comment on your last comment?

Mr. CONTE. Yes.

Mr. BROWN. You read from a sentence which began—

Such regulations have the force of law—

That is, the Federal Aviation Administration regulations—

but should anyone in or out of Congress feel the need to enact permanent legislation to reemphasize such a regulation, I shall be happy to join them even though I feel it is unnecessary.

“I feel it is unnecessary” relates to the question of Federal Aviation Administration regulation which I think has the force of law and does not require congressional legislation.

Mr. CONTE. Well, that may be so, Mr. Brown, but that sentence that you have there scares the daylight out of me and I am going to read it again in toto:

The fact is that American military aircraft have been flying supersonically over various populated parts of the world for years and the number and degree of damage objections have been minimal.

I think that they have been a nuisance and I have received a lot of complaints from my people. I don't like them. I don't like to hear a supersonic boom when I am out there trout fishing or I am out there walking around in the forest, and what I tell you about the chickens is absolutely true. I have seen them. I have seen chickens when you have a supersonic boom just rush into a corner and also suffocate. We have lost thousands of chicks because of the noise. I don't want to endorse it in the least.

Mr. BROWN. I don't think we have any difference of opinion, Mr. Conte.

Mr. CONTE. OK.

Mr. BROWN. To the extent that I think the Federal Aviation Administration regulation which has been enunciated, which would prohibit supersonic flight over land areas in this country, and that is the only thing we can control, has the force of law and therefore would make unnecessary a congressional-passed law on this subject. However, if there are those in the Congress or outside who feel that such is necessary, that a congressional law has to be passed, then I will be happy to support that.

Mr. CONTE. I agree with you. I am not disputing that, but you just volunteered a little too much with the next sentence. Then you said:

The fact is that American military aircraft have been flying supersonically over various populated parts of the world for years and the number and degree of damage objections have been minimal.

I have no further questions.

Mr. McFALL. Any further questions down here?

Mr. MINSHALL. Mr. Chairman, I would like to welcome our colleague from the great State of Ohio to this hearing room. He certainly has comported himself with distinction, and to put it very succinctly: I don't know how you got so smart so quick, but you have become very knowledgeable about this program. It just shows that your genes were very good to you, that you inherited a lot of the brainpower of your good father.

Mr. BROWN. Thank you very much.

Mr. MINSHALL. I am glad to have you here and we certainly will weigh your testimony very carefully and give it every consideration. Thank you very much.

Mr. McFALL. Mr. Edwards?

Mr. EDWARDS. Thank you, Mr. Chairman. I just walked in and I am sorry I missed the gentleman's testimony but I shall read it with great interest and look forward to the information it contains.

#### COMMENT BY PRESIDENT OF CONTINENTAL AIRLINES ON THE CONCORDE

Mr. YATES. Mr. Chairman, may I just have the chairman's patience for one thing further? There is an excerpt from the testimony of Mr. Robert Six, who is the president of the Continental Airlines, before the Senate Commerce Committee on February 3 in response to a question from Senator Inouye. Senator Inouye asked this question:

It is possible by an act of Congress we will not be able to manufacture an SST, but we notice the British, the French, and the Russians are proceeding. If any of the Big Four decides to carry out their options and purchase the British and French job would the airline industry be forced to purchase?

Mr. Six made this reply:

We all have optioned on the Concorde. That is the French one; I know of no options on the Russian aircraft. The Concorde, Continental was very early in that. We hope in 1973 to have delivery of the Concorde. Technically, in my opinion, the Concorde is a good airplane. I think the economics of it are poor at the present time. It escalated in price from \$13 million to a price unknown today, somewhere between \$20 and \$25 or even more millions.

The economics are poor. Based upon present requirements, you can fly over water in the case of Continental. It would cut the time about in half but you would have to have in the Concorde roughly 120 passengers on all first-class superfare and I don't think we have that kind of a market in the Hawaiian market to stand that kind of a fare structure. So, to answer your question, if they exercise, it depends on how many they exercise and where they are going to

fly them as to whether or not we have to have the Concorde. I consider the American SST a good airplane. I think the biggest problem, contrary to what has been testified to, is the noise situation. It is poor. I think by the time we are talking about, delivery in 1978 or 1980, whatever it may be and I don't think there is a rush for it, we can probably overcome the sonic boom problem, that is the only problem I can see on the big SST—sonic boom, we must lick that problem.

The only point I make in reading that is Mr. Six agrees that the economics of the Concorde are very poor, so he is in agreement with BOAC.

Mr. BROWN. Mr. Chairman, I would like to repeat again that the economics of the American SST are, I think, vastly superior to the economics of the Concorde. I think the people who are developing the Concorde would concede that a plane that does not fly as fast and carries something less than half the payload would not have as good economics as an American SST. It is an aluminum plane. Ours is a titanium plane.

You asked about cost overruns. I think there is a prospect, as I indicated in my testimony, that some of those cost overruns that might have come from initial development of titanium technology have already been absorbed by this Government of ours in the development of other supersonic military airplanes, so I don't think that there is a comparable indication or there is no comparable indication of any cost overruns in the completion of a commercial SST in the United States.

Mr. YATES. Well, I hope you are right. Thank you very much for your statement.

Mr. BROWN. Thank you.

Mr. McFALL. Thank you very much, Mr. Brown.

Mr. BROWN. Thank you, Mr. Chairman.

#### STATEMENT OF FLOYD E. SMITH

Mr. McFALL. We are happy to have Mr. Floyd E. Smith, president of the International Association of Machinists and Aerospace Workers. We will be glad to have your testimony at this time, Mr. Smith.

Mr. SMITH. Well, Mr. Chairman and members of the subcommittee, since I previously submitted a fairly long statement for the record, I would like to use this time to briefly summarize the points I made in that statement. Then if you desire, I can answer questions.

(Mr. Smith's prepared statement follows:)

**Testimony by Floyd E. Smith**

**International President**

**International Association of Machinists  
and Aerospace Workers**

**Before the House Subcommittee of the  
Committee on Appropriations**

**Washington, D. C.**

**March 3, 1971**

**Mr. Chairman and members of the subcommittee:**

**My name is Floyd E. Smith. I am appearing before this subcommittee both as President of the International Association of Machinists and Aerospace Workers and as a Vice President and member of the Executive Council of the AFL-CIO. I am here specifically to urge you to approve an appropriation sufficient to complete the development of the two prototypes of the supersonic transport that are being built by the Boeing Corporation in Seattle, Washington. It is relevant to note that the union I represent is the largest organization of aerospace workers in the world. A sizable proportion of our membership depends on employment in this industry. This means we have a direct stake in the development of the SST -- in terms of the employment opportunities it will create for our members. But we believe that the nation also has a stake -- in terms of its long range impact on the economy as a whole. For many years aerospace has been America's largest direct employer of manufacturing workers. It has also been one of its primary exporters of manufactured goods.**

During the course of these hearings you will be presented with a wide range of testimony. You will hear many conflicting statements as to ecological probabilities and much argument on questions of national priorities. Since others will be thoroughly covering such aspects I believe I can best use my own -- and the committee's -- time by concentrating on the specific phase of the overall issue with which I am most directly acquainted. And that is, of course, the relationship between present development and future production of the SST and present and future employment opportunities in America's aerospace industry. As an overall frame of reference for my remarks let me note that unemployment -- which is both sizable and growing -- is one of the nation's most critical concerns. The President candidly acknowledged this in his televised conversation with members of the press on January 4. According to latest figures released by the Bureau of Labor Statistics 5.4 million people were unemployed in January, 1971. This is the largest number of jobless workers in ten years.

While the unemployment rate is 6% for the nation as a whole it is -- and for some time has been -- much higher than that for the nation's centers of aerospace production. Rates of joblessness range from 7.2% to 8.9% in Southern California and have reached a staggering total of 10.9% in Seattle.

In Southern California aerospace employment hit a peak of 616,000 in 1967. It has been falling steadily and is expected to reach an annual average of around 450,000 this year.

In Seattle, Boeing alone has laid off 60,000 of the 101,500 employees who were on its payroll only two years ago. And the end is not yet in

sight. Total employment at Boeing is expected to sink to 32,500 within the next 9 months. If the SST prototype development is not funded it will drop even more drastically.

During the last 18 months alone, aerospace employment dropped from 1,345,000 to 1,044,000 -- or 22%. This decrease has not been limited to skilled production workers -- although their numbers have declined 27½%. It includes technicians, scientists and engineers who have normally been immune to deep layoffs when specific aerospace companies have trimmed their work force in the past.

This time the recession in the aerospace industry is so deep and future prospects are so dismal that 18.3% of the technicians and 12.9% of the scientists and engineers have been laid off. And let me repeat and stress that these particular declines have all taken place in the last 18 months. The overall decrease since the peak of 1967 has been even more drastic.

As a result the nation's aerospace cities -- which include population centers containing millions of people -- have become economic disaster areas. To use a familiar image, when aerospace sneezes the overall economy in the nation's major centers of aerospace production catches cold. In Seattle, for example, business has fallen to depths comparable to the great depression of the 1930's. Sales of new and used cars are off from 30% to 50%. More than a dozen dealers have already gone under. Apartment vacancies are running as high as 40% in some suburbs. Thousands of people have lost their homes as well as the equity they had been building for many years. Hundreds of small business men -- restaurateurs, shopkeepers and service people -- have either gone under or are on the ropes.

As business and employment opportunities decline the revenues of local governments also decline. This means curtailment of expenditures for education, health, social and other essential services. Obviously it is a sad paradox that such services must be curtailed at a time when they are most needed.

For every child who was eligible for free school lunches two years ago, fifty are eligible today. With 71,500 people out of work 66,000 are on welfare and 72,000 are drawing food stamps.

Some of our friends in the Senate have suggested that since so many of these hundreds of thousands of unemployed aerospace workers are highly skilled they can be absorbed into the economy in other areas and/or other industries. Some Senators were apparently impressed by an article by Professor Leontief of Harvard University which was inserted in the Congressional Record in which he stated that SST development will absorb "several hundred thousand years of skilled labor ... at a time when the shortage of such resources compels us to forego badly needed improvements in public health care, education, housing and mass transportation."

Mr. Chairman, I can affirm that we are talking about good, skilled, conscientious workers. They want work. They do not want hand outs. But where is this shortage of labor that this professor and some of our friends in the Senate refer to? I agree that the nation needs to develop new employment opportunities in solving national problems in health, education, housing and mass transit. I will go the good professor one better and suggest we also need to create jobs in pollution control. But such jobs do not exist. They are still waiting

to be created. And it will take time -- much more time than the average aerospace worker can wait -- not only to set up jobs of this kind but to recruit and train workers for them. When we are talking about funding the continued development of the SST prototypes we are talking about what we can do here and now and not sometime in the far off future. Members of the Machinists Union are concerned with immediate practicalities and not with the idealistic economic theories of college professors.

If I appear to feel strongly about the urgent need for the appropriation this subcommittee is now considering it is because behind all these statistics and numbers and figures that I have been citing are people. When we discuss large total numbers -- like 300,000 unemployed aerospace workers -- we tend to obscure the fact that each one of these 300,000 statistics is a human being with a name and identity. Most have families, with children to support and obligations to meet. Many have worked in aerospace for 10, 15 and 20 years. They are the kind of good solid people who are the backbone of this nation. But now, many are in their forties and fifties and no one wants them. Mr. Chairman, I know these people. I've been to their homes. I've seen the way of life they've tried to build for their families. It's a good way of life. But now, because of conditions beyond their control, many of these people are losing everything they've worked for through the years -- including their pension rights.

We have suffered through declines in aerospace production before. Aerospace workers have become inured to periods of boom and bust. Time after time they've been caught in contract cancellations and project phase outs. But never before has the bottom fallen out of the entire

industry so completely and so quickly. It may be hard to visualize 300,000 statistics as 300,000 individual identities. But when we realize that there are only 535 Representatives and Senators in the Congress we begin to see the enormity of the disaster that has struck the aerospace industry. It may be easy and comforting for some Congressmen and Senators to ignore the pain these people are suffering by pretending that they can find jobs outside of aerospace. If these Senators and Congressmen will only show me the jobs I will be happy to show them the workers who are available.

Although nothing dramatizes the plight of the aerospace work force more vividly than a personal visit to places like Seattle or San Diego the economic damage has not been limited to such areas. It is being felt throughout the country. Aerospace workers have not only been laid off in Washington and California but in New York, Florida, Connecticut, Missouri, Georgia, Kansas and Texas. Moreover, the thousands of small and medium sized firms that depend on subcontracts from the major producers are even more widely spread.

Admittedly, mere funding of the final development of the two SST prototypes will not resurrect the aerospace industry. At this point such funding will only provide 14,000 jobs directly. But this is a start. And it will have a healthy ripple effect. Just as layoffs in aerospace set off a chain reaction of unemployment in supporting industries -- causing machinists, lathe operators, tool and die makers, electricians, engineers and others to lose their jobs in a wide range of subcontracting companies -- hiring in aerospace generates new jobs in electronics, basic metals, machine shops and other supplying firms.

I am told that the program being discussed here -- which is only the prototype phase -- will generate some 42,000 jobs. Personally, I think this is a pretty conservative estimate. Because of the ripple effect 42,000 direct and indirect jobs are only a fraction of the total employment that will be created.

There can no longer be any reasonable doubt that the SST is the plane of the future -- if not of the 1970's then certainly of the 1980's and 1990's. There can also be no doubt that this plane will be built. The Soviet TU-144 has already flown supersonically. The French and British Concorde have already had almost 400 hours of flight testing, including 90 hours of supersonic flight. Obviously, if the French, British and Russians can build SST's we can also build them. And based on past performance I am confident that we can build them better.

As soon as we get by the testing of the prototypes and into production American-built supersonic transports will provide direct employment for at least 50,000 workers. And again, the ripple effect will create at least 100,000 more jobs in supporting industries. These industries and jobs will not be concentrated in a few areas. They will involve thousands of firms in virtually every state. They will provide not less than 120,000 jobs from 1974 through 1986 and substantial employment well into the 1990's.

In urging development of these two prototypes we are fighting for the future life of the American aerospace industry. We believe the SST is the key to continued U. S. technological superiority in this industry. If we tramp the brakes down on our SST development at this point other nations will not only shoot rapidly ahead in aerospace technology but

will inevitably take over world markets we have long dominated. Even more important, however, if we lose this industry we will lose the research, development and production team that is necessary to our military strength.

America has already lost too many of its industries because of national policies that encourage the export of jobs. At one time we were the leading shipbuilding nation in the world. Today our once proud shipbuilding industry has been reduced to that of a fourth-rate power. Moreover, in the last decade many other important industries have succumbed to floods of foreign imports. It's becoming increasingly difficult to buy a U. S.-made television, radio, typewriter, calculator or many other kinds of goods.

Having taken over so many of our other industries, foreign producers will only be too happy to take over our markets in aerospace as well. And there can be no other outcome if Congress now permits the SST to die by default.

The question before this Subcommittee and eventually the whole Congress is whether the people of the U. S. will be better off with -- or without -- an American produced SST. To me the answer is self-evident. If we do not build an American SST we will:

... Eliminate 50,000 jobs directly, and at least 100,000 jobs indirectly.

... Reduce the nation's tax sources and add to its welfare and unemployment compensation rolls.

... Allow a technological gap that will reduce our ability to create more jobs, and better jobs, for our citizens in the decades ahead.

... Adversely affect our balance of trade by \$22 billion by having no SST to sell to foreign carriers as well as by forcing our air lines to buy foreign produced SST's in order to stay competitive.

In conclusion let me note that there is no group in America more concerned with the total welfare of the nation than the AFL-CIO. The Executive Council of the AFL-CIO is especially concerned with the danger of pollution or ecological damage from any source. However, the Executive Council notes and I quote "No environmental harm can come from the production of two prototypes. Two government councils have stated that on the basis of knowledge available today ... there is no reason to believe that a fleet of supersonic air liners will degrade the atmosphere."

Accordingly, the AFL-CIO Executive Council is strongly urging Congress to vote funds for the development of an American SST. As the Council has also said, "The age of supersonic travel over water will soon be here. The U. S. cannot afford to be left in the lurch."

Mr. SMITH. I am here because the union I represent, the Machinists Union, is the largest organization of aerospace workers in the world. This means we have a direct stake in the jobs that the SST will provide. But more important than our interest is the Nation's interest, and for the reasons that I will specify, we are convinced that the development of the SST is very much in the Nation's interest.

For many years aerospace has provided more direct jobs in manufacturing than any other industry. It has also been one of America's primary sources of dollars earned from sales of manufactured goods overseas. Aerospace, both directly and indirectly, provides employment in thousands of factories and in hundreds of communities throughout the United States. Just as aerospace is important to the future of the economy, the SST is important to the future of aerospace.

Make no mistake; the SST is the plane of the future, if not of the 1970's, then certainly of the 1980's and beyond. The supersonic transport plane will be produced and flown, if not by us, then certainly by other countries. If we are not prepared to produce the plane of the future, the American aerospace industry will have no future.

The SST has aroused a lot of opposition among conservationists, and those who would sacrifice it on the altar of reordered priorities. Since other witnesses will deal with these issues, I will limit my remarks to the area with which I am most familiar, and that of course is its impact on employment.

As we all know, our economy is in a deep recession. Despite the administration's efforts to reverse this decline, unemployment has reached an overall average of 6 percent. Of all the industries in America, none has been hit harder than aerospace. This is by far the most depressed sector of our total economy.

Aerospace workers have become the walking-wounded in the battle of the budget. Rates of joblessness range from 7½ percent in Connecticut to almost 9 percent in certain localities in southern California, and almost 11 percent in the Seattle area.

#### AEROSPACE EMPLOYMENT

During the last 18 months alone, aerospace employment has dropped by 22 percent, or 300,000 people. The cuts have not been limited to machinists and production workers. Engineers, scientists, and highly trained technicians have been displaced in large numbers.

The Nation's aerospace centers have become disaster areas. In Seattle, for example, 77,500 people are unemployed, 66,000 are on welfare, more than 72,000 are drawing food stamps. For every child who was receiving a free school lunch 2 years ago, 50 are getting them today.

Mr. Chairman, I know these people. I have been in their homes. They are good, skilled, hardworking people, the backbone of America. They do not want welfare and food stamps. They want jobs.

Some SST opponents claim that America cannot afford to waste their skills in SST development because it needs them to help meet the Nation's deficiencies in education, health, pollution control, mass transit, and the like. I wholeheartedly agree that America needs to make greater efforts in all these areas.

Mr. Chairman, I want to know and the aerospace workers want to know, where are these jobs? If anyone can show me these jobs, I can

direct them to a ready supply of skilled, able, and eager workers. Seattle may be worse than other areas, but it is not unique. Similar conditions can be found in aerospace centers from coast to coast.

Three hundred thousand workers are a lot of people. It is hard to translate 300,000 faceless statistics into 300,000 individual human beings with names and families and children to support. But when we realize there are only 535 Representatives and Senators in Congress, we begin to see the enormity of the disaster that has struck the aerospace industry.

We have had declines in aerospace before. Aerospace workers are used to being laid off. They are used to going from company to company, from State to State, in search of jobs. But we have never approached such depths of total industrywide depression before.

#### IMPACT OF PROTOTYPE PROGRAM ON EMPLOYMENT

Continued development of the two SST prototypes, which is the issue here, will not restore the aerospace industry to economic health. In fact, the immediate impact will be quite small. The appropriation we are seeking will provide for 14,000 direct and 28,000 indirect jobs, a drop in the bucket compared to the vast pool of aerospace unemployed, but it is important because it sets our course in the right direction. It will tell the aerospace industry that it does have a future.

As I have noted, SST's are going to be produced and sold. In the past we built and sold more planes than any other nation, because we built them better and we sold them cheaper. What we have done in the past, we can also do in the future.

Right now we are behind in the race. We have forfeited the markets of the first generation SST's, those that will be flown in the late 1970's. But we can still come through with the second generation, the planes of the 1980's and beyond.

Once we get past prototype development and into actual production, the relatively small investment we are asking Congress to make will pay off in 50,000 direct and 100,000 indirect jobs in aerospace supporting industries. These jobs will not be limited to a few localities, but will be located in most of the States. The long-range benefit to these communities and the Nation is beyond calculation.

We know what the current downturn has done to family incomes, business profits, and Government revenues in the aerospace industry. We also know the difference that an upswing will make.

Mr. Chairman, let me make just one more point. We cannot permit one industry after another to wither away because of lack of national concern. Once we were the greatest shipbuilders in the world. Today our shipbuilding industry trails that of 10 other nations. Once, not too long ago, we were the dominant producer of electronic goods in the world. Today, it is difficult to find an American-made radio, TV, typewriter, calculator, or many other electronic items.

When we lose industries such as these, we not only lose jobs, we also lose the sophisticated technology that we need to stay strong as a Nation. We cannot afford to lose our aerospace industry. If we do, we will disperse the research, development, and production teams that are necessary to our national defense.

## SUMMARY OF EMPLOYMENT IMPACT OF THE SST

To sum it up, Mr. Chairman, this committee and eventually this Congress must decide whether saving the relatively small investment now needed to carry forth the development of the two SST prototypes is worth; (1) eliminating 42,000 jobs now and 150,000 jobs in the future, (2) reducing the Nation's tax resources while adding to its welfare and unemployment compensation rolls, (3) allowing a technological gap that will reduce our ability to create more jobs in the decades ahead, (4) adversely affecting our balance of trade by \$22 billion, by having no SST to sell to foreign carriers, as well as forcing our airlines to buy foreign-produced SST's, (5) breaking up the research, development, and production teams we need for our defense.

As the AFL-CIO executive council has said, the age of supersonic travel will soon be here, and the United States cannot afford to be left in the lurch.

Thank you.

Mr. McFALL. Thank you, Mr. Smith.

It has been contended, I believe, that if we do not produce the SST, we will produce a greater number of subsonic aircraft and, therefore, the impact of the SST on the aerospace industry is not as significant as you have indicated.

Will you comment on this?

Mr. SMITH. Mr. Chairman, the country that produces the lead aircraft—the lead aircraft would be the SST—will also produce the non-supersonic airplanes. If foreign competition alone produces the SST, they will take over the family of airplanes. This will reduce the numbers of airplanes that will be produced here, even if they are nonsupersonic aircraft.

The 150,000 jobs could be multiplied many times, because each one is dependent upon the other.

## OTHER EMPLOYMENT FOR AEROSPACE WORKERS

Mr. McFALL. With reference to unemployment in the aerospace industry, are any efforts being made to find other work for aerospace employees at the present time?

Mr. SMITH. Yes, Mr. Chairman. The airframe industry and the unions are doing everything we can to find jobs.

One of the problems is that a person in Seattle has no way of knowing where there is a job available in any other part of the country, because the unemployment office there does not advertise jobs available anywhere else.

One of the things we want to remember is that in the past when curtailment of work took place in one airframe plant, another of them would be ready to start a new project, and they knew where to go to get the experienced people. As they were being laid off out of Boeing, they went to Lockheed, General Dynamics, or wherever it might be.

Mr. McFALL. Are aerospace employees handicapped in finding work in other industries?

Mr. SMITH. Yes, sir. The best example is an item that I believe was in the Wall Street Journal. In Houston, Tex., a company ad said no aerospace people need to apply, because they are overqualified for the type of jobs necessary in that type of industry.

#### LABOR ORGANIZATION SUPPORTING THE SST

Mr. McFALL. Are there any other labor organizations supporting the SST, to your knowledge?

Mr. SMITH. Yes. All of the international unions and national unions affiliated with the AFL-CIO, with the exception of the oil-chemical workers and the National Maritime Union, and perhaps the United Auto Workers, although they have not made a statement. All other international unions and national unions are in support of the SST, because jobs are created in many fields—in construction, in component parts, in many fields. It would take too long to name the jobs the prototype SST would create.

Mr. McFALL. Thank you.

Any questions on this side?

Mr. YATES. I would like to say you have made a very good statement, Mr. Smith. I am sorry I find myself on the opposite side. I have been good friends with Roy Siemiller and all the members of your union for many years. I know how important this is to you. I really do.

I am persuaded however. I have to be on the other side. You did present a very good statement.

Mr. SMITH. Thank you.

Mr. CONTE. I want to compliment the gentleman for an outstanding statement in his presentation here today.

Mr. McFALL. Thank you, Mr. Smith.

Mr. SMITH. Thank you.

Mr. McFALL. We shall now go back to Mr. Magruder and the Department of Transportation.

Dr. Singer, Dr. Kellogg, and Dr. Beranek will also testify.

I thought we would have their statements given, and then we could cross-examine them as well as Mr. Magruder.

Dr. Singer, if you are ready.

#### ADVISORY COMMITTEE ON ENVIRONMENT

Mr. MAGRUDER. With your permission, may I introduce these environmental experts.

By way of introduction, I would like to start out by using one or two charts, just to show the content of the environmental committee.

There has been some confusion in the past about the composition of the Advisory Committees on Environment (fig. 25, p. 273) and Noise. Do they constitute Government employees or are they people from outside? Do they have selfish interests or are they truly unbiased people?

When I came on board in April and all of these very serious concerns were brought, at least for the first time, to my attention—with all due respect to Congressman Conte, I have taken to heart your very serious concerns about acting with haste and deliberation on all the questions that have been raised with regard to the environment, I sought a committee that would act, with people who have the expertise

in and out of the Government. A great deal of scientific attention and research have been done by qualified people within the Government. I did not want to eliminate that.

At the same time, I realized that people who might be opposed to the program would feel that, if it were solely isolated to experts within the Government, it might not be considered an unbiased group of individuals.

Within the Government I have asked Dr. Singer to Chair the SST Environmental Advisory Committee. Dr. Singer has had considerable professional interest in the field of environment both through Government and university service. He was the first Director of the National Environmental Satellite Center which is now called the National Oceanographic and Atmospheric Agency. Dr. Singer was also dean of the School of Environmental Sciences at the University of Miami. He is now Deputy Assistant Secretary for Scientific Affairs, Department of the Interior.

His scientific interests include atmospheric physics, space physics, and oceanography. He has authored and edited a recent book entitled "Global Effects of Environmental Pollution." He is currently chairman of the American Geophysical Union's Committee on Environmental Quality.

You will notice that besides Dr. Fred Singer, who I consider my chairman or adviser on SST environmental concerns, the chart lists many people such as Dr. Tribus and Dr. Kellogg, people within and outside of the Government, whose collective expertise covers all areas of environmental concern.

As the next chart shows (fig. 26, p. 273) I also went to the Commerce Department for help because the Commerce Department has an organization called CTAB, Commerce Department Technical Advisory Board. None of these people work for the Government or receive remuneration from the Government for this work. They are top people from all over the United States.

I asked the Commerce Department to put together a committee that would have experts completely outside the Government to advise on these environmental concerns. So, I think I have taken into account the worry that within the Government there might be bias or a feeling of nonobjectivity and, at the same time, I have not eliminated any of the expertise made available by many years of work and millions of dollars of research within Government.

Both committees act in an advisory capacity to my office through Dr. Fred Singer.

#### ADVISORY COMMITTEE ON NOISE

In addition to environment, a major concern was noise. In my experience, being an aviation man most of my life, probably the most outstanding expert in the area of noise is Dr. Leo Beranek, the director and Chief Scientist, of Bolt, Beranek and Newman, Inc. He is a member of the National Academy of Engineering, and a past president of the two acoustical societies in this country.

Dr. Beranek has put together a very specialized group of experts that are shown on chart (fig. 27, p. 274). Again, you will see that none of those people are working for the Government.

Mr. Clifton Moore was picked specifically as an airport operator who has the biggest problem on airport sideline noise. He was specifically picked for that reason. I did not want to leave out Government experts, so in addition to Dr. Beranek's permanent members the committee includes advisory or liaison members, which takes into account all of the experts that I have been able to make available.

There are other experts, but these are the top men in their field in NASA, the FAA, the Department of Transportation, Library of Congress, Health, Education, and Welfare, Air Force, and so forth as shown on fig. 28, p. 274.

To clear up any confusion, in both the environmental and noise areas I have tried to put together a team outside the Government, not beholden to any of us, and yet have provided as liaison to them experts who do represent the Government's vast technical and scientific background.

#### INTRODUCTION OF DR. WILLIAM M. KELLOGG

Also with us today is Dr. Will Kellogg. Dr. Kellogg is Associate Director of the National Center for Atmospheric Research, sometimes called NCAR. He was the chairman of the Study of Critical Environmental Problems (SCEP) Working Group on Climatic Change, the summer study group that met at Williams College, Williamstown, Mass., sponsored by MIT. He is a member of the President's Scientific Advisory Committee panel on the environment. He is a member of the American Geophysical Union Committee on Environmental Quality. He is also vice president of its meteorological section.

He was formerly a member of the international group on potential harmful effects of space experiments, and has made studies of contamination by large rockets. He is a member of the National Academy of Sciences' Committee on Atmospheric Science and a former member of the Space Science Board.

With that introduction, I think it would be proper for me now to turn the testimony over to the chairman of the SCEP group, Dr. Kellogg, with your permission.

#### PREPARED STATEMENT BY DR. KELLOGG

Mr. McFALL. I have been quoting you from time to time, Dr. Kellogg, in the last couple of days. We are glad to have you here in person. We will insert your prepared statement and you may proceed as you wish.

(Dr. Kellogg's prepared statement follows:)

PREPARED STATEMENT BY DR. WILLIAM W. KELLOGG  
ASSOCIATE DIRECTOR, NATIONAL CENTER FOR ATMOSPHERIC RESEARCH  
FOR DELIVERY BEFORE  
HOUSE APPROPRIATIONS TRANSPORTATION SUBCOMMITTEE  
MARCH 3, 1971

Effects of SST Operations on the Global Atmosphere

Background: What Causes Climate Change?

We are familiar with the idea that our planet Earth's climate has changed many times. Some have been relatively minor changes, such as the gradual warming of the first half of this century (by about  $0.4^{\circ}\text{C}$ ), and some have been very profound, such as the last Ice Age when Canada and parts of Northern Europe were covered with ice.

Obviously there must be natural causes for climate change, though we have only a vague understanding of them. Recently we have been haunted by the realization that some of mankind's activities are rivaling the forces of nature, and can play a part in changing the climate of a region -- perhaps even the climate of the entire globe.

The key to any climate change must lie primarily in a change in some part of the heat balance of the atmosphere--ocean system. The atmosphere and the oceans are in fact massive, inefficient heat engines, and any change in the heat energy available to run these engines will change the patterns of their motion. Therefore, if we suspect a possible influence on the climate from some human activity, the first thing we must look for is a change in the heat balance.

There are substantial areas of the earth, for example, the Los Angeles basin, where the amount of heat released by burning fuel can be a few percent of the total heat available to the region from the sun, and so can have a small but direct effect. On a larger scale, however, we probably cannot expect to compete with the sun's energy directly; but, we can change the ability of the atmosphere and the surface to absorb solar energy and emit infrared radiation. This achieves the same result: It changes the heat energy available to the atmosphere.

How can we do this? By adding smoke and smog, for example, that both scatter and absorb sunlight. Adding certain gases that absorb and emit infrared radiation, such as carbon dioxide or water vapor, also change the net heat balance of the atmosphere. It is common knowledge by now that the carbon dioxide concentration in the atmosphere has indeed risen since the Industrial Revolution, due to mankind's diligence in burning fossil fuels and unlocking the carbon stored under the ground. This increase in atmospheric carbon dioxide, acting all by itself, could have caused a rise of the mean surface temperature by several tenths of a degree Centigrade since the mid-Nineteenth Century, according to the most recent calculations.

Thus, it can be said that man has already caused a change in the composition of the global atmosphere that is capable of producing a small change in the climate of the world. Since the atmosphere has actually been cooling off since 1940, however, it seems that this particular man-made effect is currently being overwhelmed by some other influences that we cannot yet identify.

Can SST's Influence the Climate?

With this background in mind, let us consider the possible influences of a fleet of 500 operational SST's on the climate of the earth. The reason for raising the issue at all lies in the relatively long residence times for the exhaust products in the stratosphere at SST altitudes, which is 1 to 3 years. This long residence time allows these exhaust gases and particules to accumulate in a limited part of the atmosphere. Then, if these contaminants can influence the heat balance of the atmosphere to an appreciable extent, we have some justification for suspecting a possible climate change.

The question of what is an "appreciable extent" and what can be considered "insignificant" is, of course, a troublesome one. It implies a value judgment. Some will take the extreme view that any change that is worldwide will be a cause for concern, no matter how trivial. I think most atmospheric scientists, who should have a sense of proportion about the real atmosphere, are accustomed to the vagaries of the atmosphere, its changes from day-to-day and from season-to-season, and the very great natural forces at work in the sun and the crust of the earth. (We will return to the matter of volcanoes shortly.) Thus, while there are large fluctuations, there is always a tendency for the system to come back to its more or less normal state -- there are feedback mechanisms that stabilize the atmosphere in the face of change. Thus, in this context a global change caused by man is "appreciable" only when it rivals or exceeds the natural large-scale and long-term changes that occur. This is the point of view that I will adopt.

The SST environmental case was examined by the National Academy of Sciences Committee on Atmospheric Science in a 1966 report, and it was concluded that there might be a small increase in stratospheric water vapor, but that it would have no appreciable effect on the temperature balance of the lower atmosphere.

Last July the Study of Critical Environmental Problems (SCEP), held in Williamstown, Massachusetts, again reviewed the SST matter, along with a number of other global environmental issues. I was the Chairman of the Climatic Effects Working Group for SCEP, and will summarize our conclusions. (Since the SCEP report is now widely available, it will not be necessary to go into great detail here. Its title is, "Man's Impact on the Global Environment", published by the M.I.T. Press, 1970).

The conclusion concerning the water vapor added to the stratosphere by 500 SST's operating 7 hours per day was essentially the same as that of the earlier NAS report, namely, that there would be about a 10 percent addition to the stratospheric water vapor on a global basis (from about 3.0 ppm to 3.2 ppm (parts per million). In limited regions of heavy traffic we estimated that the increase might be as much as ten times more.

In 1967, S. Manabe and R. T. Wetherald, of the NOAA Geophysical Fluid Dynamics Laboratory, published a careful calculation of the influence of a change in stratospheric water vapor on the temperature balance of the atmosphere as a whole, and using their results we concluded that the global increase in surface temperature due to the SST water vapor would be considerably less than  $0.1^{\circ}\text{C}$ .

The SCEP also looked into the matter of whether SST's would cause more cloudiness in the stratosphere. At the level of SST operation, the air is exceedingly dry, and we are quite certain that there would be no condensation trails or clouds formed at 20 km by SST's, an exception being in the polar winter when the SST's could aid in the formation of a rare phenomenon known as "mother-of-pearl-clouds" occasionally reported over Scandinavia. Such clouds do form at SST heights when the atmosphere becomes exceedingly cold and there are mountain waves to cause further cooling. They would probably have a negligible effect on the heat balance of the atmosphere, though this point deserves further investigation.

Incidentally, least it be noted that the major exhaust products of a jet engine is carbon dioxide ( $\text{CO}_2$ ) and that I have not mentioned its effect, rest assured, that this was looked into by both the NAS and SCEP, and it turned out that the SST contribution to the  $\text{CO}_2$  already in the stratosphere would be quite insignificant.

There is another effect of a change of stratospheric water vapor, and that is the result of its chemical reaction with ozone. Here we took advantage of some recent calculations of the photochemical equilibrium of ozone in the stratosphere by J. London and J. Park, of the University of Colorado, and it turns out that a 10 percent increase in water vapor would decrease the total ozone content of the stratosphere by 1 or 2 percent.

This change would be too imperceptible to measure, and would be superimposed on normal day-to-day and season-to-season fluctuations of 50 to 75 percent in total ozone. One passes through at least 2 percent of the total ozone between the surface and the top of the atmosphere in going up in altitude from sea level to Denver. Thus, while in principle the net effect of the added water vapor would be an increase in ultraviolet radiation at the ground due to the decrease in total ozone, it would be imperceptible and quite trivial relative to the natural fluctuations that occur all the time.

One more point might be made in this regard: The Naval Research Laboratory's J. Mastenbrook has been making accurate water vapor measurements in the stratosphere since the early 1960's (a difficult measurement due to the very dry atmosphere there), and there has been an upward trend from 2 ppm to 3 ppm over Anacostia, or an increase of 50 percent. No global decrease in total ozone has been reported for this same period, so far as I am aware, though it is conceivable that the trend over Anacostia does not represent a global trend. It is unfortunate that Mastenbrook's stratospheric humidity measurements represent the only reliable continuous record of its kind.

There is one other class of exhaust products from the SST's that we consider in the SCEP report, and that is the particles of various kinds. Each engine produces each hour, according to preliminary estimates of the General Electric Company engineers, about 5 pounds of soot (remarkably little compared with current jet engines), 6 to 30 pounds of sulfur dioxide

(SO<sub>2</sub>) (the amount depends on the initial sulfur content of the jet fuel), 16 pounds of unused hydrocarbon fuel, and 1,400 pounds of nitric oxide (NO) (though the General Electric Company now thinks this may be too high an estimate). The soot is initially in the form of small particles, and we considered that the unburned fuel would turn into smog particles under the combined influence of ultraviolet radiation and the NO, and we considered that the SO<sub>2</sub> would rapidly be oxidized and hydrolyzed to droplets of sulfuric acid similar to the droplets found in the stratosphere due to volcanic eruptions. We concluded in the report that the global concentration of all these particles in the stratosphere, assuming a two-year residence time (the same as is observed for radioactive debris at the same level) and a certain amount of particle settling, would be  $6.9 \times 10^{-4}$  ppm by mass using the larger SO<sub>2</sub> production, and  $3.1 \times 10^{-4}$  ppm using the smaller SO<sub>2</sub> figure. It is likely that the concentrations in the airways used by the SST's would be considerably higher, but the global value is probably of more interest.

These artificially created concentrations of stratospheric dust particles can be compared with measurements at about 20 km altitude made from balloons in 1961 (by C. Junge and his colleagues) and from high-flying Air Weather Service aircraft from 1968 to the present (by R. Cadle, A. Lazrus, W. H. Pollock, and J. P. Shedlovsky of the National Center for Atmospheric Research). The 1961 concentrations averaged  $1.2 \times 10^{-4}$  ppm, the 1968 and 1969 concentrations averaged  $36 \times 10^{-4}$  ppm, and at the end of 1970 the concentrations had fallen to nearly the same as in 1961. The

predominant component of these particles of volcanic origin was almost invariably sulfate (probably in the form of sulfuric acid droplets), and there were much smaller and variable amounts of such elements as Ca, Si, Cl, Br, etc. Curiously enough, the concentrations of these particles tended to be a maximum at around 20 km altitude at all latitudes where the sampling was carried out. The generally accepted hypothesis for the origin of these sulfate particles in the stratosphere is that they were injected by major volcanic eruptions in which the volcanic gases and dust particles were forced to very great heights. J. F. Cronin, of the Air Force Cambridge Research Laboratories, has recently documented the eruptions in which the volcanic cloud was observed to have penetrated into the stratosphere. It seems that there was a period of seven years of little activity until March 1963, when Mount Agung in Bali injected so much material into the stratosphere that gold and purple sunsets were noticed around the world for the next two years. Agung was followed by the eruptions of Surtsey, Iceland, in late 1963 and 1964; Awu, Celebes, in 1966; and Fernandina, Galapagos, in 1968, each of which produced clouds that penetrated into the stratosphere. The most recent NCAR results suggest that the stratosphere is now becoming depleted again and may be returning to the pre-Agung levels measured by Junge -- if there is no other major eruption.

What is the effect of such eruptions and their stratospheric debris on the climate? The answer is not clear, though we do have some moderately good indication. J. M. Mitchell, Jr., of NOAA, a climatologist who has carefully reviewed the records of all past eruptions since good temperature

records were kept around the world, finds no statistically significant change in surface temperature on the average following large eruptions. (However, the cataclysmic eruptions of Mount Tambora, 1815, and of Krakatao, 1883, were followed by some decrease in temperature for a short time -- possibly a significant effect.)

The effect on the temperature of the stratosphere itself, however, appears to be quite significant. The Australian meteorologists, J. G. Sparrow, R. N. Kulkarn and F. A. Berson, and more recently, R. E. Newell of the Massachusetts Institute of Technology, have all noted that the temperature at 15 to 20 km altitude in a wide belt around the Equator rose by 5° to 7° C, immediately following the Agung eruption, and remained 2° to 3° C. above the pre-Agung mean until at least 1967. (I regret that I have not had a chance to check on the situation between 1967 and the present to see how the mean temperature in the tropical stratosphere has been behaving recently -- nor do I know of anyone else who has. This should certainly be done.)

If we grant, then, that the injection of volcanic ash and SO<sub>2</sub> into the stratosphere can raise the temperature there by a few degrees, then we could conclude that SST's might do the same. However, recall that our best estimate of the SST contribution to stratospheric particle concentrations was 3 to 7 x 10<sup>-4</sup> ppm, whereas the 1968 and 1969 values observed during the later part of the period of volcanic activity were about 36 x 10<sup>-4</sup> ppm, now decreasing to the earlier pre-Agung level of 1.2 x 10<sup>-4</sup> ppm. (Alas, we have no samples of the stratospheric particles when they were probably at their peak concentration in 1963.)

One can conclude, somewhat tentatively, that the SST's are likely to raise the particle concentration of the stratosphere during a period of low volcanic activity by a factor of 3 to 6, but that the SST contribution falls far short of matching that from the eruptions of the period 1963 to 1968, by a factor of at least 5 and probably much more. These numbers are clearly a bit uncertain, but they serve quite well to give the relative magnitudes.

If the Agung eruption raised the temperature of the tropical stratosphere by about  $5^{\circ}\text{C}$ , then the SST's would have an effect of less than 1/5 this much, or less than  $1^{\circ}\text{C}$ . On a global basis the temperature change would probably be even less. Again I must emphasize that these conclusions are rather tentative, and the real answer could be higher or lower. If I did not think they were "in the ballpark", however, I would not bother to present them at all.

A prolonged  $1^{\circ}\text{C}$ . change in mean stratospheric temperature might be barely detectable, but not if it were confined to a limited region of the world. In any case, we see that this "SST effect" is probably going to be considerably smaller than the "Agung effect" (or the "Surtsey effect" or the "Fernandina effect"), and I therefore believe we can say that it will be insignificant compared to the natural changes that have taken place in the past century and that will undoubtedly take place again many times in the history of our planet.

Concluding Remarks

We can summarize the conclusions that are now available regarding the climatic impact of the operation of 500 SST's as follows:

There will be a global increase in stratospheric water vapor of about 10 percent, somewhat more in regions of heavy flight activity.

This increase will have a quite negligible influence on the heat balance of the global atmosphere.

It will only cause increased cloudiness at SST altitudes in the polar wintertime, if at all.

Carbon dioxide increase will be negligible and causes no special problem.

The added water vapor will decrease the total ozone in the atmosphere by 1 or 2 percent, and this is trivial compared to the natural fluctuations of ozone. The same can be said of the corresponding changes in ultraviolet radiation reaching the ground.

Particles added to the stratosphere by SST's could have a small but possibly measurable effect on stratospheric temperature during periods of low volcanic activity, but the SST contributions would be swamped by the contributions from a large eruption of the sort that appeared at least four times in the past decade.

Neither of the recent volcanic particles nor the SST particles would appear to have an influence on surface temperature.

In short, I have found no environmental basis for delaying the Government's SST program to develop two prototype SST's. The best estimate we have today regarding the climatic aspects of large-scale SST operations indicate that the effects will be generally imperceptible and trivial when compared to the changes we experience from natural causes.

It should be emphasized, however, that there are some uncertainties in these "best estimates" due to a lack of knowledge of the interactions in the high atmosphere, and of chemical reactions that take place there. In fact, our general theories of climatic change are still very shaky, though we can analyze individual components of the picture. We should know a great deal more about these matters than we do at this time. This is the point that concerns some of us that have studied the situation.

The SST's are a conspicuous symbol of advancing technology, and we applaud the Government's plan to conduct an environmental research program concurrently with the development of two prototype aircraft. We are confident that decisions in the future regarding the SST program will take the environmental issues into account very seriously, and as we improve our understanding of the environmental implications, we can make more rational decisions.

A program of research relative to future SST operations was recommended by the SCEP. A limited part of this research is already underway by the National Center for Atmospheric Research with National Science Foundation's support. The Department of Transportation has also been studying these recommendations carefully and has formulated an ambitious and imaginative research program that promises to resolve most of the outstanding questions regarding the SST's environmental impact. This research program can probably achieve most of its aims before 1973, when the decision of whether to produce the U.S. SST will have to be made -- providing that funds are made available to support the program.

## STATEMENT OF DR. WILLIAM W. KELLOGG

Dr. KELLOGG. Thank you, Mr. Chairman.

I am honored to be here and to be able to talk to you directly instead of indirectly, as sometimes happens.

I see at least one member of the committee has a copy of the book, "Man's Impact on the Global Environment," which I also have in front of me. It goes into the question of climatic changes in a good deal of detail, and since Dr. Jim McDonald, who is an old friend and honored scientific colleague of mine, was here yesterday telling you about the question of climatic change, I think I would like very quickly to summarize my prepared statement and then be prepared to answer a few questions.

The original reason for our concern about supersonic transports in large numbers in the stratosphere has a fairly long history. It goes back to the National Academy of Science study in 1966 which has frequently been quoted. It goes back even further than that in certain more specialized forums.

The reason there is concern about a large fleet of SST's, of course, is because the contaminants remain in the stratosphere for a long time, because the stratosphere is very dry and, therefore, the additional water vapor can have an effect there.

We feel that the additional water vapor will probably not have an effect on cloudiness because of the very dryness which I just referred to, but that the extra water vapor can have an effect on the ozone because it reacts with the ozone. The effect is such that it decreases the ozone, and it can also have an effect on the temperature of the stratosphere. These effects are worked out in some detail in the SCEP report.

Last summer, during the SCEP study, we raised an additional question which had not been looked at very carefully before. That is the possibility that, in effect, the SST's could create a smog problem in the stratosphere. The reason we were concerned about this is because particles in the stratosphere also can have an effect on the temperature.

Considering all these effects—and the effects are enumerated in my written testimony which is a part of the record—and also considering our uncertainties about the details of how the stratosphere will behave when these exhaust contaminants are added, I conclude that in all the respects I have mentioned, we are quite confident that the changes caused in the stratosphere or the lower atmosphere will be very much smaller than the natural fluctuations that we live with all the time, and will therefore be undetectable on a global basis.

These fluctuations in the atmosphere are inherent in the way it behaves. In addition, volcanic eruptions of the sort that we have had in the past few years would have a much larger effect on the particles in the stratosphere than would SST's.

Furthermore, it is clear that there are natural influences that cause climatic changes, influences that we do not understand very well, and these are quietly at work, apparently causing much larger changes than the ones we predict from SST contamination.

I therefore urge that the SST issue be decided on grounds that are more significant than the effect on the environment.

I also urge that we continue to study the possible environmental effects so we can refine our present predictions.

That is the end of my statement, Mr. Chairman. I would be most happy to answer any questions that the committee may wish to raise.

PREPARED STATEMENT BY DR. SINGER

Mr. McFALL. I think we would like to have the other two gentlemen make their statements, and then we can go to a question period.

Dr. Singer, are you next?

(Dr. Singer's prepared statement follows:)

PREPARED STATEMENT BY DR. S. FRED SINGER  
CHAIRMAN, SST ENVIRONMENTAL ADVISORY COMMITTEE  
FOR DELIVERY BEFORE  
HOUSE APPROPRIATIONS TRANSPORTATION SUBCOMMITTEE  
MARCH 3, 1971

I am pleased to appear before this Subcommittee to discuss the role of the SST Environmental Advisory Committee and its views regarding the environmental concerns that have been raised concerning the SST. I will also summarize the Committee's concept of how to best resolve these concerns. Finally, I want to make some general remarks on man's impact on the environment.

By way of background, I have had considerable professional interest in the field of environment, both through governmental and university service. I was the first Director of the National Environmental Satellite Center in what is now called NOAA, and subsequently was Dean of the School of Environmental Sciences at the University of Miami. My scientific interests include atmospheric physics, space physics and oceanography. I have authored and edited a recent book entitled Global Effects of Environmental Pollution. I am currently Chairman of the American Geophysical Union's Committee on Environmental Quality. One of our mandates is to actively insure that scientific information regarding environmental matters is neither unwittingly nor mischievously misused. In keeping with that mandate, I was very pleased when I was requested, this past January, to accept the chairmanship of the SST Environmental Advisory Committee.

The request came as a result of the resignation of the first Chairman, Assistant Secretary of Commerce Myron Tribus, who recently has entered private business. Dr. Tribus had considerable expertise and great interest in the effects of supersonic aircraft operating in the stratosphere, both professionally and in his Commerce Department position as overseer of the Nation's atmospheric laboratories.

I might mention here to this Committee that I served as a member of a Special Study Group on Noise and Sonic Boom Problems which recommended to the then Secretary of the Interior that SST flights over populated areas be allowed only on a controlled experimental basis.

I accepted the DOT's invitation with certain provisions.

I want to quote from my reply:

"In accepting the chairmanship of this Committee, I want to be sure that there are no misunderstandings between us. I am not now a supporter of the SST program and have not taken a stand either for or against it previously. The reason, very simply, is that I have not had a chance to study personally what I consider to be the important questions, which relate primarily to the economics of the project and to national priorities. My field of expertise, of course, is environment and radiation, and here I will be happy to serve because I want

to make sure that scientific data are not misused, either to support the SST program or to oppose it. This is in line with the philosophy that we have formulated in the American Geophysical Union where I serve as the Chairman of the Committee on Environmental Quality."

"...I expect to have a frank discussion with you regarding the purposes, responsibilities, and membership of the Committee. As I see it right now, we don't want to sit back and wait for an invitation to give advice on specific problems. We should be working actively to define the problems ourselves, and we should cooperate with you in formulating the crucial questions. They should be precisely defined and stated in writing. You appreciate, I am sure, that this Committee is made up of scientists who have a professional reputation to uphold. We therefore want to avoid any danger of misunderstanding or misquotation."

"We also recognize that it is difficult or even impossible to answer certain questions without adequate research. We intend, therefore, to review in some detail the on-going and proposed research programs which are crucial to the possible environmental effects of the SST and will inform you regarding their priority, adequacy, and quality."

"Also, in order to carry out our job, we will want to talk with experts outside of our Committee, especially to scientists who are critical of the SST program."

I noted at once that the Committee's membership consisted largely of expert atmospheric scientists from the government laboratories which perform virtually all of the Nation's atmospheric research. Dr. Tribus had concluded that this was precisely the sort of talent needed to perform these functions, yet he was aware that certain critics claimed a "credibility gap" in the critics' apparent conviction that government management can silence or alter the scientific judgment of scientists who happen to possess a governmental laboratory address.

Be that as it may, an outside, non-government Panel has been established under the Department of Commerce Technical Advisory Board. CTAB is a body of 16 non-government scientists who advise the Secretary of Commerce and, through him, other Cabinet Officers or Presidential Advisors on matters pertaining to technology, its effects, etc. The CTAB established a Panel on SST Environmental Research as a result of the DOT's request to Secretary Stans. The Panel, headed by a CTAB member, Dr. Fred Henriques, is composed exclusively of first-rank non-government scientists including Dr. Thomas Malone, an atmospheric physicist and Vice-President of the International Council of Scientific Unions. I might add it has female representation, too, in the presence of Dr. Harriet Hardy, Assistant Director of the MIT Medical School, and a charming lady.

I want to be sure that this Subcommittee understands the respective roles of our two groups. My Committee is a DOT Advisory Committee, and we advise that Department on the correct scientific positions to take and help DOT to assemble and carry out a responsive environmental research program. The CTAB Panel is a totally independent body which evaluates the various environmental questions that have been raised and thoroughly analyzes existing research together with DOT's planned environmental research program. I expect it will make its own judgments on which questions are truly significant and will recommend whatever changes it believes necessary to the DOT research effort. I keep in touch with Dr. Henriques to insure that the CTAB Panel obtains all the cooperation it desires from the Advisory Committee; but apart from this communication, CTAB operates in its own domain. I understand CTAB Panels submit their reports to the full sixteen-man Board for approval, and then their reports are published with a departmental disclaimer to the usual effect that the views are not necessarily those of the Department of Commerce.

With that explanation, let me turn quickly to the main reason I am here. That is, of course, to tell you the views of our SST Environmental Advisory Committee on the principal environmental concerns which have been raised regarding large-scale operation of supersonic transports in the stratosphere and to tell you of the environmental research program which we are helping DOT to structure in order to resolve these concerns.

We regard the SCEP Study\* as an outstanding professional effort in assessing the possible environmental effects of the SST. Its only shortcoming is that it uses, at every point, the worst possible assumptions and therefore arrives at the most conservative position, but it provides no estimate of the probability of noticeable effects to occur.

(i) For example, they make a "worst assumption" on the sulfur content of the fuel, an item which can be improved easily by a factor of 5.

(ii) They assume that all the particulate material will be of equal size and able to float in the stratosphere for about 2 years, but in reality there will be a size distribution, with much of the mass ending up in larger particles that immediately fall out of the stratosphere.

(iii) The SCEP Study does not consider offsetting effects. For example, while particulate material might result in a local heating of the stratosphere, the water vapor, which is certainly emitted, results in local cooling. These two effects are not compared, nor do we have any way of judging which of the effects would be bad, the cooling or the heating.

---

\* which has been repeatedly referred to in earlier testimony.

Now we would not quarrel with taking the most conservative position, but it is important to assess quantitatively the probability for a "significant" effect. This means narrowing all of the important uncertainties, so that our prediction can be refined. We need to know the amount and the properties of the injected pollutants; for example, how many particles are formed and what is their size distribution? How long do they survive in the stratosphere? What is the "lifetime" of the released water vapor? And, most important: What is the natural content of these pollutants and what are the natural variations, both at different locations and at different times? Only by knowing the background can we assess whether the SST releases are "significant." We are currently shaping the research program of DoT to get these answers in the shortest possible time so that uncertainties can be removed and the various concerns can be allayed.

Let me finally give you some personal views which are not necessarily those of my Committee. Why has there been so much fuss raised about the SST? Why is the conflict focused on this particular new technology? I think the answer is complex, but perhaps one of the important reasons is that the SST has become a symbol. In my view, we are witnessing here a general reaction against all technological progress, and against basic science itself, on the part of a coalition of people which--paradoxically--includes scientists. On the one extreme,

there are those who feel that all technology is evil; on the other side there are those who feel that only certain kinds of technology will produce adverse effects. I happen to believe that the latter point of view is correct, but I also believe that to overcome the adverse effects you need more of the right kind of technology. Certainly we must try to assess in advance what the impact of a technological development is on our quality of life--not just in the GNP--and we must be continually alert to the possibility that a technological development or a new chemical may produce an environmental effect which is very harmful.

Now we have had many scares, some propagated even by scientifically-trained people, that we are going to run out of oxygen, because we are burning up fossil fuels, or because we may be destroying the green plants in the ocean that produce oxygen. This scare has proven to be quite baseless. But that doesn't mean that other effects could not exist that are equally far-reaching. Let me point out to you that the operation of automobiles every year is producing nearly 80 million tons of toxic carbon monoxide in the U.S. alone which pours into the atmosphere. This development has taken place without any advance assessment and without hardly any current assessment. It is a very fortunate thing indeed that there seems to be a natural mechanism which removes the carbon monoxide before it kills us. It does not seem to build up in

the atmosphere, and the strange thing is we don't know what is removing it. Our best guess is that it might be bacteria in the soil, but some people think that it may be removed in the upper atmosphere by photochemical means. Whatever it is, we seem to be safe, not because we were smart, but because we were lucky. We can't always be lucky. That is why we must take all possible environmental effects, including those of the SST, seriously, and that is why we are spending a great deal of time in narrowing the uncertainties and in setting up the necessary research.

Let me give you another example. You heard that the SST will add water vapor to the stratosphere, and there are those who feel that the effects would be important as well as harmful. It has occurred to me recently that we have been adding water vapor to the stratosphere in increasing amounts for the last 50 to 100 years by releasing methane into the atmosphere which has turned into water vapor when it reaches the stratosphere. This effect has never been looked into as far as I am aware, and we don't really know how much water vapor is added nor do we know even how much methane we have put into the atmosphere every year. But do you know where the methane comes from? It comes from releases of natural gas, from coal mines, and from flatulent cows. The bacteria in their stomachs generate the methane. Now the amount of natural gas released, the

amount of coal mined, and the number of cows grown have all gone up as population increased so that the release of methane must have increased and will continue to be more and more important. Here is something to think about.

If you want to talk about real global environmental effects produced by our technology, let me give you a couple more examples. Almost all of our production of energy today is based on the burning of fossil fuels and the inevitable result of the burning of coal, oil, and gas is the production of carbon dioxide which goes into the atmosphere. There is no doubt whatsoever that we have experienced an actual increase of nearly 10 percent in carbon dioxide over the last 50 years. And we can predict with fair certainty that the concentration will increase by another 20 percent by the year 2000: The carbon dioxide affects the radiation balance in the atmosphere and therefore has some influence on the climate unless it is offset by other factors. Yet I have not heard any demands that we shut down all of our power stations.

Let me give you one final example. We are very concerned about the presence of mercury compounds in fish, in other food stuffs, and in the human body. The government is making every attempt to force industry to cut down its releases, and if we are smart we will insist on and offer incentives for the recycling of mercury. But in the last few

months we have become aware that perhaps as much as 50 percent of the mercury released to the environment comes from the burning of coal in power stations throughout the world.

Let's then put matters into perspective. There is no question whatsoever that many human activities are affecting the environment, are changing the atmosphere, and are putting out pollutants that are spread throughout the world. There is no question that the SST is going to release some pollutants into the atmosphere, but it is doubtful whether they will be of any significance. In the balance, I believe that the question of whether we should or should not have an SST must be decided on the basis of economics and national priorities, with the environmental effects having a very small weight indeed. If the SST is going to be turned down, let's be sure that it is turned down for the right reasons.

## STATEMENT OF DR. S. FRED SINGER

Dr. SINGER. Thank you, Mr. Chairman.

I am certainly pleased to appear before this subcommittee to discuss the role of the SST Environmental Advisory Committee and its views regarding the environmental concerns that have been raised about the SST.

I will also summarize the committee's concept of how best to resolve these concerns.

Finally, I want to make some general remarks on man's impact on the environment.

It was mentioned that I am serving as chairman of the American Geophysical Union's Committee on Environmental Quality. One of our mandates is to insure that scientific information regarding environmental matters is properly used. So, in keeping with this mandate, I was quite pleased when I was asked by Mr. Magruder this past January to accept the chairmanship of this SST Environmental Advisory Committee.

The request came about because of the resignation of the first chairman, the Assistant Secretary of Commerce, Myron Tribus, who has recently entered private business.

Incidentally, I might mention to this committee that 3 years ago I served as a member of a special study group on noise and sonic boom problems for the SST, which recommended to the then Secretary of the Interior, whom you heard yesterday, that SST flights over populated areas be allowed only on a controlled experimental basis.

I mention this to establish that I think my prior connection with the SST program would be judged to be that of an opponent.

I accepted the invitation, therefore, from the Department of Transportation with certain provisions. I would like to quote from my reply:

In accepting the chairmanship of this committee, I want to be sure that there are no misunderstandings between us.

I am not now a supporter of the SST program and have not taken a stand either for or against it previously. The reason, very simply, is that I have not had a chance to study personally what I consider to be the important questions, which relate primarily to the economics of the project and to national priorities. My field of expertise, of course, is environment and radiation, and here I will be happy to serve because I want to make sure that scientific data are not misused either to support the SST program or to oppose it. This is in line with the philosophy that we have formulated in the American Geophysical Union—which is our primary professional society in the area of geophysics.

I go on to say:

I expect to have a frank discussion with you regarding the purposes, responsibilities, and membership of the committee. As I see it right now, we don't want to sit back and wait for an invitation to give advice on specific problems.

We should be working actively to define the problems ourselves, and we should cooperate with you in formulating the crucial questions. They should be precisely defined and stated in writing.

You appreciate, I am sure, that this committee is made up of scientists who have a professional reputation to uphold. We therefore want to avoid any danger of misunderstanding or misquotation.

We also recognize that it is difficult or even impossible to answer certain questions without adequate research. We intend, therefore, to review in some detail the ongoing and proposed research programs which are crucial to the

possible environmental effects of the SST, and will inform you regarding their priority, adequacy, and quality.

Also, in order to carry out our job, we will want to talk with experts outside of our committee, especially to scientists who are critical of the SST program.

#### VIEWS OF SST ENVIRONMENTAL ADVISORY COMMITTEE

Let me turn quickly to the main reason I am here. That is, of course, to tell you the views of our SST Environmental Advisory Committee on the principal environmental concerns which have been raised regarding large-scale operation of supersonic transports in the stratosphere, and to tell you of the environmental research program which we are now helping DOT to structure in order to resolve these concerns.

We regard the SCEP study, which has been mentioned several times in these hearings and which Dr. Kellogg chaired, as an outstanding professional effort in assessing the possible environmental effects of the SST. Its only shortcoming, as far as we can tell, is that it uses at every point the worst possible assumptions and, therefore, arrives at the most conservative position. This is quite proper, but it does not provide an estimate of the probability for any noticeable effects to occur.

For example, the SCEP study makes a worst case assumption on the sulfur content of the fuel, an item which can be improved easily by a factor of 5. They also assume that all of the sulfur would be converted into particles. They assume all the particulate material will be of equal size and will be able to float in the stratosphere for about 2 years. But in reality, there must be some kind of size distribution with an undetermined amount ending up in larger particles that fall out of the stratosphere more quickly.

Finally, the SCEP study does not consider offsetting effects. For example, while particulate material might result in a local heating of the stratosphere, the water vapor, which is certainly also emitted, results in local cooling. These two effects are not compared, nor do we have any way of judging which of the effects would be bad, the cooling or the heating.

We do not and would not quarrel with taking the most conservative position in a matter like this, but it is important to assess quantitatively the probability for a significant effect. This means that we have to narrow down all of the important uncertainties so that our prediction can be refined.

We need to know, for example, the amount and the properties of the injected pollutants. For example, how many particles are formed and what is their size distribution? How long do they survive in the stratosphere? What is the lifetime of the released water vapor?

Most important, what is the natural content of these pollutants, and what are the natural variations, both at different locations and at different times?

Only by knowing the background can we assess whether the SST releases are significant.

We are currently shaping the research program of DOT to get these answers in the shortest possible time so that the uncertainties can be removed.

However, our best present judgment is that the effects of an SST fleet on the stratospheric composition will be within the normal range of variability.

#### ENVIRONMENTAL EFFECTS OF TECHNOLOGICAL PROGRESS

Let me finally, then, give you some personal views which are not necessarily those of my committee.

Why has there been so much fuss raised about the SST? Why is the conflict focused on this particular new technology?

I think the answer is complex, but perhaps one of the important reasons is that the SST has become a symbol. In my view, we are witnessing here a general reaction against all technological progress and against basic science itself, on the part of a coalition of people which paradoxically also includes scientists. On the one extreme there are those who feel that all technology is evil. On the other side, there are those who feel that only certain kinds of technology will produce adverse effects. I happen to believe the latter, but I also believe that to overcome the adverse effects you need more of the right kind of technology.

Certainly, we must try to assess in advance what the impact of a technological development is in our quality of life, not just in the GNP, and we must be continually alert to the possibility that a technological development or a new chemical may produce an environmental effect which is very harmful.

I think we have here in the SST program perhaps the first instance where we are making a thorough environmental evaluation before undertaking a major technological effort, that is, the production of an SST fleet.

We have had many scares in the past, some propagated even by scientifically trained people. For example, a scare that we are going to run out of oxygen because we are burning up fossil fuels, or because we may be destroying the green plants in the ocean that produce oxygen. This scare has proven to be quite baseless. But that does not mean that other effects could not exist that are equally far reaching.

Let me point out to you that the operation of automobiles every year is producing nearly 80 million tons of toxic carbon monoxide in the United States alone, and all of this pours into the atmosphere. This development has taken place without any advance assessment and with hardly any current assessment.

It is a very fortunate thing, indeed, that there seems to be a natural mechanism which removes the carbon monoxide before it kills us. It does not seem to build up in the atmosphere, and the strange thing is that we do not know what is removing it to this day. Our best guess is that it might be bacteria in the soil, but some people think that it may be removed in the upper atmosphere by photochemical means.

Whatever it is, we seem to be safe, not because we were smart, but because we were lucky.

We cannot always be lucky. That is why we must take all possible environmental effects, including those of the SST, very seriously, and that is why we are spending a great deal of time in narrowing the uncertainties and in setting up the necessary research.

Let me give you another example. You heard that the SST will add water vapor to the stratosphere, and there are those who feel that the effects would be important as well as harmful. It has occurred to me recently that we have been adding water vapor to the stratosphere in increasing amounts for the last 50 to 100 years by releasing methane into the atmosphere, which turns into water vapor when it reaches the stratosphere.

This particular pollution effect has not been looked into, as far as I am aware, and we do not really know how much water vapor is added, nor do we know how much methane we put into the atmosphere every year. But do you know where the methane comes from? It comes from rice paddies and swamps and from the releases of natural gas, which is methane, from coal mines, and from the flatulence of cows. In fact, the biological input is quite large, perhaps as much as 50 percent. The bacteria in the stomachs of the cows and all ruminants generate the methane. The amount of natural gas released, the amount of coal mined, and the number of cows grown, have all gone up as population increased, so that the release of methane must have increased and will continue to be more and more important. So, here is something for you to think about.

If you want to talk about real global environmental effects produced by our technology, let me give you a couple more examples.

Almost all of our production of energy today is based on the burning of fossil fuels, and the inevitable result of the burning of coal, oil, and gas in the production of carbon dioxide which goes into the atmosphere. There is no doubt whatsoever that we have experienced an actual increase of nearly 10 percent in carbon dioxide over the last 50 years. And we can predict with fair certainty that the concentration will increase by another 20 percent by the year 2000. The carbon dioxide affects the radiation balance in the atmosphere and, therefore, has some influence on the climate unless it is offset by other factors. Yet, I have not heard any demands that we shut down all of our power stations.

Let me give you one final example. We are very concerned about the presence of mercury compounds in fish, in other foodstuffs and in the human body. The Government is making every attempt to force industry to cut down its releases, and if we are smart, we will insist on and offer incentives for the recycling of mercury, because this is the best way to handle it. But in the last few months we have become aware suddenly that perhaps as much as 50 percent of the mercury is released to the environment from the burning of coal in power stations throughout the world.

#### SST DECISION—ENVIRONMENTAL OR ECONOMIC

So, let us then put matters into perspective. There is no question whatsoever that many human activities are affecting the environment right now, are changing the atmosphere, and are putting out pollutants that are spread throughout the world. There is no question that the SST is going to release some pollutants into the atmosphere, but it is doubtful whether they will be of any significance.

In the balance, I believe that the question of whether we should or should not have an SST must be decided on the basis of economics.

Based on our best present judgments, the potential environmental effects should have a very small weight, indeed, in these deliberations. If the SST is to be turned down, let us not turn it down for the wrong reasons.

Thank you.

Mr. McFALL. Thank you.

Mr. YATES. May I request that Dr. Beranek be separated from these two, because his testimony will be entirely different.

Mr. McFALL. Let us get all three of them while we are fresh and we can understand them.

Mr. YATES. His is an entirely different subject.

PREPARED STATEMENT BY DR. BERANEK

Mr. McFALL. We will hear Dr. Beranek and we will be able to question any of the witnesses.

I would like to refer to the fact that Dr. Leo Beranek is the chief scientist, Bolt, Beranek & Newman, Inc., as Mr. Magruder has pointed out.

Go right ahead, please.

(Dr. Beranek's prepared statement follows:)

PREPARED STATEMENT BY DR. LEO L. BERANEK  
CHAIRMAN, SST COMMUNITY NOISE ADVISORY COMMITTEE,  
FOR DELIVERY BEFORE  
HOUSE APPROPRIATIONS TRANSPORTATION SUBCOMMITTEE  
MARCH 3, 1971

Mr. Chairman, Members of the Committee, I want to thank you for the opportunity to appear before you to express the views of a select group of technical experts regarding supersonic transport noise. The group of men to which I refer is known as the Supersonic Transport Community Noise Advisory Committee, of which I am its Chairman. The Committee was established in July 1970 following discussions between me and the Department of Transportation, Supersonic Transport Development Office. During these discussions, I became convinced of the earnest need for unbiased technical advice and counsel with regard to concerns being publicly expressed of the SST's potential noise hazards. The members subsequently appointed to serve on the Committee, besides myself, are:

Professor Raymond A. Bauer, (Social Psychology) Harvard  
Business School

Mr. Kenneth McK. Eldred, (Acoustics) Wyle Laboratories

Professor Jack L. Kerrebrock, (Jet Engines) Massachusetts  
Institute of Technology

Mr. Franklin W. Kolk, (Chairman, SAE Committee on  
Aircraft Noise: A-21) American Airlines

Mr. Aubert L. McPike, (Member, National Aircraft Noise  
Abatement Council) Douglas Aircraft Company

Mr. Clifton A. Moore, (General Manager) Los Angeles Airports

In addition, eight government liaison members were appointed who have met with the Committee on a number of occasions.

At the time the Committee began its deliberations, the noise objectives for the production supersonic transport aircraft were those established in 1966. Those objectives, in present terms, called for a maximum sideline noise level during takeoff, at a sideline distance of 0.35 nautical miles, of 120 EPNdB. However, information published in the January 5, 1970, issue of AVIATION WEEK AND SPACE TECHNOLOGY, which was based upon statements made by the General Electric Company, indicated that the state-of-the-art of jet noise suppression when applied to the J6G version of their GE4 engine would produce a noise level at the sideline of 124 EPNdB; a number that was 4 EPNdB in excess of the objectives. This number was based upon a primary-noise suppressor which was said to offer up to 4 EPNdB reduction in noise levels. It was also stated in the AVIATION WEEK article that for higher thrust losses greater amounts of noise reduction might be possible.

When our Committee was established, it was stated that the purposes of the Committee were to give accurate general information on noise and noise control; second, to assist in the establishment of goals for community noise around airports that would accommodate the SST; third, to assess the available technology that could be employed by Boeing and General Electric for the control of SST noise; and last to recommend research programs that would be likely, in the time-frame of the production SST, to produce noise levels that would meet the levels recommended by the Committee for allowable community noise.

The first meeting of the Committee was held on July 31, 1970, and numerous meetings were held thereafter. By September 11, 1970, the Committee had reviewed available information in regard to the reaction of people in communities surrounding the nation's airports to aircraft noise. We had also investigated the expected effects on community noise of projected improvements that would result from the introduction of new, quieter, subsonic airplanes meeting certification requirements of Part 36 of the Federal Aviation Regulations (Noise Standards: Aircraft Type Certification). This regulation is commonly referred to as FAR 36. Finally, we held meetings with representatives from the Airport Operators Council International, those airlines contemplating purchase of the production SST and the Boeing and General Electric Companies. On the afternoon

of September 11, 1970, I reported, on an interim basis, the first conclusions of the Committee; these were:

1. The Noise levels for the production SST should be the same as those imposed by FAR 36 for new four-engine, intercontinental, subsonic transport aircraft.
2. To meet the above objective, added emphasis should be given by Boeing and General Electric in their respective noise programs.

As you are probably aware, the certification requirements of FAR 36 for large subsonic aircraft call for nominal noise levels of 108 EPNdB at three positions; at a point under the takeoff flight path 3.5 nautical miles from start of takeoff roll; also at a point beneath the landing path 1 nautical mile before touchdown; and at all points along a line 0.35 nautical miles to the side of the line of takeoff.

At the time of the Committee's meeting with the Boeing and General Electric Companies they stated that they could achieve 4 decibels noise reduction with a particular design of noise suppressor consisting of radial "fingers" that extend into the jet exhaust stream. They also reported that reductions of up to 12 EPNdB might be possible with a multi-tube type suppressor. Neither of these reductions were adequate to meet the requirements of FAR 36. Moreover, the multi-tube suppressor would require cooling and/or the use of high temperature materials to permit operation at afterburning temperatures.

As an additional item the Committee investigated the procedures then in use by the Boeing and General Electric Companies for converting engine noise levels measured around engine test stands (on the ground) into predicted in-motion noise levels for the SST. This study was conducted with particular emphasis on the noise levels predicted for takeoff operation with full power at positions 0.35 nautical miles to either side of the centerline of the runway. We found that based on full-scale GE4 engine static testing, together with results of F106 flight testing by NASA, Lewis Research Center, the conversion numbers they were using should be modified. The result would be a lowering of predicted in-flight perceived noise levels by about 4 EPNdB below those that they had been reporting. We recommended that the new conversion numbers be used in subsequent predictions of sideline in-motion noise levels.

In the period between September 11, 1970, and early February 1971, the Boeing and General Electric Companies reexamined the whole question of designing an SST/engine combination that would produce noise levels meeting FAR 36.

In early February, at their invitation, five members of our Committee traveled to Seattle, Washington, to the Boeing Company to investigate the status of engine and aircraft design of the production SST with respect to noise. Two versions of a commercial SST aircraft incorporating engine/

noise suppressor combinations that would result in noise levels meeting FAR 36 were reviewed in detail. Both of these designs would produce sufficiently low noise levels because of the following combination of factors:

1. The engines were to be slightly larger in diameter than those proposed for the prototype SST and would accordingly have larger mass flows of air. The exhaust temperature would be substantially reduced since afterburning would not be employed during takeoff.
2. Two types of exhaust noise suppressors were presented, either of which would produce the required number of decibels of noise reduction at reasonably low thrust losses. These suppressors would be required to operate at temperatures well within demonstrated state-of-the-art.
3. Wind tunnel tests made on large-scale models of the SST at the NASA Ames Laboratory in California revealed a more efficient aerodynamic design than was expected, which resulted in lower requirements on thrust on takeoff.

On February 5, 1971, we reported our conclusions as follows:

"We conclude that the level of technology demonstrated by Boeing and General Electric is sufficient to achieve the noise level objectives we recommended. We are available to discuss our findings with you and other concerned parties as you deem appropriate."

I have attached to my prepared statement a full copy of the Committee's interim report for insertion in the record of the hearings.

With the above statement as a basis, I should like to respond to the specific issues which have been raised in the past in regard to the SST's noise. My comments should not be interpreted as an attempt to discredit or refute testimony which has been given previously, but rather to make available to this Committee and other interested parties the findings and judgments of a group of technical experts regarding the SST as a potential noise hazard.

Issue

The sideline noise of the commercial SST during takeoff will be too great.

Status

Noise objectives for the commercial SST are consistent with the noise levels specified in FAR 36. The nominal values

specified are 108 EPNdB sideline during takeoff and 108 EPNdB over the community after takeoff and during landing, at FAR 36 measuring distances.

These objectives are fully compatible with the airport environment projected for the late 1970's and beyond.

#### Issue

It is unlikely that the sideline noise level of the SST can be substantially reduced below 124 EPNdB.

#### Status

- A. A big step forward has been made in the development of jet noise suppressors. This will result in a larger noise reduction for an allowable loss in thrust than that thought possible in early 1970.
- B. Better aerodynamic performance of the airframe has been achieved during wind tunnel testing of large-scale models of the SST than was predicted prior to 1971. This improvement will permit the use of lower thrust levels during takeoff of the commercial SST which will result in lower noise levels.

- C. Afterburning in the engine during takeoff will be eliminated thereby reducing the level of jet noise and also the difficulty of employing a suppressor.
- D. Engineering calculation methods used to transfer engine test stand noise data over to in-flight noise data for the SST have been refined. The uncertainties in predicting in-flight noise levels of the SST have been largely eliminated as a result of recent tests.

In summary, based on the findings of the SST Community Noise Advisory Committee, there does not appear to be any technical reasons why a commercial supersonic transport cannot be built which will be acceptable with regard to noise. The airlines are presently evaluating two SST design configurations which can meet the noise standards of FAR 36. Out of these airline evaluations, and others which undoubtedly will occur, we feel certain that a viable SST should result.

[From Who's Who in America, 1970-1971]

Beranek, Leo Leroy, scientist and administrator; born in Solon, Iowa, on September 15, 1914; the son of Edward Fred and Beatrice (Stahle) B.; A.B., Cornell Coll., 1933, D. Sc., 1946; M.S., Harvard, 1937, D. Sc., 1940; m. Phyllis Knight, September 6, 1941; children—James Knight and Thomas Haynes. Instructor of physics Harvard University, 1940-43, dir. research on sound, 1943-45, dir. electro-acoustics and systems research, 1945-46; asso prof. communications engring, Mass. Inst. Tech., 1947-58, lectr., 1958—; tech dir. Acoustics Lab., 1947-53; pres., dir. Bolt, Beranek & Newman, research, cons. devel., Cambridge, 1953—; pres., dir. Boston Broadcasters, Inc. 1963—; chmn. bd. Mueller-BBN GmbH, Munich, Germany, 1963—; director Mormac-BBN Corp., Cambridge, Mass. Chairman of the panel on acoustics Research and Development Bd. Nat. Def., 1940-52; mem. com. on hearing and bioacoustics Armed Forces NRC, 1955-58; mem. Mass. Commn. Ocean Devel., 1968—. Charter mem. bd. overseers Boston Symphony Orch., 1968—; mem. vis. com. Center Behavioral Scis. Harvard, 1964—; adv. com. mgmt. devel. Harvard Bus Sch., 1965—; trustee Cornell Coll, dir. Boston Opera Co. (pres. 1961-63). Recipient John Simon Guggenheim fellowship, 1946-47. Presidential certificate of merit, 1948, Cornell Coll. Alumni Citation, 1953; Wallace Clement Sabine Archtl. Acoustics award, 1961; 1st medal le Grouperment des Acousticiens de Langue Francaise, Paris, France, 1966. Fellow Acoustical Soc. Am. (Biennial award 1944; mem. exec. council; vp. 1949-50, pres.-elect, 1953-54, pres., 1954-55; asso. editor, 1946-60, Wallace Clement Sabine Archtl. Acoustics award 1961), Am. Acad. Arts and Scis., Am. Phys. Soc., A.A.A.S., Audio Engring. Soc. (pres. 1967-68), Nat. Acad. Engring., I.E.E.E. (chmn. prof. group audio 1950-51); mem. Am. Standards Assoc. (chairman acoustical standards bd.; dir.). Cambridge Soc. Early Music (pres. and mem. bd. directors). Phi Beta Kappa, Sigma XI, Eta Kappa Nu. Clubs; Mass. Inst. Tech. Faculty, Winchester County, Author: Principles of Sound Control in Airplanes (with others), 1944; Acoustic Measurements, 1949; Acoustics, 1951; Noise Reduction (with others), 1960; Music, Acoustics, and Architecture, 1962. Editor Magazine Noise Control, 1945-55; asso. editor Sound mag., 1961-63. Contrb. articles on acoustics, audio and speech communications systems to tech. publi. Home: 7 Ledgewood Rd., Winchester, Mass. Office: 50 Moulton St., Cambridge, Mass.

#### STATEMENT OF DR. LEO L. BERANEK

Dr. BERANEK. Thank you, Mr. Chairman.

Mr. Chairman and members of the committee:

I am here to express the views of a group of technical experts who, as has been pointed out, came into this to do what we could to understand and, if possible, to help reduce noise levels, not to take a position on the SST as a national need.

I would like to deviate from my prepared testimony, which I have handed out to you, and to talk a little about some of the general points that keep coming up, so you will understand the background for what I have to say.

#### FAR 36 NOISE REGULATION

First, I would like to discuss some aspects of the Federal Aviation Regulations, part 36, issued by the FAA in November 1969. That regulation, which I shall call FAR 36, for short, prescribes certification procedures for new subsonic aircraft in regard to noise.

In it, the noise number 108 EPNdB, which, as you know by now, means effective perceived noise in decibels, appears as the nominal noise standard at several measurement points relative to a takeoff and landing runway. I want to pose four questions in the context of all of this, and then try to answer them.

First, how are people affected by noise?

Second, how are the noise levels measured on an airplane undergoing certification determined?

Third, how was the number 108 EPNdB in FAR 36 arrived at originally by the FAA?

And, fourth, how does this number 108 relate to noise levels in neighborhoods around airports?

Noise has always been present in urban areas. Just by way of an aside, the noise of chariots rolling over cobblestones in Rome were the subject of ancient writings. Only recently, singing street vendors were banned in Lisbon, Portugal. Of course, if things are quiet, even the birds at 4 a.m., in the morning will awaken some people.

This brings up the question: What is known about the response of people to noise? A lot is known about damage to hearing due to noise. For example, we need a steady noise—by “steady” I mean it does not vary in amplitude but keeps going all the time—at 108 PNdB 4 hours a day for 20 years to cause just a moderate hearing loss in 15 percent of the people; 85 percent would not suffer that moderate hearing loss. Aircraft noise is not steady and therefore it does not damage the hearing of residents in neighborhoods.

The procedure for rating noise in FAR 36 is as follows. I bring this up so you will understand what this 108 EPNdB really is. The noise levels of the new aircraft that are undergoing certification test are established at specified weather conditions. The aircraft must be at its maximum takeoff weight. It must also be at its maximum landing weight. The noise is then measured at the three positions you have heard about,  $3\frac{1}{2}$  nautical miles from start of takeoff, 1 nautical mile before the touchdown point, and along two lines each one about one-third of a nautical mile to either side of the runway all along the runway and extending out to a point that is parallel to the  $3\frac{1}{2}$  mile point.

FAR 36 says that for large subsonic aircraft along these side lines and at the two end points, the noise must not exceed 108 EPNdB during the 1 second or so that it is at its peak. Observe that this peak period is a very brief period, and airplanes do not take off more than about one per minute at busy airports at rush hours.

Furthermore, at airports very few planes take off fully loaded.

Hence, the levels are usually substantially lower than the 108 EPNdB.

The same runways are not used all the time, both because of weather and because of changing traffic conditions. Hence, only occasionally and for only a second or so at a time does the noise of a “certified airplane” reach 108 EPNdB at a measuring point.

The conclusion from this is that aircraft noise does not damage hearing, and a second conclusion is that you cannot make direct comparisons between these numbers and numbers that are quoted for steady traffic noise or steady background noise in cities because of the fact that this is a very special kind of measurement.

#### EFFECTS OF NOISE

Now let us repeat the question that I stated a few minutes ago: What does aircraft noise do?

Well, it interrupts the sleep of some people and it annoys some people. Of course, a greater number are annoyed as the noise gets louder. There is no evidence that noise affects task performance, people working at their jobs, unless the person has not slept at all the night before.

We have to ask the question: How do we find out about the effects of noise? The answer is that we conduct social surveys. That is to say, we send experienced social surveyors out with questionnaires, and this certainly has been done. Surveys have been made in this country through the years. I think some four very good surveys exist.

There have been two in England, one very recent.

These involve in some cases very large numbers of people.

What have we learned? First, there is no single noise level above which people complain and below which they do not complain. There is no magic number of decibels.

Second, people complain about dogs, children, doors banging, trucks, motorcycles, and airplanes, and all of these have very different levels. Lawnmowers, too, and snowmobiles.

One important conclusion came out of this. About 25 percent of the people interviewed are not bothered by noise at all. They can sleep through loud noise levels. They do not know what all this shouting is about.

Another 10 percent are bothered by almost any noise, and there is no level of noise that will satisfy them, including the noise of birds, children, and so forth.

Of course, the remaining 65 percent range along a continuum in between.

In the light of these facts, what has the Federal Government done or what stands have they taken in regard to aircraft noise? The Congress passed and the President signed Public Law 90-411 in July 1968. That law required the FAA to initiate a noise abatement regulatory program for aircraft. Because there was no magic decibel number below which noise was fully acceptable, the FAA solicited national comment.

From the responses received, they determined the lowest possible noise level consistent with flight safety, economic reasonableness, and technological practicability. This number turned out to be 108 EPNdB for large four-engine subsonic aircraft, and lower numbers for those smaller aircraft where it was economically and technologically possible to achieve lower levels.

I should point out this 108 EPNdB number, this certification requirement for new subsonic aircraft, cannot, to the best of my knowledge, be met by any large four-engine jet aircraft now flying commercially. The closest that we come to it is the 747, and it misses it a little, and they have a period of a few years in which to try to correct that. The first planes expected to meet this standard will be the Douglas DC-10 and the Lockheed L-1011 if it is built.

Thus, the FAR 36 noise limit is the future level, and will probably prevail as the limit for many years to come.

#### NOISE OBJECTIVES OF SST

So far I have dealt with FAR 36 related to subsonic aircraft, and I would like to turn to page 2 of my prepared testimony and discuss the SST. I will skip over a few things on the way.

At the time the committee began its deliberations, the noise objectives for the production supersonic transport aircraft were those established in 1966. Those objectives, in present terms—by that I mean using the EPNdB concept—called for a maximum sideline noise level

during takeoff, at a sideline distance of 0.35 nautical mile, of 120 EPNdB. However, information published in the January 5, 1970, issue of Aviation Week and Space Technology, which was based upon statements made by the General Electric Co., indicated that the then state of the art of jet noise suppression when applied to the J6G version of their GE4 engine would produce a noise level at the sideline of 124 EPNdB; a number that was 4 EPNdB in excess of the objectives. This number was based upon a primary chute-noise suppressor which was said to offer up to 4 EPNdB reduction in noise levels. Thus, the unsuppressed engine had a noise level of 128 EPNdB. It was also stated in the Aviation Week article that at higher thrust losses greater amounts of noise reduction might be possible.

It was also indicated that these thrust losses were going to be large enough that they probably could not be tolerated. That is the condition under which we started.

We held our first committee meeting at the end of July, and we had numerous meetings thereafter. We were interested not only in obtaining facts on the status of contract efforts, but also in determining whether the combined knowledge of the group might be employed to obtain lower objective noise levels for the production plane.

By September 11, the committee had reviewed available information in regard to the reaction of people. We had also investigated the expected effects on the community noise as a result of FAR 36 coming into the picture.

Finally, we held meetings with representatives from the Airport Operators Council International, who felt they had a big stake in the noise problem, and those airlines contemplating purchase of the production SST, who also felt they had a big stake in the noise problem, and the Boeing and the General Electric Cos.

On the afternoon of September 11, we came to our first conclusions after these many meetings, and reported to Mr. Magruder's office that (1) we recommend that the noise levels for the production SST should be the same as those imposed by FAR 36 for the new 4-engine intercontinental subsonic transport aircraft, and (2) added emphasis should be given by Boeing and General Electric in their respective noise programs.

#### SST NOISE REDUCTION EFFORTS

At that time it was not clear how this objective would be met in the production aircraft.

To show you how things looked, on September 10 and 11, we had meetings with Boeing and General Electric, during which they received test data that indicated they could certainly achieve 4 decibels of noise reduction of an afterburning jet stream with a chute or spoke suppressor. They also reviewed research underway which involved what is called a multitube suppressor that might give reductions of up to 12 EPNdB. Neither of these reductions was adequate to meet the requirements of FAR 36. Moreover, the multitube suppressor would require cooling and/or the use of high-temperature materials to permit operation at afterburning temperatures.

The very positive recommendations of the committee and the ensuing action that Mr. Magruder's office took in respect to the contractors led them to go back and reexamine this whole problem, I suspect night and day.

In the period between then and the first week in February, they came up with an engine airplane combination, which we are convinced from the mass of evidence that they presented to the committee can be built to produce noise levels that meet FAR 36. I hope today I can also convince you that we have sufficient evidence to make that decision.

Five members of our committee—these were the non-Government members—went to Seattle on February 4 to the Boeing company to investigate their present status.

We reviewed two versions of a commercial SST aircraft incorporating engine noise suppressor combinations that would result in noise levels meeting FAR 36. Both of these designs would produce sufficiently low noise levels because of the following combination of factors. I have put these on the board (fig. 59).

(The information being discussed follows:)

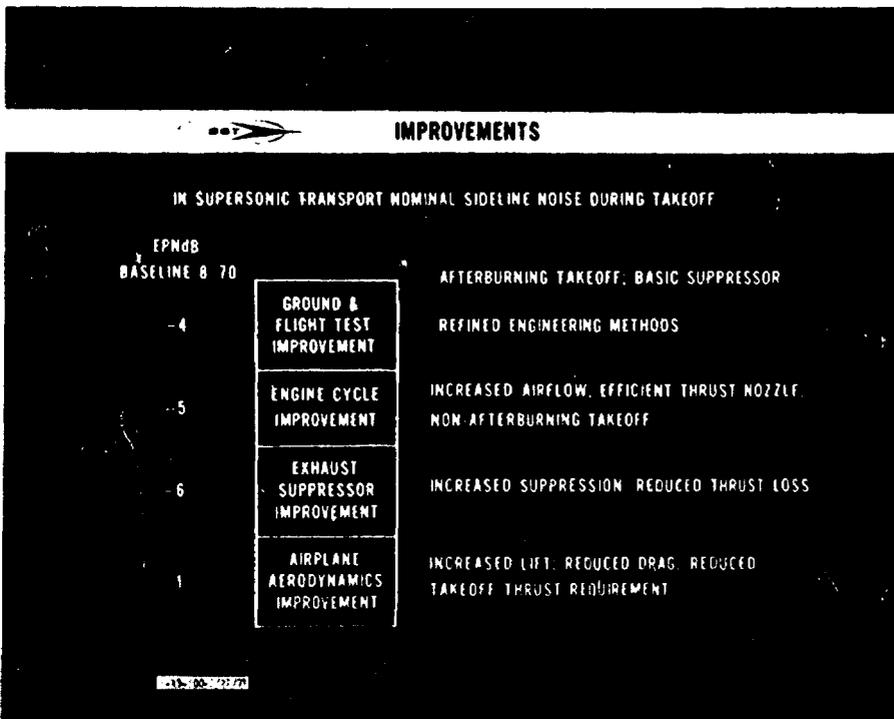


Fig. 59

Dr. BERANEK. The top of that graph is 124 EPNdB, which was the situation at the time the committee came into the picture. This was using an engine that had an afterburner on takeoff, and used a basic 4 EPNdB suppressor.

#### NOISE CALCULATION METHOD

One of the first things we did with Boeing and GE was to reexamine their engineering method of calculation in regard to converting engine noise levels measured for an engine that was mounted on a test

stand on the ground over into inflight moving airplane noise levels. We found that they were using an engineering technique for this conversion that had been developed for subsonic aircraft, and in particular for aircraft of the 707 and the DC-8 variety that was not applicable to a plane that takes off with the speed and climbs with the speed the SST plane does. Fortunately, we were just beginning to get the details of the British-French plane in, and also, fortunately, NASA Lewis Research Center was just beginning to fly an F-106 plane with a J-85 engine on it, and we began to see that the faster takeoff speeds resulted in a different conversion factor. Based on these results we were able to refine our conversion which results in a 4 EPNdB reduction of sideline noise, previously quoted.

This has also now been verified in the case of the British-French plane. They have also found this. This now comes under the category of an updating of the engineering procedures used in calculating what the production plane will do.

#### AFTERBURNER USE

Second, they decided that an afterburner would not be used on takeoff. To accomplish that, it is necessary to increase the airflow through the engine to obtain the required thrust levels. This increase can be accomplished by a small increase in the diameter of the engine, several inches. Getting rid of the afterburner means that the exhaust gas now is at a lower temperature and lower speed. The net result is a 5 EPNdB reduction in the noise.

#### NOISE SUPPRESSORS

Because of the reduction in temperature, we can now start talking about state-of-the-art suppressor of the type that have been fully tested out on the DC-8 and the 707 engines. There are several possible types of state-of-the-art suppressors. Two alternatives were presented, one of which produces between 10 and 12 EPNdB and is called a chute suppressors; and another one, called the multitube suppressor, which would produce between 12 and 16 EPNdB.

What is required? If we take off the four that are already on the base engine, the additional suppression required is six, as I have shown. It means that if the chute suppressor works at its minimum expectation, it will be suitable, and it happens to be mechanically a little bit simpler to carry and stow than the multitube suppressor.

The multitube suppressor has the potential of greater suppression although just a little bit harder mechanically to stow when it is not wanted.

It is our belief that the chute suppressor is going to make it.

Another surprise came out of this. The studies on the chute suppressor showed that it had a lower thrust loss than we had been led to believe was going to be possible, and this meant it was not going to hurt the range of the airplane to the extent we might have thought before this whole study was gone into.

To back up those two suppressors, they produced measured data on 5-to-1 scale models, which is a satisfactory scale modeling, and they also had the experience which they tied in with these scale models

with the DC-8 and the 707. We are convinced that those tests adequate demonstrate the feasibility of this type of suppression.

Then there is a 1 EPNdB difference which came about because they had just completed in December and January aerodynamic tests on the large-scale model of the SST; these aerodynamic tests were done at the NASA Ames Research Laboratories.

They showed that the plane actually had a more efficient aerodynamic design, and this results in a lower requirement for thrust on takeoff. That picks up about 1 EPNdB, and means that the suppressor requirement is just 1 EPNdB less.

#### CONCLUSIONS OF SST NOISE COMMITTEE

Having studied this and having reviewed the data which included reports, charts, and blueprints that were laid out the length of the table here, that we studied, having on the committee people with different kinds of understanding of the problem—there were two members of the group who understood the noise and suppressor field very well from years of experience. We had a man from an airframe manufacturer to look at whether the airframe structure they were showing was feasible from a manufacturing standpoint. We had an engineman from MIT who could comment on the feasibility of a slightly larger engine to make sure there was nothing in this that was out of the state of the art or nothing that they had not already tried in other places. We also had a representative from the airlines who could worry about the efficiencies or the route operating distances and could say whether or not this seemed to be the kind of baseline airplane that they would be interested in.

On February 5, we reported our conclusions as follows to Mr. Magruder's office:

We conclude that the level of technology demonstrated by Boeing and General Electric is sufficient to achieve the noise-level objectives we recommended.

Then we said we were available to discuss these findings with him and other concerned parties that he deemed appropriate.

I have attached a copy of the committee's interim report for insertion in the record of the hearings.

(The information follows:)

#### MEMORANDUM

FEBRUARY 5, 1971.

To: Mr. William M. Magruder, Director, SST Development, Department of Transportation.

From: Dr. Leo L. Beranek, Chairman, SST Community Noise Advisory Committee.

Subject: Supersonic Transport Noise.

We are pleased to submit this interim report on the activities of the SST Community Noise Advisory Committee, which you appointed in July 1970. Our initial step was to review the SST noise objectives in relation to the noise at the Nation's airports, together with the projected improvements resulting from the introduction of new, quieter subsonic airplanes meeting certification requirements of FAR 36 (Federal Aviation Regulation—Part 36: Noise Standards, Aircraft-Type Certification). This review also included meetings with the airlines, airport operators, Boeing, General Electric, and representatives of Government agencies active in aircraft noise.

On September 11, 1970, I reported the first conclusions of the committee to you as follows:

1. The noise levels for the production SST should be the same as those imposed by FAR 36 for new four-engine, intercontinental, subsonic transport aircraft.

2. To meet the above objective, added emphasis should be given by Boeing and General Electric in their respective noise programs.

Since that oral report, the committee has kept abreast of the progress on the program relative to reduction of the noise levels projected for the production SST. On February 4, 1971, we reviewed in detail with Boeing and General Electric the status of engine and aircraft design of the production SST with respect to noise. This review included results of recent tests on a number of jet noise suppressors, aircraft and engine performance, and the adequacy of engineering methods in predicting the noise levels for the production SST.

We conclude that the level of technology demonstrated by Boeing and General Electric is sufficient to achieve the noise level objectives we recommended. We are available to discuss our findings with you and other concerned parties as you deem appropriate.

LEO L. BERANEK,

*Chairman, SST Community Noise Advisory Committee.*

Dr. BERANEK. In summary, based on the findings of this committee, there does not appear any technical reason why a commercial supersonic transport cannot be built which will be acceptable with regard to noise, and we conclude from the other evidence that was presented to us and which is contained in reports that have been sent to the airlines for them to study, that this airplane will achieve the goals that the SST office has set up for it in terms of range and load-carrying factor.

Thank you very much.

#### PRODUCTIVITY

Mr. McFALL. Thank you, Dr. Beranek.

Before we start the questioning of the distinguished panel, including yourself, have you any comment you would like to make about any of the testimony we have heard during the past day?

Mr. MAGRUDER. Yes; I do, Mr. Chairman. I appreciate the opportunity to do that at this time. Then perhaps we can open up the whole group to your cross-examination, if that pleases the committee.

First of all, a gentleman testified yesterday on the subject of the validity of our productivity factors. I think the implication was that because we did not include costs, our productivity factors were perhaps not valid.

I want to say in the strongest possible way that this is nonsense. I think in the terms of the dictionary, productivity is defined as that quality having power of producing work. Productivity is that quality or state of being productive. Cost is not a part of the definition of productivity.

I would like further to reemphasize, as I said in my opening statement before I testified, that all of the productivity and balance-of-trade studies that I testified to yesterday have been reviewed both with respect to the formula, the content, and the actual level of the numbers, with the Civil Aeronautics Board, the Treasury Department, the Commerce Department, and the Export-Import Bank. We are in complete agreement on the definition and the equation.

#### TOTAL COST

That does not mean that cost is not an important and decisive factor in the overall economics, but it is not in opposition in any way to the validity of productivity numbers that I offered yesterday.

Total cost includes, in terms of operating costs, some of the following items.

Crew costs are included. These, by the way, are speed-sensitive. In other words, you can get an advantage by having a more productive airplane in that equation which includes a faster airplane.

Fuel and oil costs, which are speed-sensitive.

Insurance costs, which are speed-sensitive.

Depreciation costs and maintenance costs, both of which are speed-sensitive.

Ground property and equipment.

Aircraft servicing, which is speed-sensitive. That means the faster airplane has a break. It will do better than the slower, subsonic airplane.

Aircraft control costs.

Cabin attendants and passenger food, which are both speed-sensitive.

Traffic servicing.

Administrative services.

Reservation and sales.

Cargo sales and general administration.

All add up to the total direct and total indirect costs.

You will remember the curve I showed yesterday with the total operating costs (fig. 56).

I want to assure you that those are the understood numbers that are accepted by the agencies, and the ones that we use. In summary the DOT studies show consistent and accurate detail on the elements of costs. The gentlemen testifying, I am afraid, from the information that I saw, and that which was related to me, dealt in generalities, where we tried to deal in specifics. We submitted all of our testimony to the proper agencies inside the Government and to the airlines and got complete agreement. Many of the assumptions that were testified to yesterday by the opposition are incorrect. Turnaround times, the number of seats, the block times, et cetera, were incorrect for supersonic transport operating costs. What I would like to recommend is that my office supply for the record what we consider to be accurate and correct productivity factors.

Then a comparison can be made using the opposition's methods but with what we consider to be the correct data for operating speed for the aircraft and the number of seats. This will show, I believe, that our methods and the opposition's methods, are the same, if you use the proper inputs.

#### SST VS. 747 PRODUCTIVITY

I will give an example. At 3,600 nautical miles using the opposition's data, the SST seats divided by time is 281 divided by 2.8 for 100. The 747 seats divided by time is 384 seats over 7 hours for 55. The ratio of productivity is a ratio of approximately 2. The exact number is 1.82. You will notice in my testimony yesterday I said the SST was approximately twice the productivity of the largest and most efficient jumbo subsonic jet. With your permission, I would like to do that calculation and submit that for the record.

(The information follows:)

PRODUCTIVITY—SST VS. 747, BASED ON TECHNICAL DATA FOR 3,600 STATUTE MILE FLIGHT<sup>1</sup> USING EQUATIONS PROPOSED BY RUSSELL BROWN, MARCH 3, 1971

	SST	747	Ratio--SST to 747
No. seats 10/90 1st class/coach configuration on comparable basis <sup>2</sup> .....	281	384	.....
Block time—hours <sup>3</sup> .....	2.8	7	.....
Equivalent speed—m.p.h.....	(1,286)	(514)	.....
Equation—passenger seats per hour.....	$\frac{281}{2.8} = 100$	$\frac{384}{7} = 55$	$\frac{100}{55} = 1.82$
			= 2 rounded
Passenger seats per hour X distance = seat miles per hour (DOT standard) <sup>4</sup> .....	$100 \times 3,600 = 360,000$	$55 \times 3,600 = 198,000$	1.82

<sup>1</sup> Approximates CAB distance of 3,635 st. miles, New York-Paris.

<sup>2</sup> From table 6, Summary of Current Economic Studies of the U.S. SST, September 1969, Office of SST Development.

<sup>3</sup> Includes all taxi and flight time according to standard definition of block time by Air Transport Association and all aircraft manufacturers. Excludes turnaround time which is not an element of block time and not related to aircraft productivity.

<sup>4</sup> Standard used in Figure 50, opening statement of W. M. Magruder.

#### AIRLINES' SUPPORT OF SST

Mr. MAGRUDER. Second of all, a gentleman in opposition, a former Secretary of the Interior, testified that the airlines do not want the SST.

I have letters from the board chairmen or presidents of the top airlines in the United States and in the free world indicating support for the SST. These letters have been made available and are a part of the record.

Mr. Yates read two letters which I would like to emphasize are obsolete and do not represent in any way the 1970 position of those particular airlines. With your permission, I would like to read the actual letters for the record from those two airlines.

The first is United Airlines, addressed to me and signed by the president of United Airlines, at that time Mr. George Keck. This is dated June 25, 1970.

(The letter follows:)



Mailing address: P.O. Box 66100, Chicago, Illinois 60666 Phone: (312) 437-2300

OFFICE OF THE PRESIDENT

June 25, 1970

Mr. W. M. Magruder  
 Director SST Development  
 Office of the Secretary of Transportation  
 Washington, D. C. 20590

Dear Bill:

Recently several of us representing the trunk line industry discussed the SST development program and the industry's position relative to it. There was unanimous agreement that the most helpful action that could be forthcoming from the industry would be the issuance of an industry position through the ATA. Stu Tipton is currently drafting this statement for the industry and I would expect that it should be available in the reasonably near future.

Therefore, I would prefer not to make any statements that are to be used publicly in the name of United Air Lines at this time. It may be that you would wish to discuss this matter further with Stu Tipton.

Best regards,

Sincerely,

*George*  
 G. E. Keck

*m. l.*

GEK:ml

(Dictated by Mr. Keck but  
 signed in his absence)

## LETTER FROM THE PRESIDENT OF EASTERN AIRLINES

Mr. MAGRUDER. Mr. Tipton is here and is going to testify. I need only say that he did testify last year in complete and 100-percent support of the SST, reflecting Mr. Keck's position also.

I also have a letter here signed by Mr. Sam Higginbottom, now president of Eastern Airlines, dated June 24, 1970. I would like to insert it in the record.

Mr. McFALL. We shall include it in the record at this point.  
(The letter follows:)

EXECUTIVE VICE PRESIDENT AND GENERAL MANAGER

June 24, 1970

Mr. W. M. Magruder  
Director, SST Development  
Office of the Secretary of Transportation  
Washington, D. C. 20590

Dear Bill:

During the past few months, the U. S. SST Program has reached a stage of development where little, if any, gains can be made by additional study. The technical questions remaining can only be answered by actual flight tests of the proposed configuration. Eastern has believed strongly in the continued improvement of air transportation, and while speed is not the only service we can offer, it certainly contributes heavily to both convenience of service and improved productivity.

Historically, the advantages of speed have always borne fruit. Larger and fancier ships and trains did not save those modes of transportation from the competitive push of the aircraft, and certainly the growth of air travel in the past decade would not have been nearly as spectacular if the jet had not entered the picture. While the current generation of wide body jets does offer the possibility of substantial improvement in service and productivity, they all lack the element of speed improvement that has been characteristic of our business. There is no question in my mind but that progress will demand the advent of the SST, if not by a U. S. manufacturer, then, by some other government sponsored project.

As you are no doubt aware, the Concorde seems to be meeting its technical objectives very well, and if there can be any criticism of that program, it should be aimed more at the apparent mismatch of revenue potential and forecast operating cost. Much of this can be attributed to the length of time it has taken to develop the aircraft while a rapidly changing economy has literally run away from the revenue capability with little or nothing the manufacturers could do about it once they were committed.

Mr. W. M. Magruder  
Page 2.

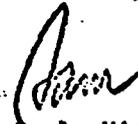
June 24, 1970

It has been our desire to avoid this pitfall on the U. S. Program, and to this end we have always advocated a decoupling of the prototype and production program so that we can get the maximum benefit of the test program before production, and then having achieved that benefit, move into the production design as rapidly as possible to minimize the creation of any economic gap.

In summary, it is Eastern's position that:

1. Increased speed of aircraft will be a saleable commodity in the future just as it has in the past.
2. Other countries are substantially ahead of the U. S. in the development of the SST, although their aircraft leaves something to be desired from an economic point of view.
3. In order for the United States to maintain its leadership in the manufacture of air transportation, we must proceed with new development on all fronts.
4. The U. S. SST prototype program should go forth as rapidly as possible, or we run the risk of allowing our competitors sufficient time to develop and produce more attractive versions of the present design.

Sincerely,



S. L. Higginbottom

cc: Mr. F. D. Hall

Mr. MAGRUDER. I also have available for the record a summary of a very unusual hearing dated last year, I believe, December 7, wherein the top airline presidents gathered in emergency session in the Wings Club in New York, and issued a very strong statement on behalf of the airlines, supporting the SST prototype development program. That meeting was chaired by Mr. Halaby, but was attended by the big five, and included letters from other major airlines. I would like to say I don't know who Secretary Udall talks to in the airlines, but it is certainly not the presidents and board chairmen.

(The information follows:)

Major airlines of the United States held a press conference today, December 7, 1970, at the Wings Club in New York City's Biltmore Hotel. Attending were Najeb Halaby, President and Chief Executive of Pan American World Airways; Charles Tillinghast, Chairman of the Board, TWA; George Spator, President and Chief Executive Officer, American Airlines; Lloyd Hall, President and Chief Executive Officer, Eastern Air Lines; and John Blackman, Vice President Public Affairs representing George Keck, President and Chief Executive Officer, United Airlines.

In a statement on behalf of those present Mr. Halaby said:

We are here today to express our convictions that the United States should proceed with the program to build two prototype supersonic transports for test and research purposes.

This program is essential so that we do not foreclose the possibility of our country building the airplane of the future and forfeit that opportunity instead to the British, French or Russians.

The Senate's reversal of America's supersonic transport program is a drastic extreme measure. Here was a nine year old policy supported by three Presidents---initiated by President Kennedy and supported by Presidents Johnson and Nixon---and by five Congresses since then, a program studied by scores of Congressional committees. We thought there was no doubt as to the country's policy, only the question of how much appropriation should be allocated on what schedule.

After studying the debate, the Chief Executive of the airlines represented here today realize that <sup>the Senate</sup> 52 senators of the United States do not understand the program and has reversed its field in the ninth year of the program.

There have been a number of questions asked on the U.S. SST development program and we would like to reply to them.

The first question is whether or not the airlines support this program?

The answer is unequivocally we support the program to build two prototypes, then to decide whether or not a production model should be built, of what specifications with all of the test data before us, not speculation by scientists pro and con but actual hard facts before us. This program, therefore, has the support of the airline industry.

Second, are we able to pay for our part of the program?

We believe that the government and the aerospace industry and the airlines will be able to arrange for each to pay its part in the time period 1975 to 1980.

Third, are we prepared to invest in the program?

Twenty/<sup>six</sup> airlines have already put up \$81 million in the program--\$18 million for Pan Am alone--money we could have used otherwise, but which we paid into the U.S. Treasury five years ago as our evidence of faith in the program.

Fourth, how about the airplane engine and engine manufacturers?

They have invested some \$206 million and are committed to invest further as the program progresses.

Fifth, what about jobs?

The American program means jobs... tax revenues... a favorable balance of trade. It means the creation of jobs for Americans, not the export of jobs-- not only for 1971 and 1972 but for the entire decade and probably the next two decades. We think that keeping thousands of highly skilled people employed in any economy that has almost five million unemployed would be a high national priority.

Sixth, is this a subsidy by the U. S. Government?

It is not a subsidy to labor, the manufacturers or to the airlines. The government estimates that the SST, if successful will return its investment to the U.S. Government--a billion dollars if 500 aircraft are sold.

Seventh, what sort of a supersonic will we as airlines accept?

Only one that is safe and economically and socially acceptable.

We haven't the slightest intention of sonic booming our passengers or prospective passengers or our prospective shippers. We haven't the slightest intention of making any more disturbances at airports than we now make and we have assumed all along that none of the Governments in which we might be permitted to operate this airplane would permit any such social damage or disturbance. Not only does the Government prohibit such damage or disturbance, but we would not undertake it. The fact is that we do not yet know whether there would be any damage or disturbance. We will only know when development and testing are complete.

The SST is coming. The sole question is whether we do it, or whether we let someone else do it. If we do it we will gain the benefits.

If somebody else does it, we will lose world leadership in aviation as we have lost it in shipping. As we look around the world and see what is happening in steel production, automobile production, textile production, is there not some basis for the conclusion that we had better hold tight to what production advantages we still have?

We believe opponents of the SST have been misguided in wanting to cancel the prototype program when that program is specifically designed to determine whether or not an environmentally satisfactory SST can be built.

We believe opponents of the SST have seriously underestimated the adverse economic effects, both immediate and long term, of canceling the program.

## ROYALTY

Mr. MAGRUDER. A second item I would like to answer is the point made in the testimony yesterday in opposition to the SST, that there will be no royalty paid back to the Government until the 101st aircraft. I want to emphasize most strongly this is simply not true. The contract says the United States Government can require a royalty on the very first airplane.

## OIL RESERVES

The next item that I would like to rebut is a statement to the effect that the United States' SST, or SST's in general, will use up the world's oil reserves.

I am not an expert on the size of the oil reserves and would like to quote from the following study from the Department of the Interior which my office asked for, following publication of a similar statement in a London newspaper. By the way, it was the same newspaper that recently published an article saying that BOAC and Air France did not want the Concorde. This statement was followed within 24 hours by denials from both BOAC and Air France, fully supporting their position on purchasing the Concorde.

This particular letter is addressed to me from the Assistant Secretary of the Interior, and I quote:

The results of our investigations are attached for your information. The basic conclusion is that the SST's will not be a threat to the world's oil supply. There will be adequate jet fuel available to power the total world jet fleet aircraft well into the year 2000 and beyond.

They offer some figures already included in the testimony that show this. One figure shows that the oil reserves are being discovered at a significantly faster rate than oil is being consumed, in spite of jets, SST's, and so forth. Another figure shows that 5 percent of the projected crude oil production, a very conservative estimate, is more than adequate to supply all of the civil jet fuel demands, including the SST's. That is through the year 2000. Another figure shows that gasoline for automobiles, and not jet fuel for aircraft, will continue to be the major driving force in crude oil consumption.

Mr. CONTE. I couldn't hear that.

Mr. MAGRUDER. The last item was a figure which showed that gasoline for automobiles, not jet fuel for aircraft, will continue to be the major driving force in crude oil consumption. As a matter of fact, I think that the jet fleet represents something of the order of 3 percent of the total consumption of fuel, so it is a very small percentage.

Mr. CONTE. Can I make an observation here?

Mr. McFALL. Yes.

Mr. CONTE. Dr. Singer was snickering there, I noticed, in regard to the oil shortage; but let me tell you we have difficulty on the eastern seaboard getting oil. There is an oil quota put on by the Federal Government for the past year to preserve the oil supply and resources of Texas, Oklahoma, and Louisiana. That is the only reason (in the guise of national security) that we can't use up this oil. We have a shortage of oil in New England today.

Mr. YATES. We have a shortage in Illinois, too, Mr. Conte.

Mr. CONTE. A very serious one.

Dr. SINGER. You misread my smile. I am well aware of the oil shortage, since I am in the Department of the Interior.

Mr. CONTE. Maybe you can help me get rid of that quota then. Thank you.

## INTERNATIONAL AIR TRAVEL

Mr. MAGRUDER. Another item, Mr. Chairman, that I would like to rebut, is a statement made by a Congressman who testified yesterday that only 1 percent of the population benefited from the SST.

Mr. BOLAND. Mr. Magruder, will you give that statement again? What was the testimony?

Mr. MAGRUDER. Yes. A Congressman testified yesterday that only 1 percent of the U.S. population would benefit from the SST. I would like to put in the record that, based on calculations that have been reviewed by the CAB and ATA, it can be shown that 10 percent of the 1985 U.S. population, or 25 million people, will be traveling by SST's. I would like to further point out that 900,000 passengers traveled during July of last year, between the United States and Europe, based on IATA data, and by 1985 that number will triple.

This number of 10 percent of the population, or 25 million, does not include people who will be traveling from the western shore to Honolulu, and from the eastern shore to places in the Caribbean, which is expected to be another 9 million Americans, so the 1-percent population benefit statement is quite misleading, based on the statistics available.

Mr. YATES. How does IATA know that?

Mr. MAGRUDER. I beg your pardon?

Mr. YATES. How does IATA come to that conclusion of what the passenger travel in 1985 will be?

Mr. MAGRUDER. The estimates are based on studies—

Mr. YATES. There is no SST in existence at the present time. It will not be in existence for many years.

Mr. MAGRUDER. It is based on the projection of travel up through the present time, which is known, plus the travel which will be projected on a conservative growth, which I showed the other day, of about a 9-percent rate.

Then we use 75 to 80 percent of the international air routes as SST routes, and by that projection we can arrive at 20 million Americans will be traveling by 1985 on SST's. The IATA figure, I must say, is the current figure of 900,000 for July of 1970.

Mr. YATES. I am sorry?

Mr. MAGRUDER. The IATA figure is the current figure. The projections are our own, with assistance from CAB, ATA, and others.

Mr. MCFALL. Have you concluded, Mr. Magruder?

Mr. MAGRUDER. I have one more.

Mr. YATES. I didn't understand that last answer, Mr. Magruder. Did you say you testified as to what the IATA figure would be for 1985? Are you now saying that is not the IATA figure, but yours?

Mr. MAGRUDER. I am sorry if I misled you. The IATA figures are International Air Transport figures based on what is going on currently, and I quoted numbers, for July of 1970. I think I said, 900,000 passengers went to and from Europe.

Mr. YATES. But not by SST.

Mr. MAGRUDER. In July of 1970?

Mr. YATES. What you did then was to extrapolate?

Mr. MAGRUDER. Yes, sir.

Mr. YATES. Based upon what the present international travel is, and what you conceive the SST routes will be in the future, and use that as being the basis for SST travel in 1985, which assumes that there will be, at some point between now and 1985, SST's coming into existence.

Mr. MAGRUDER. Your statement is correct, and that is the only way we can do it, and the only way the CAB and others can do it.

Mr. McFALL. It is important to know the basic information as to how many people are flying today overseas.

Mr. MAGRUDER. Absolutely.

Mr. McFALL. I think there is a substantial number, and if we have that for record, what the expectation of overseas travel would be in 1980, I am sure we will have solid information. I think the testimony yesterday was that this is a jet set which is a very minor part of our luxury-loving population.

Mr. BOLAND. But one of the most telling arguments with the public, of course.

Mr. YATES. And rightfully so. It will be for a superfare group.

Mr. BOLAND. That is questionable.

Mr. McFALL. We will have a recorded teller vote, we are informed, in a very short time. For that reason, we will recess for a short time.

(Recess.)

Mr. McFALL. You had one more point that you wanted to make.

Mr. MAGRUDER. I am ready for any cross-examination.

#### NEW YORK TIMES ARTICLE ON SCEP

Mr. McFALL. Dr. Kellogg, on page 4 of your statement you refer to the fact that you were chairman of the Climatic Effects Working Group for SCEP. On August 2, 1970, the New York Times carried an article entitled "Scientists Ask SST Delay Pending Study of Pollution." I will read the first two paragraphs of that article.

Scientists from the United States and Europe, after a month-long meeting here on environmental problems, recommended today that large-scale operation of supersonic transport planes be delayed until serious questions about the planes' potential for environmental contamination can be answered.

The scientists, concluding their study of global pollution problems and effects on the earth and its climate, indicated that regular stratospheric flights by such planes could cause an increase in cloud formation and higher stratospheric temperatures, with consequences that are unpredictable.

Are you familiar with this article?

Dr. KELLOGG. Yes, I am, Mr. Chairman.

Mr. McFALL. Do you feel the article accurately presented the results of your study?

Dr. KELLOGG. The article as a whole—it has been sometime since I read it—my impression was that the article as a whole reported fairly on it, and I think it was just the headline that was very misleading, and, of course, some people just look at the headlines. Let me read the statement in this report that is echoed in that headline incorrectly. The statement in the report is as follows:

We recommend that uncertainties about SST contamination and its effects be resolved before large-scale operation of SST's begins.

Of course the intent, if anybody read the report, of that would be clear. We were recommending a research program. We felt that with an adequate research program, we could resolve the uncertainties in our estimate before a decision had to be made about full-scale operations of the SST's. There wasn't anybody in our working group who would not have been violently opposed to the SST program, if we could find an environmental effect that would be deleterious. We couldn't find anything that would be deleterious. We, nevertheless, recommended that we look into it. We did not recommend that the SST program hold its breath while we looked into it.

Mr. McFALL. A portion of the report was presented to the committee yesterday. This is from page 107.

We perceive that man's activities as he flies the projected 500 SST's can have a clearly measurable effect in large regions of the world where they will fly, and quite possibly on a global scale. The effects will be most pronounced in the stratosphere, but we cannot exclude the possibility of significant effects at the surface. We must emphasize that, due to the uncertainties in the available information and its interpretation, we cannot be certain about the magnitude of the various effects.

Therefore, we recommend that uncertainties about SST contamination and its effects be resolved before large-scale operation of SST's is implemented.

Is this the same thing that you discussed?

Dr. KELLOGG. The way the report is organized is to have a summary of all of the recommendations at the beginning. The summary that I was reading from earlier was on page 17. On page 107 is the full text, which includes that statement. It is the same statement word for word, I believe.

#### ENVIRONMENTAL RESEARCH

Mr. McFALL. What environmental research is presently being accomplished that will provide answers related to the SST climate modification questions?

Dr. KELLOGG. The environmental research planned?

Mr. McFALL. Presently being accomplished or planned?

Dr. KELLOGG. The SCEP report does go into some of the research that is needed, in order to clarify the question, and I can summarize this very briefly. Incidentally this is also the basis for a program that the Department of Transportation is already planning, which covers the same general elements that I will mention.

First of all, we need to know what the emissions of the SST are in flight. At the time we did the study, there were quite a few uncertainties about just what is going to come out of that tailpipe, and in particular the particle emission and the nitric oxide emission. This needs to be clarified.

Another aspect is what happens to these particles in the stratosphere where they are subject to a very complicated environment involving a lot of ozone and ultraviolet radiation.

We understand a good deal about the reactions that take place there, but it seems to me that there are enough uncertainties so that we have to do some more homework, to refine what we have concluded. In particular we must look at the question of the interaction between water vapor and maybe some of the other products of exhaust and ozone.

## PROTOTYPE AS RESEARCH VEHICLE

Mr. McFALL. But as I recall the statement that Mr. Magruder quoted that you made, your opinion is that we can do this kind of research as we build prototypes. There is no need to delay building the prototypes or stop the program at the present time, in order to find the answers to these environmental questions.

Dr. KELLOGG. This is correct, for two reasons really. One is that at the present time there would be no reason, on an environmental basis, for not going ahead with the prototypes, or with the whole program for that matter.

Second, we don't need to have the prototypes in being, in order to get started on the research program, because we can use other aircraft. We can study these matters in the laboratory and theoretically.

Dr. SINGER. May I just add a word, Mr. Chairman. The matter has come up from time to time, do we need the prototypes in order to meet all of our environmental concerns, and it has been debated both ways. We have thought about this long and hard.

Our considered opinion is that we can resolve the outstanding concerns by immediate research programs, but that there will be a few matters left, where we would like to have prototypes, in order to be 100 percent sure. It is perhaps a difference between 99 percent sure and being 100 percent sure. Therefore, the prototypes will certainly aid in narrowing our uncertainty considerably, and increasing our confidence. The program as we have had it presented to us by the Department of Transportation would in fact be completed in approximately 2 years time, and give us the answers that we need in order to resolve these concerns.

Mr. McFALL. Certainly you are not going to know the kind of sonic boom, are you that this plane in its configuration is going to produce?

Dr. SINGER. That is entirely correct.

Mr. McFALL. Without the plane?

Dr. SINGER. That is entirely correct. I am speaking now, however, just of the weather modification or climate modification aspects that we have discussed here, in our testimony.

## ENVIRONMENTAL MEASUREMENTS

Dr. KELLOGG. Mr. Chairman, there are a couple of other items that I would like to mention that need to be looked into here, in order to have a meaningful research program. We have to go on into, for instance, measurements of the conditions in the stratosphere. We at the National Center for Atmospheric Research, with the help of the Air Force, have been making such measurements in the stratosphere, but on sort of a shoestring and a piggyback basis, and not often enough to really get a complete picture of what is there. This work should be extended. This also is part of the Department of Transportation recommendation or proposed program.

Then, another aspect that needs to be looked into is a theoretical one, one that we can probably do by atmospheric models, using large computers. This is to determine what happens to the atmosphere when you change something in the stratosphere. The interactions in the atmosphere, as you, I am sure, are aware, are very complex. We are not sure

what happens, for instance, when you change the ozone, when you change the water vapor. We know the direction of the change, but we are not sure of the magnitude; and we can get at this by good atmospheric models, but these are hard to construct. We need the very best meteorologists we can find to work on this problem. They are not working on it right now.

There are other aspects which I don't think I need to go into. I feel they are a little less important, such as the study of cloudiness in polar regions and so forth. I think I have named the many components of the research program that I would like to see done, and I think the Department of Transportation, the NOAA, the AEC, which has been sampling the stratosphere, and of course the National Center for Atmospheric Research are all eager to work on this problem.

Mr. MAGRUDER. Mr. Chairman, I was wondering if you could give me some guidance. We had not intended that Dr. Beranek and Dr. Kellogg be here tomorrow. Do you think that they would be required tomorrow?

Mr. McFALL. Unless we finish with them tonight, and I don't see how we can do that. Mr. Conte, would you like to ask questions of any of these gentlemen?

Mr. CONTE. Yes.

Mr. MAGRUDER. Mr. Chairman, would it meet with your approval if only Dr. Singer and Dr. Beranek are here tomorrow morning? Dr. Kellogg has a 9 o'clock meeting at the Goddard Space Center tomorrow, but Dr. Singer can field the same questions that Dr. Kellogg does.

Mr. CONTE. Actually, I will be very, very brief. I don't imagine we will have many questions.

Mr. MAGRUDER. We are happy to stay here at your discretion.

Mr. McFALL. In order to take care of this one particular little problem, let's see if we can get all the questions asked of Dr. Kellogg tonight.

#### SKIN CANCER

Mr. CONTE. You state on page 5, Dr. Kellogg, that a 10-percent increase in water vapor would decrease the total ozone content of the stratosphere by 1 or 2 percent, but this change would be, using your words, "too imperceptible to measure."

Yesterday we heard from Dr. James McDonald. He stated that a 1-percent decrease in ozone can result in a 5- to 10-percent increase in skin cancer. I am sorry, yesterday, I didn't ask him how he reached his conclusion on skin cancer because he was not an MD. Do you disagree with these findings? Would you care to comment on these findings?

Dr. KELLOGG. I think, as I mentioned earlier, Mr. Conte, Professor Jim McDonald is a very good atmospheric scientist, and when he sticks to the subject of the atmosphere, I have really no quarrel with what he says. I think he understands the way the atmosphere behaves as well as anybody.

The matter of putting this in perspective is what he tried to do, and I think there he gets a little out of his field, and I don't want to tangle on the medical question. I would just simply like to put this into perspective.

Mr. CONTE. Let me interrupt you there, and I hesitate to do so, but wouldn't it require some medical background to arrive at this conclusion, or could you arrive at this conclusion without medical background?

Dr. KELLOGG. I would rather not answer that question. I certainly wouldn't want personally to arrive at such a conclusion without a great deal of support from competent medical people.

Mr. CONTE. You have answered it. Go ahead.

Dr. KELLOGG. The 1 percent in total ozone, or make it 2 percent change in total ozone is superimposed on very big fluctuations, 50 to 75 percent, and these occur from day to day, season to season, and from place to place. It is a variable thing. You can change the ozone above you, which is what we are talking about, by about 1½ percent by going from sea level to my home in Boulder, Colo. You can also change it by going something in the order of 50 to 100 miles north or south. Then on the airplane coming in Wednesday, I was playing with Jim McDonald's figure of 10,000 cases of skin cancer, and decided it might be fun to play his game for a moment. Everything is related to everything else, according to his argument, in a perfectly linear way, so if you change something by a certain fraction, everything else changes by the same fraction.

Ten thousand cases of skin cancer in a population of 200 million corresponds to about one in 20,000, so in a sense it has a probability of affecting you or me of one in 20,000, and anything we can do to reduce our exposure by that same fraction ought to eliminate the effect of the SST's, and on that basis, a man who goes out into the sun every day of his life has to wear a hat one day—you live about 20,000 days, you see, so you have reduced that probability, and in a sense eliminated the effect of the SST. If you are like me and just go out weekends, I figure you have to wear a hat once in 100 years, and if you have to go and sit on the beach, and you are worried about total body exposure, then you should cover your bikini with a bathrobe once in 2,000 years, about. It seems to me that this kind of thing puts the McDonald type of argument into perspective.

#### WATER VAPOR

Mr. CONTE. Page 6 of your statement: In view of "the inadequacies of the Mastenbrook stratospheric humidity measurements," are other programs being set up to rectify the situation and if so, what are they?

Dr. KELLOGG. The measurements of stratospheric water vapor are extremely difficult, and so far as I know Henry Mastenbrook is the only one who has been making a long series of measurements with proper instrumentation. There have been other attempts, but they have given results which don't make very much sense.

I think it is fair to say that there are several plans to get into this business, and measure water vapor in the stratosphere more extensively, including plans at the National Center for Atmospheric Research, but we have only just begun them. This is part of the Department of Transportation's program, and I hope that we can get started right away on this.

Mr. CONTE. On page 12 of your statement you state that: "Our general theories of climatic change are still very shaky." There is a need

for a great deal more knowledge about these matters. According to your group, how large a scale would SST operations have to be to have imperceptible and trivial effects on the climate?

Dr. KELLOGG. The statements are based on calculations which have taken only two things into account in the atmosphere, water vapor absorption and infrared radiation. You can calculate how much infrared radiation will be absorbed and emitted, when you add more water vapor to the stratosphere.

The best calculations that have been done so far, that I know about, were those made by Dr. Manabe and his colleague, Wetherald, at the NOAA Geophysics Laboratory which published these results in 1967. These are the results that we quote. However, the reason I say these are incomplete calculations is because they only calculate what happens in a vertical column of the atmosphere, and these calculations do not take into account the way in which the atmosphere would adjust on a larger scale. If you heat the atmosphere in one place it is going to start moving to readjust itself, and there the Manabe-Wetherald calculation does not take what we call the dynamics situation into account. It is the best calculation we have, however.

Mr. CONTE. I read something the other day that intrigued me. This is really a diversion, that the air is warmer in the Atlantic for the SST run than it would be from the west coast of the United States over to Australia, let's say. There the air would be much colder. As you get up higher over the Atlantic, the air becomes warmer. Is that true?

Dr. KELLOGG. I think maybe you are referring to the latitude change in temperature. The stratosphere is colder in equatorial regions at this level than it is at middle latitudes and is warmer over the pole. It is peculiar. It is just the opposite of the way it is here at the ground.

#### ENVIRONMENTAL RESEARCH GROUPS

Mr. CONTE. That is how limited my knowledge is about climatic conditions. On page 13, can you outline for the committee exactly what the research group is engaged in, relative to future SST operations?

Dr. KELLOGG. Well, a number of research groups would be involved. There are very few involved right at the moment. The work that we know about going on right now has to do with engine emission tests underway at the General Electric Co. In fact, it is the results of the GE studies that were quoted in our SCEP report. I understand that they are still working on this and have better numbers now, so that is one group that is working on it already, General Electric.

As I mentioned, NCAR, my organization, with the help of the Air Weather Service and the AEC, has for some time been undertaking sampling of the stratosphere, and the AEC even before these hearings had agreed to step up this sampling program to twice a year on a basis which will involve four stations up and down roughly the West Coast of the United States, Central America, and South America. One of those bases will be in Argentina. And from these four bases in Argentina, Panama, Albuquerque, and Alaska we will run a really good cross section of the stratosphere to find out what is there. As I say, this is AEC-sponsored and involves Air Weather Service and NCAR, with filters and sampling devices on the aircraft.

The NOAA has also made a long series of observations from the ground of various residuals in the atmosphere, particularly from Mauna Loa Observatory, which I think are pertinent to this question. They also have the Geophysical Fluid Dynamics Laboratory, which I already referred to, in Princeton, N.J., which is doing outstanding work in modeling of the atmosphere, so they will also be, hopefully, involved in further studies of these theoretical questions that are so difficult right now.

Mr. CONTE. Will you be working closely in this program with DOT?

Dr. KELLOGG. Yes, sir; I think my name showed up on Dr. Singer's advisory committee to DOT, and I will be extremely interested in seeing that this program is a good one. I will give it all the advice I can and hope that NCAR itself can also help where we have some know-how.

There is one other aspect of it. I mentioned ozone in the photochemical reactions that involve water vapor in ozone, and the University of Colorado is still working on that problem under Professor London. It is a group that is trying to refine the calculations that have been quoted by our SCEP report and also by Professor McDonald. It is a very complicated calculation.

#### POSITION OF DR. SINGER WITH RESPECT TO THE SST

Mr. CONTE. You mentioned Dr. Singer's committee. I was intrigued with Dr. Singer's opening statement in which he said that when he accepted this chairmanship he was not a supporter of the SST program and he had not taken a stand either for or against the SST.

Dr. SINGER. That is correct, sir.

Mr. CONTE. Have you changed your position since you became chairman?

Dr. SINGER. I have only been chairman for a very short time. I have not had a chance to study the program. The first briefing I had on the SST was this week at these committee hearings and the first exposure that I have had to the economics of the SST was yesterday when Mr. Magruder gave his presentation.

Mr. CONTE. So, in answer to my question, have you changed your position?

Dr. SINGER. No; I don't think so. I haven't heard all the sides yet and I must say I am very impressed by Mr. Magruder's statement and it sounds logical to me. I think I want to study it carefully and I would like to also see what the other side has to say. I am speaking about economics now.

Mr. CONTE. That makes my job a lot easier because I have the same difficulties.

#### OIL RESERVES

Dr. SINGER. Incidentally, when I smiled before it was in connection with the statement that the SST would use up oil resources. It is a sad thing that our oil resources will be used up but it won't be because of the SST.

Mr. CONTE. No, but, you see, we get buffeted. I say we. The people who have been fighting for increased oil get buffeted from all sides. We get buffeted from Interior. You know, "There is a shortage of oil

and therefore we have to have these quotas because of the national security," and then you are buffeted on the other side and guys come over here now and say, "We have enough oil. We have oil coming out of our ears until the year 2000." I get all these contradictory statements. After a while, I get a bit frustrated, to say the least, especially when you come from my part of the country which is so dependent upon oil. If there is that much oil, why not give it to us? Why not do away with the quota system? Then you go to another department and they give you another story.

Dr. SINGER. Perhaps this is a separate question, but as far as transportation is concerned, by far the largest amount of oil will be used by the automobile at all times.

Mr. CONTE. Unless we change the engine.

Dr. SINGER. Unless we make it much more efficient, yes, unless we give up the automobile for mass transportation. The great advantage of vehicles of mass transportation like jets of all kinds, subsonic, supersonic, of course is that they take more people in a more efficient way, so they are actually saving us oil.

Mr. CONTE. On the noise and cutting the noise factor down, I don't know whether you should field this question, but has that cut down the efficiency of the motor? Has it slowed down the speed?

Dr. BERANEK. No. Actually, the change to the nonafterburning type of engine has increased the efficiency of the engine and there will be more complete combustion with the nonafterburning type than there will be with the afterburner type.

Dr. SINGER. When you get more complete combustion you get less pollution. So the overall change has been very efficient from every point of view.

Mr. CONTE. Mr. Chairman, I have no further questions of Mr. Kellogg.

#### EFFECT OF SST POLLUTANTS

Mr. BOLAND. I don't have any particular questions for Dr. Kellogg, but I am chairing another committee tomorrow and since we are bidding our time until Mr. Yates gets back I may direct some of my questions to Dr. Singer.

Doctor, I was impressed with your statement, very much impressed with it, and I was particularly impressed with the provisions under which you took the assignment. You indicated that your field of expertise is the environment and radiation and you would be happy to serve because you want to make sure the scientific data are not misused either to support the SST program or to oppose it. I couldn't think of a statement that deserves to be more applauded I know that over the past few years people have been taking what they say is scientific data to support the SST or to oppose it. I note that on the last page of your statement, page 11, you indicate there is no question that the SST is going to release some pollutants into the atmosphere, but it is doubtful whether they will be of any significance. You rest on that statement, don't you?

Dr. SINGER. Yes, sir.

Mr. BOLAND. Can you say that that is so now without any further research on what the impact of the SST will be upon the environment?

Dr. SINGER. I could.

Mr. BOLAND. You could?

Dr. SINGER. But I won't.

Mr. BOLAND. But you won't?

Dr. SINGER. No, because I am not sure enough.

Mr. BOLAND. That is precisely how I feel about it. But there has been an awful lot of misinformation with respect to what the SST will do to the environment without people actually knowing what it can or will do without having the research that is necessary to determine what it can or will do. I have just a couple of questions for Dr. Beranek.

Mr. CONTE. May I ask a question of Dr. Singer, or are you going to go back?

Mr. BOLAND. Go ahead now.

#### DOT RESEARCH PROGRAM

Mr. CONTE. I have just a couple, Mr. Singer, and I will be all done. On page 7 you state, and this is in conjunction with Mr. Boland, that you are currently shaping the research program of DOT. How long will it take to do this?

Dr. SINGER. The shaping?

Mr. CONTE. Yes.

Dr. SINGER. I would say another 2 to 3 weeks. We have heard about 50 percent of the story. We have made some strong recommendations to them in terms of priorities and emphasis. We are still waiting to hear the rest of the story on monitoring and on the cloudiness.

Mr. CONTE. What other major problems do you think the research program can examine?

Dr. SINGER. I have pointed to some of these, or to most of these, in my statement. We would like to be able to narrow the uncertainties, particularly, once the engine actually exhausts into the atmosphere, in what happens to the material that is exhausted; how long does it stay in the stratosphere; how much of it accumulates; what effects does it have on the stratosphere itself; and what these stratospheric effects will do to the climate. Naturally we have to look into the background variations, too, because the stratosphere is constantly being disturbed by volcanoes, by the influx of what I would call natural pollutants of various types. I have even pointed to some pollutants that are entering the stratosphere because of human activity even though we have never realized it.

Mr. CONTE. You can expect meaningful results from this research?

Dr. SINGER. I think we will have some immediate meaningful results which will come, say, in the next few weeks or months and I think we will have some that will only come in a year or two from now.

Mr. CONTE. I took another view. On page 11 you said:

There is no question that the SST is going to release some pollutants into the atmosphere, but it is doubtful whether they will be of any significance.

The thing that triggered me when I read that and heard you testify was that you were prejudging the research program that you are presently setting up.

Dr. SINGER. No, I am not. If you were to force me right now to make a statement as to whether the SST effects will be significant or

not I will give you such a statement but I would rather not do it because I have doubts.

Mr. CONTE. That is all right.

Dr. SINGER. But I think when the research program is finished and when the results are in I will be able to give you this kind of a statement with very little doubt.

Mr. CONTE. As a last question, is it your general position that the objections raised by the environmentalists that we have heard here in the last 2 days about this program are unfounded and of little concern?

Dr. SINGER. No. On the contrary, I think the objections that have been raised have to be looked at very carefully and I think every concern that has been brought forward needs to be examined on its merits regardless of who made it and regardless of whether he does or does not believe in flying saucers or whatever else. I think it is the fact that the concern has been brought forward that needs to be investigated.

Mr. CONTE. Examined. Thank you, Mr. Chairman.

#### NOISE REDUCTION PENALTIES

Mr. BOLAND. These questions are directed to Dr. Beranek and these questions are propounded as a result of an article which was written by Mr. Christopher Lydon of the New York Times who sits over here, a very distinguished writer. He writes on transportation matters and is based here in Washington. The article in the New York Times on March 5, 1971, is headed "The Backers of the Supersonic Plane are Making a Strong Comeback as the issue shifts from the environment to profits", and that seemed to be the direction in which it is headed.

But with respect to the noise factor, the conclusion of your committee, Dr. Beranek, was that the level of technology demonstrated by Boeing and GE is sufficient to achieve the noise level objectives which you recommended. That is your conclusion?

Dr. BERANEK. Yes.

Mr. BOLAND. The article indicates that—

Far from representing a breakthrough of science and ingenuity, it reflects a policy judgment that gave reduction of engine noise the highest priority and then accepted significant penalties in weight, range, and operating efficiency as a means of reaching the goal.

Is that a correct statement?

Dr. BERANEK. No, it is not correct in its entirety. I think with respect to weight it is correct. The weight has gone up from 750,000 pounds to 800,000 pounds. In respect to range, Mr. Lydon took, I think, his cue from a statement that one of the Boeing executives made in testimony in Boston on a noise problem in which he indicated 50 miles of range loss to an increase in decibels.

Mr. BOLAND. I can understand why he took it because he wonders why if Mr. Whithington made some statement to some committee of the Massachusetts Legislature and indicated that you lose 50 pounds per one decibel, 50 miles in range times 16 decibels makes 800 miles. So he asks a very pertinent question and I would like to get the answer.

Dr. BERANEK. The answer was given as a general statement and I think the question has to be answered in its entirety. The facts are that

the original payload-range written in the base line contract, as I understand it, and Mr. Magruder may want to straighten out the details on how to relate the curve showing the relationship of range to payload. It is a straight line on a graph that says as you load up with more passengers you go a shorter distance for a fixed maximum take-off weight. I presume that is a fuel tradeoff. You will have less fuel and more people, and the new design not only comes up to that curve but it will go a slightly longer range than was contemplated on that.

Now, this curve was presented to us covering range-payload during the meeting. I would like to have Mr. Magruder straighten me out on where this curve comes from. I don't know whether it is in a contract or goal.

#### AIRPLANE WEIGHT

Mr. MAGRUDER. I think Dr. Beranek is talking about the break in the payload range curve which occurs when you reach the full fuel capacity of the airplane and at that point range is a function of how much payload you put on. I would like to help answer that question that you have raised. As the program manager, I am not yet willing to accept what the exact weight is going to be of the production airplane. I would prefer that the statement in the record show that with the airplane meeting the new noise requirements, which are roughly twice as good as the present jets and meet the new requirements for four-engine intercontinental subsonic jets, I would expect that the weight of the airplane will be somewhere between 750,000 pounds and 800,000 pounds. That does indeed reflect a change in the objectives and goals of the airplane since the original contract was written in 1966 or 1967.

Mr. YATES. How much will the prototype weigh?

Mr. MAGRUDER. The prototype is not changed by this decision.

Mr. YATES. How much will it weigh?

Mr. MAGRUDER. 635,000 pounds.

Mr. YATES. Thank you.

Mr. MAGRUDER. "What is the weight of the prototype plane?" was the question. The other aspect was the question of whether or not this will in any way hurt the operating economics of the production airplane. Increase in takeoff weight is, frankly, the cheapest kind of weight that a designer can put in. This is adding fuel, some structural weight, but much of it in adding fuel to hold your payload range characteristics. Removing the afterburner deletes a very hot section and, as was pointed out earlier, a less efficient part of the engine. By increasing the airflow we are only increasing the diameter of the engine 2 inches out of 90 inches, so this isn't an extraordinary thing and by that one change, plus the ones that Dr. Beranek outlined before, we should be able to keep the plane at the same field length as subsonic jets or better.

By holding our payload constant for a weight range of 750,000 to 800,000 pounds and maintaining the same operating procedures, the price might change slightly, however maintenance, reliability and spare parts consumption will go down and all of these are very strongly and linearly in the equation for airline operating economics of the airplane.

The answer to this is that we won't know until we fly the prototype and measure the result just exactly what the production airplane is

going to be like. We are now back to why we really want to do a prototype, which is to measure its operating economics, reliability, spare parts consumption, airport compatibility, sonic boom noise, and to some extent the emission characteristics which have to do with pollution.

#### COMMUNITY NOISE

Mr. BOLAND. I wonder if Dr. Beranek would want to comment on this statement which comes from a pamphlet of the Coalition Against The SST. It is called "New Facts on the SST." I was wondering whether or not this is a new fact. It seems to be old hat because it comes from the hearings of the Senate Appropriations Committee, August 28, 1970. It is a statement by Laurence I. Moss and it talks about community noise.

"The impression given by Boeing and the Department of Transportation is that although airport noise is a problem community noise is not. They cite the fact that the SST is expected to climb at a steeper angle immediately following its takeoff than is the case for subsonic jets. When the SST reaches an elevation of approximately 1,500 feet above the airport, engine power will be reduced to 40 percent of full thrust, thereby significantly reducing engine noise. When it passes over the community, according to claim, the combination of relatively high altitude and reduced engine power will reproduce less annoyance than current subsonic jets. Upon examination this claim proves to be misleading. The reason is that the engine noise during initial climb while the plane is still over or close to the airport is of such magnitude that widespread areas of the community will be exposed to unprecedented noise levels even though the SST does not fly over those areas."

Would you agree with that?

Dr. BERANEK. Of course, remember now that we are talking about numbers in their case of 124 EPNdB.

I would like to straighten out the misconception—

Mr. BOLAND. It is no longer 124. It is going to be 108.

Dr. BERANEK. Yes, and that report was talking 124 EPNdB.

Mr. BOLAND. That is right, but this just came out February 4, 1971, so really it is an old fact. It is not a new fact, is it?

Dr. BERANEK. That is right, because our report of the committee following the investigation at Boeing came out February 5. They had no way of knowing that it was going to be the next day.

Mr. BOLAND. I know the coalition against the SST would not want to distribute information that was not correct. I am sure that the coalition would want to correct that statement.

Dr. BERANEK. There was some confusion between what was community noise and what was airport noise in some of those reports, and the facts are the new 108 EPNdB extends all the way along the sideline right out into the community up to this 3½-mile point where it has to be 108 EPNdB there. Beyond those lines it will always be less and there was a time in which they said, "Well, you are looking at that point and you are forgetting about the bulge in the community. between the time you leave the end of the runway and the time you get up to that point," but the new numbers are taking all of that into account. Nobody outside of that box, which is the extension of the

.35-mile line on either side and the 3½ miles out from the start of takeoff, nobody outside of that box will have more than 108 EPNdB. That is the level.

Mr. BOLAND. Doctor, thank you very much.

Mr. McFALL. Mr. Minshall.

#### EFFECTS ON STRATOSPHERE

Mr. MINSHALL. Mr. Chairman, I am sorry because of personal urgent commitments and rollicalls that I haven't heard all this testimony. Maybe this has all been answered in the record, but maybe you can, with these experts here, Dr. Kellogg, Dr. Singer, and we have the Director back, and Dr. Beranek, at least give me a summary of what your collective opinion is on the effects on the stratosphere, on the ozone layer. We have testimony and I would like to get your thoughts on this without any more dressing up than you can help.

Dr. SINGER. The facts are, and I am quoting from my statement:

There is no question that the SST is going to release some pollutants into the atmosphere, but it is doubtful whether they will be of any significance.

That is, we cannot be absolutely sure that they will be of no significance.

Mr. MINSHALL. Why do you use those words "but it is doubtful?" What research do you have to base that on?

Dr. SINGER. That is based on the SCEP report plus the things that we have learned since the SCEP report was written last summer, plus the accumulated knowledge and expertise of our committee who have examined the SCEP report and other evidence.

Mr. MINSHALL. Well, you say it is doubtful. How doubtful?

Dr. SINGER. All right. We have not put numbers on this, but if you ask me to put numbers on this—

Mr. MINSHALL. I am asking you if you can.

Dr. SINGER. I will give you a guess.

Mr. MINSHALL. I understand it is an estimate, but let's have it if you can come up with something.

Dr. SINGER. I would say I am 95 percent sure that there will be no problem from an SST fleet. I don't think that is good enough. I think we are dealing with much too serious a matter so than even 95 percent is not good enough. I think when we finish our research program, if it is carried out in the way we think it should be structured, we can be 99.99 percent sure.

Mr. MINSHALL. When?

Dr. SINGER. Two years from now.

Mr. MINSHALL. You mean in 1973, in March?

Dr. SINGER. That is correct, sir; yes, sir, at about the time, plus or minus maybe a few months. I cannot give you the exact date on which we will be sure.

Mr. MINSHALL. I hope you will pardon me for being skeptical but I have been through these exercises, as I have said, with the military. I am sure Mr. Magruder knows this. I have been through a number of these things where they keep dangling a carrot in front of our nose and saying "Look, just give us a couple of more years and we are going to have everything ironed out." It hasn't worked out that

way and I can see program after program starting way back with the Air Force Bomarc missile. Then we get into the TFX and I have had it right up to here.

#### ENVIRONMENTAL RESEARCH PROGRAMS

Dr. SINGER. I fully share your concern, sir. I would like to point out we are not talking about a hardware program here. I am not even concerned about the building of the prototype these days. We are talking about making certain measurements in the atmosphere which is there all the time for us to measure, measurements that have not been made up to now, measurements that will be specifically directed toward reducing certain concerns that we have about what will happen. Once these measurements are made and once we have the numbers, I think our uncertainties will be much reduced; and we will have full confidence in these judgments.

Mr. MINSHALL. And you say you will have this full report by March of 1973, and how many months then or years is it that we have been working on this intensive research and development program?

Dr. SINGER. I think this is a question that I cannot answer very easily because my association with this is very recent, but I will say that the DOT has not had specific money available to mount a specific research program to measure the environmental effects of the SST. However, general atmospheric research programs of course have been going on for many, many years; and our basic knowledge, our basic judgements, are based on what we understand about the atmosphere from the programs that have been carried out by the Weather Bureau, by the Air Force, by the Atomic Energy Commission, and so on.

Mr. MINSHALL. Do you extrapolate anything out of this? Another program that we had was the XB-70 program. We have talked about this in these hearings before; but I wonder, as far as the environment is concerned, was that helpful at all?

Dr. SINGER. We can make many extrapolations; but every time you do, you introduce a certain bit of uncertainty, and these uncertainties add up. That is why I have given you a number like 95 percent, and I don't think that is good enough. I think the uncertainties have to be reduced down to the bare minimum.

Mr. MINSHALL. Mr. Magruder?

Mr. MAGRUDER. As program director I would like to make sure that the record shows a couple of dates, and that it is our intention to have the environmental program completion and the 100-hours prototype completion coincident for the reason that I said yesterday—I think you will get another degree of certainty on sonic boom and noise, and engine emission throughout the flight test program.

Mr. MINSHALL. Please don't misunderstand me. But I was one of your staunchest supporters way back when you first started this program. However, the one thing that burned in my mind was this environmental factor, and it still is to a degree, although I feel somewhat reassured here by Dr. Singer's testimony and what you have said. If you want to add anything to the record that will make this clear not only for me but for the general public and the news media, it will be most helpful. You can add anything you want to make it abundantly clear just how you feel on that.

Mr. MAGRUDER. The thing I wanted to add is that the flight test program is approximately from March through September of 1973, and we will continue the environmental research program right up through that period. At the end of that 100 hours, we will have our noise, our environment, our economic viability, the performance of the airplane; and the airlines will make a decision.

Mr. MINSHALL. I think you ought to start an organization with the SST, something like the Early Birds. My good friend Stu Tipton has been around on this program. We have seen them come and go, but he is one of the few who carries right on through. I know he has always been a strong supporter.

Mr. MAGRUDER. I think I'm an SST early bird, but I do not want to be a dead duck.

Mr. MINSHALL. But you have not been up here testifying for as long as Mr. Tipton.

Thank you, Mr. Chairman.

#### ATMOSPHERIC PHYSICS

Mr. YATES. Dr. Kellogg, is there a separate field of physics known as atmospheric physics?

Dr. KELLOGG. It is not separate from the main field of physics.

Mr. YATES. Is there a specialty?

Dr. KELLOGG. Atmospheric physics is an application of the laws of physics to the atmosphere.

Mr. YATES. Is there a specialty among physicists so one may be designated as an atmospheric physicist in contrast, for example, to a geophysicist?

Dr. KELLOGG. I do not like to make these distinctions, because when we deal with the atmosphere, we get into so many interdisciplinary problems that pure physicists and chemists and mathematicians all have to work on these problems together.

I started out in physics myself in college, and ended up getting a degree in meteorology. I call myself an atmospheric physicist.

Mr. YATES. Do you call yourself an atmospheric physicist, Dr. Singer? I thought I heard you say that.

Dr. SINGER. I called myself a geophysicist, which perhaps is a little more comprehensive, because it also includes the earth itself, the ocean and space.

Mr. YATES. Have you had occasion to do any study of atmospheric physics within the past three years?

Dr. SINGER. Yes, I have.

Mr. YATES. Were you a member of SCEP?

Dr. SINGER. No, I was not.

Mr. YATES. Dr. Kellogg, were you a member of SCEP? As a matter of fact, you were the head of the program.

Dr. KELLOGG. I was chairman of it, yes.

Mr. YATES. You have been specializing in atmospheric physics for the last 3 years, have you not?

Dr. KELLOGG. Yes.

Mr. YATES. I was pleased to hear you describe Dr. McDonald as an honored colleague, because I consider him to be a person of credentials and qualifications, do you?

Dr. KELLOGG. Yes, I do.

Mr. YATES. I think it unfortunate that the UFO was brought into this discussion, because there was much snickering as a result of that. I had occasion not only to talk to Dr. McDonald, but to Congressman Udall, who is a good friend of Dr. McDonald, and he told me about the UFO incident; that Dr. McDonald is one who is interested in what goes on in the entire atmosphere, and he has been puzzled by UFO reports that have come through from pilots and others.

Mr. Udall told me that Mr. McDonald has tried to trace them down, and has succeeded in explaining everything except about a half percent, and he is concerned about that half percent. He is that sort of curious person.

I thought that was evident from the testimony given here yesterday.

Mr. McFALL. Will you yield just a moment.

While you were answering the roll call, I asked Dr. Kellogg some questions. We got into a discussion of Mr. McDonald's testimony, and he gave a very interesting example of the importance of Dr. McDonald's testimony. The word "bikini" caught my ear. I would hope he would give you the same answer sometime during your questioning, because I think it is very useful in understanding the comparison.

Mr. YATES. The point I want to make is, I thought there was a derisive tone that was pointed at Dr. McDonald's testimony yesterday as a result of the one question that was asked him about unidentified flying objects. Members of Congress and others who were here in the audience sort of snickered at that. I do not think it was fair to Dr. McDonald. I consider him to be a very distinguished atmospheric physicist. Would you agree with that?

Dr. KELLOGG. I have no quarrel at all with that. Jim McDonald, as I said, is not only a distinguished colleague but a good friend.

Mr. YATES. I yield to the gentleman.

Mr. CONTE. I was the one who asked the question, and I hope you do not imply—

Mr. YATES. I was not implying anything. There were people in the audience—

Mr. CONTE. Yes, and even up here. I didn't. I was very sincere. I heard about this during the day, and I had no doubt it was going to be used in debate. As a result, I have done further study, and I have some real stuff here now on his ideas about this. Later on, maybe—

Mr. YATES. Maybe you want to ask the doctor about it.

Mr. McFALL. We have an expert on it here.

Mr. CONTE. Being an old trial lawyer, I was anticipating this would come up on the floor and somebody would try to destroy his evidence.

Mr. YATES. Dr. McDonald did present a very good case, you would agree.

Mr. CONTE. Certainly. I told him. You were not here when I was questioning him. I told him that.

Mr. YATES. You said that when Congressman Brown was here.

Mr. CONTE. Mr. Brown even endorses sonic booms overland.

Mr. YATES. Right. Dr. Kellogg, at the risk of going along with my chairman, who takes an opposite position to me on the SST, would you tell us the bikini story he said you told?

## SKIN CANCER

Dr. KELLOGG. I do not know when I have had a story appreciated so much.

I was attempting to put the kind of argument that Professor McDonald had made concerning the ozone and its effect on the ultraviolet and the consequent effect on skin cancer, into some kind of perspective, and trying to say that I disqualify myself completely as a person who knows anything about the medical aspects, but then neither did Jim McDonald—professionally, that is. So, I feel that I was allowed to play the same kind of a numbers game that he has played, in addition to the examples that you have already heard, such as you can change the ozone above you by 1 or 2 percent by moving 50 or 100 miles north or south; you can go from sea level to Denver and do the same thing.

Then I became intrigued by the 10,000 cases out of a population of 200 million. It works out that this means that one person in 20,000 might be affected.

If all these probabilities are linear, as McDonald's theory implies, if you change one part of the thing by one part in 20,000, that is the kind of thing we are changing.

I asked myself what would I have to do in order to protect myself from 1/20,000 of the effect if I was out in the sun every day of my life. I live about 20,000 days, and this means if I covered 1 day in my lifetime, I would have eliminated the effect of the SST's.

But you and I usually only get out on weekends, so this works out to be only once in 200 years.

Then if girls are concerned about the times that they wear bikinis, they should wear a bathrobe once in about every 2,000 years to overcome the effect of the SST's.

I meant this partly to indicate that when you get down into these very small probabilities, we are talking about things which we have to look at very carefully before we understand their meaning.

## SCEP CONCLUSIONS

Mr. YATES. Did SCEP come to the same conclusion as Dr. Singer? Dr. Singer has indicated he is pretty sure in his own mind what the effect of the SST will be. I have the impression SCEP was not sure about it. Rather, it raised the possibility that there is a real problem there, and it did not come to any conclusion about it. Is that correct?

Dr. KELLOGG. That is correct. The SCEP working group on climatic change had some people who were very concerned. They were opposed to the SST for whatever reasons. Nevertheless, the wording that is in this report was agreed to by all the people at the SCEP report, including those who for other reasons did not think the SST was a very good idea. They could not quarrel with the final wording. It said, however, that we have a concern about this, and I would share that statement. I still think we do have to be concerned about the environment.

Mr. YATES. That is right. You still have that concern?

Dr. KELLOGG. I still have that concern.

Mr. YATES. Do you think you will hold that concern until the conclusion of the testing that is being undertaken now pursuant to the appointment of the committee by Mr. Magruder?

Dr. KELLOGG. Yes. I certainly will.

#### UPPER ATMOSPHERE CHARACTERISTICS

Mr. YATES. Dr. McDonald made certain statements, and I would like to know whether you agree with them. He said:

1. The stratosphere is effectively about 100 times more sensitive to technologic contamination than is the troposphere because its turnover time averages about 100 times longer than the troposphere.

Would you agree with that?

Dr. KELLOGG. Yes.

Mr. YATES. Would you agree with this statement? The stratosphere is a region of high chemical reactivity, unlike the troposphere in which current air transport technology now operates.

Would you agree with that?

Dr. KELLOGG. Yes. In fact, I make the same point in my statement.

Mr. YATES. Would you agree with this statement: If we now start an SST transport technology and then later attempt to improve range efficiencies by modifying engine or airframe design to permit flying at still higher altitudes, or if we move on to an advanced HST technology, then we shall find that both of the preceding difficulties grow even more serious, the higher we try to fly in the stratosphere.

Would you agree with that?

Dr. KELLOGG. There is a point there that I disagree with Jim McDonald on. He said if we move up with our hypersonic transports to 100,000, or I think he mentioned even 150,000 feet, the residence time becomes 10 years. I think most of us who have studied the history of radioactive debris, where it comes from, where it goes, how fast it is removed, would disagree with that figure and would put it more like 3 years instead of 10 years.

In other words, I think he is exaggerating the storage time at those upper altitudes.

Mr. YATES. The figure 3 years is still a long time, is it not?

Dr. KELLOGG. It compares with the 2 years at the SST altitudes. Not a great deal longer, in other words.

Mr. YATES. Do you agree that the problems of the stratosphere increase as you go higher into the stratosphere?

Dr. KELLOGG. In general, I suppose they do, except that McDonald himself made the point that as you go higher, the motive for going higher would be to get better fuel efficiency and, therefore, you put less contaminants in the atmosphere per mile, I suppose, if he is right. That is what he said.

Mr. YATES. Do you agree with him on that?

Dr. KELLOGG. I do not know. I am not an aeronautical engineer. But that is what he said.

Mr. YATES. What conclusion can we draw from that?  
Only that you are not an aeronautical engineer?

Dr. KELLOGG. I draw the conclusion there are two competing factors. The higher you go, the longer things stay there, and the less atmosphere there is to begin with, but also that possibly the aircraft are

more efficient at the higher altitudes, if I accept McDonald's statement.

Mr. YATES. I take it, then, you are not concerned about the possibility of two prototypes flying in the various layers of the stratosphere, but what concerns you is the possibility, without knowing more at the present time, of what impact would be of numbers of airplanes flying.

I take it, too, as far as you know there have not been any significant data collected by the military on the effect of their flights through the stratosphere up to the present time.

Dr. KELLOGG. The answer to the first part of the statement is correct. In connection with the military, last December the American Institute of Astronautics and Aeronautics queried the Department of Defense on how much they were flying in the stratosphere at these same altitudes, and finally got an answer. It turns out that they are using about 43,245,000 pounds per year, and that is for the period October 1969 to September 1970, from all U.S. aircraft flying above 55,000 feet.

This 43 million pounds per year compares with 371 million pounds per day for the SST fleet.

So now we have a comparison. I think you see there are many orders of magnitude of difference between what we are doing at SST altitudes and what we would be doing with a fleet of 500.

#### SMUDGE EFFECT OF POLLUTION IN THE STRATOSPHERE

Mr. YATES. Do you agree with Professor McDonald in the smudge effect of pollution in the stratosphere?

Dr. KELLOGG. The things that he quoted on particulates in the atmosphere from the SST's are essentially already in our SCEP report, so I could not disagree with them.

Mr. YATES. I am trying to review Dr. McDonald's excellent qualifications as you probably perceive.

Dr. KELLOGG. I would like to say again, as I said earlier, Mr. Yates, that I read his written testimony very carefully and I think he has stated the case, when it concerns the atmosphere itself, quite fairly.

Mr. YATES. Atmosphere and stratosphere?

Dr. KELLOGG. I include the stratosphere.

Mr. YATES. I thought there was a differentiation.

Dr. KELLOGG. Yes. There are a few things I could disagree with, like the 10-year residence time at 100,000 feet, but I think his statement when he sticks to the atmosphere itself is quite a fair statement.

#### SONIC BOOM

Mr. YATES. I do not think I have any more questions of you.

Dr. BERANEK, you said you foresee the reduction of sideline noise to 108 EPNdB from the present level, and you pointed that out on the chart.

When will that happen?

Dr. BERANEK. That will happen on the production aircraft.

Mr. YATES. You cannot set the time for that. That will not be a part of the prototype?

Dr. BERANEK. That is correct.

Mr. YATES. Have you done any research in sonic boom?

Dr. BERANEK. Not personally, no.

Mr. YATES. Do you know about studies of the sonic boom?

Dr. BERANEK. I know what I read in the scientific literature. I am not an expert on that subject.

Mr. YATES. Is my understanding correct that sonic boom may be varied by the shape of the fuselage or the wing?

Dr. BERANEK. This is right. A very blunt plane will create a larger sonic boom than a long, needle-shaped plane, yes.

Mr. YATES. Will the shape of the wing alter it?

Dr. BERANEK. I am not sure that I can give you a definite answer to this, because you cannot shape the wings all that much different and have an efficient plane. But the body shape probably is a more influential thing, because you can have different lengths and diameters of bodies.

Mr. YATES. Will increases in weight of various parts of the fuselage affect sonic boom?

Dr. BERANEK. One of the factors in the sonic boom is the weight of the plane. A very light plane would make less boom. You would expect a lightweight fighter plane to make less boom than a transport.

Mr. YATES. Will the lighter prototype, which is roughly 135,000 pounds lighter than the production model of the plane, make less sonic boom?

Dr. BERANEK. There isn't that much difference, is there between the two?

Mr. YATES. I do not know where you draw the line between a fighter plane and a heavier plane that makes more of a sonic boom. Is the weight difference significant?

Dr. BERANEK. I think the number will be less than that.

Mr. YATES. I understood Mr. Magruder to say that the weight of the prototype will be 635,000 pounds, and I understood him to say, too, that the weight of the production version will be 750,000 to 800,000 pounds. Isn't that correct, Mr. Magruder?

Mr. MAGRUDER. 750,000 to 800,000 pounds.

Mr. YATES. Those are his figures, are they not? Am I correct?

Mr. MAGRUDER. The point Dr. Beranek is making is that it is around 150,000.

Mr. YATES. I beg your pardon. You are right; 135,000 pounds. That, you feel, is not a significant difference in weight that might affect the sonic boom?

Dr. BERANEK. You are talking about a change of one part in about five, if I figured that right. One part in five change is going to make a very small difference in the sonic boom, because you have to go a factor of 3 or 4 in weight to make a significant difference in it.

Mr. MAGRUDER. Could I help you with some of the answers, Mr. Yates?

Mr. YATES. You can in a minute. I would prefer that we go into these questions again tomorrow morning, because I want to release Dr. Kellogg to fly back to Arizona and you to go home and rest, and I want to turn it over to Mr. Conte at the present time, and we will all come back tomorrow morning.

## UFO OCCUPANTS

Mr. CONTE. I will be very brief.

It is unfortunate that such an issue is being made about the question I asked Mr. McDonald yesterday. I pursued this further. I think it is legitimate. It is not making him out a kook or anything, but the evidence I had and the testimony I had was that he felt unidentified flying objects could have caused a blackout on the eastern seaboard several years ago. The Federal Power Commission said no. They gave the reasons why.

On July 29, 1968, when Mr. McDonald appeared as a panelist on a UFO symposium sponsored by Congressman J. Edward Roush, of the House Science and Astronautics Committee, he distributed a prepared statement on UFO creatures. I want to quote verbatim the whole paragraph:

An extremely unusual category of cases, those involving reports of humanoid occupants of landed UFO's \* \* \* I have tended to skirt such cases on tactical grounds; the reports are bizarre \* \* \* For the record, I should have to state that my interviewing results dispose me toward acceptance of the existence of humanoid occupants in some UFO's \* \* \* My efforts over the past 2 years being aimed at arousing a new degree of scientific interest among my colleagues in the physical sciences, have led me to play down even the little that I do know about occupant sightings. One or two early attempts to touch upon that point within the time limits of a 1-hour colloquium taught me that one loses more than he gains in speaking briefly about UFO occupants \* \* \* But occupants there seem to be, and contact (with them) of a limited sort may well have occurred \* \* \*

A man who comes here and tells me that the SST flying in the stratosphere is going to cause thousands of skin cancers has to back up his theory that there are little men flying around the sky. I think this is very important.

Do you feel it will cause skin cancer?

## SKIN CANCER

Dr. KELLOGG. I have no comment to make about the skin cancer.

Mr. CONTE. You are really not qualified; are you?

Dr. KELLOGG. I am not; no.

Mr. CONTE. Of course, you are not.

Dr. SINGER, can you tell me whether you are qualified to tell me whether it will cause skin cancer?

Dr. SINGER. Let me repeat the remark I made while Congressman Yates was out. I take Dr. McDonald's statements quite seriously, and I think we need to be concerned about any statement that is brought to us which is of environmental concern, no matter what he feels about UFO or anything else. However, in listening to his testimony yesterday, this is the first time I have heard the story expounded.

Going back and doing my own calculations yesterday evening, I have come across the fact that his chain of reasoning consists of four links, three of which are very good and one is not.

This one which is very doubtful in my mind can be settled very easily without any recourse to medical opinion, just by making some simple physical measurements, namely, by measuring the amount of ultraviolet radiation reaching the surface of the earth while the ozone concentration varies.

The reason I think that McDonald has erred in this particular case is because he assumes that the ozone determines completely and uniquely the absorption of ultraviolet. This is not the case. If ozone were the only gas in the atmosphere that could absorb ultraviolet, then he would be correct; but, as a matter of fact, ultraviolet is absorbed by water droplets, by low altitude smog, by clouds, by air pollution, and by the atmosphere itself.

Mr. CONTE. I think he did say it would be absorbed by water vapor. He did say that. That was his basis, I thought.

Mr. YATES. I do, too. I remember the water vapor heating up the ozone.

Dr. SINGER. That is something else. I do not quarrel with that. That is one link in the chain.

Mr. YATES. If there is water vapor deposited in the upper levels of the stratosphere, that will diminish the amount of ozone.

Dr. SINGER. That is the second link in the chain, and that is OK. I do not quarrel with that.

Mr. CONTE. That was his main point.

Mr. YATES. If that diminishes the ozone, does that not have an effect upon ultraviolet?

Dr. SINGER. That is the question.

Mr. YATES. That is where you disagree with him?

Dr. SINGER. Yes, sir. However, I am not absolutely sure.

Mr. YATES. What is your conclusion on that, Dr. Kellogg?

Dr. KELLOGG. The reason for the statement, of course, is that ozone does absorb ultraviolet. So, you remove a little bit and there is a little bit more ultraviolet in.

It seems to me that even if you accept that ozone is the only thing that determines ultraviolet radiation—and this is what Fred Singer is questioning, too—even if you accept that, the variations are extremely small for a change of 1 or 2 percent in the total amount of ozone.

This is the point that I tried to make and tried to put it in perspective by my story.

Mr. CONTE. Will you clear it up for my own mind, though. Could it get dangerous? Could it cause skin cancer? That is the point I am trying to find out. Can you tell me that?

Dr. SINGER. The answer is that I cannot tell you this. However, I know how to measure it. All we have to do in order to check McDonald's reasoning is to check the link that I consider to be weak; namely, whether in fact a small variation in ozone in the upper atmosphere causes a variation in ultraviolet radiation at the surface of the earth. He has assumed that the only determining factor is the total amount of ozone in the atmosphere; whereas we know for a fact that there are many factors in the atmosphere which can absorb ultraviolet radiation.

Clouds, for example, will absorb ultraviolet radiation. Obviously when we have clouds, it does not make a bit of difference what the ozone concentration is in the upper atmosphere. You will not get any ultraviolet or really any solar radiation at the surface.

Mr. YATES. His statement was that if ultraviolet comes in in sufficient quantities, it will cause skin cancer.

Dr. SINGER. That thesis may not be incorrect. That is the fourth link in the chain. I want to concentrate, naturally, on the link that is weakest.

Mr. YATES. Can we end on a happy note, Dr. Singer? At the start you indicated you were once an opponent of the SST.

Dr. SINGER. No.

Mr. YATES. You said when you were with Mr. Udall and you were responsible for that report, I understood you to say you were an opponent of the SST. Am I wrong?

Dr. SINGER. Perhaps I expressed myself poorly. I did not oppose the SST. We opposed the flights of SST's overland for the same reason that Mr. Conte did. We think people would object to it.

Mr. YATES. There is no question about it.

Thank you very much, gentlemen. We will see you all in the morning.

THURSDAY, MARCH 4, 1971.

#### WITNESSES

W. M. MAGRUDER, DIRECTOR, SUPERSONIC TRANSPORT DEVELOPMENT

B. J. VIERLING, DEPUTY DIRECTOR, OFFICE OF SUPERSONIC TRANSPORT DEVELOPMENT, DOT

R. E. PARSONS, ACTING DEPUTY DIRECTOR, OFFICE OF SUPERSONIC TRANSPORT DEVELOPMENT, DOT

DR. FRED SINGER, DEPUTY ASSISTANT SECRETARY FOR SCIENTIFIC PROGRAMS, DEPARTMENT OF INTERIOR; CHAIRMAN, SUPERSONIC TRANSPORT ENVIRONMENTAL ADVISORY COMMITTEE

DR. LEO BERANEK, CHIEF SCIENTIST, BOLT, BERANEK & NEWMAN, INC.; CHAIRMAN, SUPERSONIC TRANSPORT COMMUNITY NOISE ADVISORY COMMITTEE

KARL G. HARR, JR., PRESIDENT, AEROSPACE INDUSTRIES ASSOCIATION

STUART G. TIPTON, PRESIDENT, AIR TRANSPORT ASSOCIATION OF AMERICA

CLIFTON F. VON KANN, SENIOR VICE PRESIDENT, OPERATIONS AND AIRPORTS, AIR TRANSPORT ASSOCIATION OF AMERICA

DONALD J. STRAIT, VICE CHAIRMAN, NATIONAL COMMITTEE FOR THE AMERICAN SST

JOHN O'SHEA, EXECUTIVE SECRETARY, NATIONAL COMMITTEE FOR THE AMERICAN SST

DAVID FRADIN, PRESIDENT, FLY AMERICA'S SUPERSONIC TRANSPORT

#### ATMOSPHERE POLLUTION

Mr. McFALL. The committee will come to order.

We will start with some questions for you, Dr. Singer. On page 11 you state:

There is no question that the SST is going to release some pollutants into the atmosphere, but it is doubtful whether they will be of any significance.

Are you speaking of the two prototypes or a fleet of SST's when you say "it is doubtful whether they will be of any significance"?

Dr. SINGER. In this case I am speaking of the fleet. There is no doubt at all that the prototypes will have any consequences. Nobody has ever claimed, no opponent of the program, or proponent for that

matter has ever raised any questions concerning the pollution from the prototypes, so this statement refers to the fleet of 500 SST's.

Mr. McFALL. Just to expand upon what you have said, no one says that the two prototypes are going to cause any damage at all; is that correct?

Dr. SINGER. That is correct, yes.

Mr. McFALL. There is really no environmental reason for not building the two prototypes?

Dr. SINGER. There is no environmental reason not to build them.

Mr. McFALL. And no reason not to fly them in the atmosphere?

Dr. SINGER. There is no environmental reason not to build them. There is a minor environmental reason to build them because once they are built you can test certain things on them that will illuminate further the possible environmental effects of the fleet.

Mr. McFALL. Our discussions are really concerned with what a fleet of 500 to 800 SST's flying in the atmosphere might do to us?

Dr. SINGER. Yes, sir. My testimony is addressed to the fleet.

#### ENVIRONMENTAL QUESTIONS

Mr. McFALL. Do we now have all the answers to the environmental questions about the SST and, if not, when do you think we will have the answers? I am pretty sure you discussed this in answer to other questions, but we might well have it at this time.

Dr. SINGER. Let me be brief and to the point. The answer is no, we do not have all of the environmental answers to have sufficient confidence in the fact that there will be no harmful environmental effects.

Mr. McFALL. I think you said yesterday that we have now 95 percent of the answers. Isn't that the figure you pulled out of the air?

Dr. SINGER. I was pressed. I preferred not to give any numbers but I said that my best judgment at this time would be about 95 percent that there would be no effects and 5 percent that there might be effects. Two years from now, well, actually probably in a shorter time, these figures will be narrowed down so that, as we get environmental results, as we make specific measurements on the things that are still outstanding and crucial, we should be able to say to you 2 years from now with a 99.99-percent certainty that nothing will happen, or it may turn out with a very small probability that something would happen if these measurements turn out the other way. Frankly, I don't expect they will, but there is always this possibility and that is why they have to be made.

Mr. McFALL. But in your opinion at the present time the possibilities are very small?

Dr. SINGER. Yes, sir. I think many of the measurements will be with us in a very short time. Some will take a longer period of time. This program of measurements and research is fairly involved. It has several phases to it. Some phases will be completed in a matter of a few weeks, some a few months. Others will take longer. I would estimate, along with Mr. Magruder, that the period 2-2½ years, about the completion of the prototype phase, will be the time when we will really have all of the outstanding environmental questions settled one way or the other.

## SONIC BOOM

Mr. McFALL. On page 2 you refer to serving on a special study group on noise and sonic boom problems. Do you believe the SST sonic boom problem is solved by the present operational plans and policies?

Dr. SINGER. Yes, sir; I do. At that time there was no restriction, no governmental restriction, at all concerning future flights of the SST. Our group was appointed by Secretary Udall. We listened to a number of experts. We questioned them and we formed the conclusion that SST flights over land of populated areas should be strictly controlled and only begun on an experimental basis. Subsequent to this recommendation, which we delivered to Secretary Udall, the FAA posed the regulations discussed yesterday which limit the SST to transoceanic flights.

## COSMIC RADIATION

Mr. McFALL. Are you assured that cosmic radiation is not an SST environmental problem and, if so, what gives you that assurance?

Dr. SINGER. Let me speak to this because I have worked in this field and therefore can be considered as an expert. The environmental effects here are different from any of those that we have discussed up until now. Up until now we have discussed effects of the SST on the atmosphere and, therefore, possibly on people living on the earth. Now we are discussing effects of the environment on the people flying in the SST, which is a completely different proposition.

Mr. YATES. Does that include the crew?

Dr. SINGER. It includes the crew; yes, sir.

Mr. YATES. There is a difference between the crew and the passengers in terms of what you are going to say because the crew has a greater exposure.

Dr. SINGER. Yes. The effects are qualitatively similar to those of a lower flying jet, as a 747. The difference comes about only because of the different altitude, so that the cosmic radiation will be less absorbed at the SST altitude than it will be at the 747 altitude. The intervening atmosphere acts as a shield to stop some of the cosmic rays. You can have a tradeoff here between cosmic ray intensity and time of exposure. I was involved with this problem several years ago. We set up what we called a space weather warning system when I was in the what is now NOAA but was then the U.S. Weather Bureau and we would anticipate that there could be days, about once every solar cycle, that is once every 11 years, that there might be days when the cosmic ray intensity would be so strong as to make a flight on that particular day hazardous. This will be a hazard just like a weather hazard or any other kind of environmental hazard that aviation faces. You don't fly when there are severe thunderstorms. You don't fly when there are severe icing conditions. But now I am out of my realm because I am not in aircraft operations. I think this would be a minor nuisance to the operations people, but it would have to be taken into account.

Mr. YATES. Will you yield for a question there?

Mr. McFALL. Yes, in just a minute. As I understand it, the SST crew would get less cosmic radiation because they would be up less time than those on a subsonic jet. Is that right or not?

Dr. SINGER. You multiply roughly the intensity, the radiation exposure, by the time of the exposure to get the total dose.

Mr. McFALL. And what do those figures come out to?

Dr. SINGER. Our committee hasn't looked into this specifically; so, since I don't know the times of the flight involved, I would turn this question over to Mr. Magruder who has studied it.

Mr. MAGRUDER. That is correct. It is slightly less for an intercontinental supersonic transport flight as opposed to a subsonic jet and I would say on the basis of, I think it is 200 flights a year, the same thing is true of the flight crewmembers. They would have equal or slightly less radiation dosage than they would staying in a subsonic jet which makes a 7- to 8-hour flight.

Mr. McFALL. Say New York to Paris?

Mr. MAGRUDER. From New York to Paris they would be exposed to less amount. For 8 hours they would be exposed to a slightly higher amount but for 2 hours 40 minutes—the end result on a number of flights per year—the dosage for the supersonic transport for flight crews would be slightly less than that for subsonic jets.

Dr. SINGER. Mr. Chairman, we considered this to be really a non-problem. In fact, we recommended to the DOT that they do not spend more money on research to measure cosmic ray intensities at the SST altitudes and use that money instead to measure engine exhaust and other factors that are directly pertinent to the environmental effect which an SST might cause to the atmosphere.

Mr. MAGRUDER. I might add that the warning devices, required to alert a crew that there might be a major event on solar flares, have been developed as a result of the space program and the time intervals in which this might occur have also been very accurately predicted as a result of the space program. An SST flight which might have to deviate from its flight course like it does today to avoid thunderstorms, in this case radiation, might occur once in every 25 to 50 years. That is why Dr. Singer is saying it is sort of looked on as a non-problem. Nevertheless, it has been looked at and all the solutions, instrumentation warning systems, and alerting capabilities are available for the SST.

#### ENVIRONMENTAL PROBLEMS

Mr. McFALL. Before we finish I would like to run down to make sure we have, in one place, all of the environmental problems and the possible answers to those problems. Maybe we can agree, or agree to disagree at least on the issues. Why don't you go ahead now and ask the questions you have in mind?

Mr. YATES. We may be able to stipulate as to the facts.

Mr. McFALL. Yes.

Mr. YATES. As we used to do when we were lawyers.

Mr. McFALL. We may be able to. At least, we could try to narrow the issues as much as possible.

#### PROTOTYPE FLIGHT HOURS

Mr. YATES. Mr. Magruder, how many hours is the prototype supposed to fly supersonically?

Mr. MAGRUDER. Of the 100 hours of flight testing it would probably fly something of the order of 20 percent of that time supersonically. A

good example is the Concorde program which has approximately 390 hours on two airplanes. It has better than 90 hours, or say 25 percent, that has been flown supersonically.

Mr. YATES. Is my impression correct that only one of the planes is going to fly and one is going to be on the ground, or are you going to have both of them fly?

Mr. MAGRUDER. We have an option to do it either way, but I would not be surprised but what we will emphasize getting the full 100 hours on one airplane, use the other airplane initially for structural tests, static tests, and then fly. In the case of the Concorde I think that the time that they have at mach 2 cruise which is not the only critical condition but is very important because you spend about 60 percent of your time in cruise in normal supersonic air transport operation—is something on the order of 20 hours. I think our program would be in percentages very close to that. I would say that in the 100 hours we would be able to get about 10 hours, very close to the mach 2.7 cruise conditions. That is more than adequate for measuring performance guarantees.

Mr. YATES. Approximately 10 hours, then?

Mr. MAGRUDER. At mach 2.7?

Mr. YATES. Yes; the supersonic flight.

Mr. MAGRUDER. No. I said that would be very close to probably 25 percent of the time, 20 to 25 hours.

Mr. YATES. 25 hours?

Mr. MAGRUDER. Yes; of the 100 hours.

#### ENVIRONMENTAL EXPERIMENTATION COSTS

Mr. YATES. 25 hours. Dr. Singer, I take it you are working closely in conjunction with Dr. Greenfield in the experimentation of which you are in charge?

Dr. SINGER. He has just come aboard, so we haven't even had a chance to talk.

Mr. YATES. Oh, I see.

Dr. SINGER. The experimentation will be supervised and managed by the Department of Transportation. The job of my committee is to advise Mr. Magruder, and through him the DOT, whether we think the research program is adequate, whether the priorities are sufficiently well covered, and so on.

Mr. YATES. Have you reviewed that yet?

Dr. SINGER. We are in the process of review now. We have reviewed about 50 percent of it. We have made I think some pertinent comments. We found some good receptivity to our comments and I think they will do some good.

Mr. YATES. How much money has been allocated for your program?

Dr. SINGER. For what?

Mr. YATES. How much money have you requested for the experiment?

Dr. SINGER. We don't request this. The DOT does this.

Mr. YATES. But you give them a figure, don't you, as to what you think it will cost to obtain the results that you want to obtain?

Dr. SINGER. Yes. The budget is of the order of \$4.5 million for the next fiscal year.

Mr. YATES. And will there be more for the fiscal year following? How long will your program take?

Dr. SINGER. The program will take approximately 2 years, so there is money scheduled for 1973.

Mr. YATES. When do you anticipate it will begin?

Dr. SINGER. The program has begun in the sense that there are many Government agencies that are making measurements and part of the job is to redirect them in a sense to pay attention to the SST problems. The AEC has been very receptive to using their existing planes and the existing flight program that they have in the Arctic to see whether the SST would produce contrails in the polar stratosphere. As a kind of piggyback operation we can latch on to other measurements which the AEC is making for their purposes, and the same with the Air Force and the same with NOAA.

Mr. YATES. That makes sense.

Dr. SINGER. Yes; it makes sense.

Mr. McFALL. Will you yield at that point?

Mr. YATES. Yes.

Mr. McFALL. One of the things that Dr. McDonald said the other day was that he was pretty certain that there would be no contrails.

Dr. SINGER. Yes.

Mr. McFALL. That the atmosphere is just too dry.

Dr. SINGER. Yes. We want to be absolutely sure. There are still some uncertainties. I respect McDonald's opinion. He is a very good professional in this particular area. I think he would be the first one to say "Well, if we can make these measurements let's make them so we can be absolutely sure."

Mr. YATES. Yes. Good. You said you had recommended \$4.5 million for the first year. Will it cost about the same amount for the second year, too?

Dr. SINGER. Sorry; this is not our recommendation. This is what we were told the DOT had requested and are sort of counting on.

Mr. YATES. Doesn't DOT take your recommendation on what you need for your experiment?

Dr. SINGER. I think they will. We haven't completed our survey yet. We haven't added up all the numbers.

Mr. YATES. In other words, the \$4.5 million that DOT has recommended may be too much or may be inadequate?

Dr. SINGER. That is correct, yes.

Mr. YATES. So you don't know at this point how much the program will cost?

Dr. SINGER. My impression is, and I am quite familiar with the cost of atmospheric research programs, is that they have a lot of money there.

Mr. YATES. Who has a lot of money where?

Dr. SINGER. I shouldn't say this too loudly.

Mr. YATES. You say they have a lot of money. Who has a lot of money where?

Dr. SINGER. DOT, I think, has an adequate amount of money to do the job.

Mr. YATES. I agree Dot has the money. I am trying to pinpoint this. If you are authorized to go ahead by this committee I want to make sure that you have enough money to do the kind of job that has

to be done. I will yield in a moment, Mr. Magruder. And the fact that Mr. Magruder says that there is \$4.5 million allocated for this program seems to me to be sort of a back door approach to it. It seems to me the recommendation has to come from your committee in the first instance, really. Wouldn't you think so, Mr. Magruder?

Mr. MAGRUDER. Thank you very much for yielding, I think we have been a little bit unfair, unavoidably, to Dr. Singer. He has just come on board during the last 2 months. Prior to that time the previous chairman, Dr. Tribus, went out to the involved agencies and thoroughly reviewed the amount of research and development required. In fiscal 1971, DOT and NASA have programed \$6.15 million for noise. The DOT fiscal 1972 appropriation request was \$8.24 million, \$2.9 million on the SST itself. Funding needs for fiscal 1973 are yet to be determined. That is what Dr. Beranek is going to be working on. Now, in fiscal 1972 it is \$4.75 million for the weather modification studies and we are reprogramming in fiscal 1971 \$2.5 million.

What Dr. Singer is trying to explain is that he as the new chairman is gathering his committee. People from HEW and elsewhere that have been concerned and have expertise are coming on board, so his first duty as the new chairman has been to get on board, look at what we did before, reassess it, and make new recommendations. What I think he is trying to say very firmly is that he feels from his experience that the previous people had plenty of money in all of the appropriate agencies. Now he is going to re-allot it, and just like he said, maybe not to do so much on radiation, but a little more on engine emissions. I want to assure you and the chairman we will be responsive. I look to my chairman for complete guidance and he has all of the resources of those experts at his disposal.

#### ENVIRONMENTAL TESTING WITH PROTOTYPE

Mr. YATES. Very good. Dr. Singer, how many supersonic flights do you need to come to a determination as to whether or not there would be a pollution of the atmosphere through supersonic flight? As I understand what Mr. Ruckelshaus and Mr. Greenfield said, they needed none, that they could do it by building appropriate instrumentation and, I assume, by using military planes and sending balloons aloft.

Dr. SINGER. You have raised a very good point. I think many people would answer by saying they could do the program—I am speaking of the weather modification part—without flying a prototype SST. However, there will always be people, and our colleague, Dr. McDonald, is one, who quite properly say “Well, you have done all this on the ground and you have done all this in the air but you have not used the right engine and you haven't really measured everything that you can measure and”—I quote him by memory—“you haven't measured nitrogen oxide. You can't do this if you don't fly with the right engine, GE-4, at the right altitude and right speed.”

Mr. YATES. As I understand what Dr. Beranek told us yesterday, the GE-4 engine will not be in the prototype, so you are still going to have other people say “but you haven't flown the new engine in the stratosphere.”

Mr. MAGRUDER. I would like to correct that. That is not quite true. I don't believe that is exactly what he said.

Mr. YATES. Didn't you say that, Dr. Beranek? I asked you when the new engine would come into existence and you said with the production version.

Dr. BERANEK. That is right. I think the question that we are addressing ourselves to here is a little different than the way you are apparently phrasing it. The engine that will go on the production aircraft will be a different engine in only slightly different ways. The afterburner is removed but, in any event, the afterburner—and check me if I am right on this—will not operate in cruise conditions. Isn't that right? It never will, or would it?

Mr. MAGRUDER. On the prototype airplane the afterburner will be required to accelerate the airplane, at heavy weight, to supersonic cruise conditions but then you can fly without it and get the measurements.

Dr. BERANEK. You didn't answer my question. You don't use it in the cruise part of the flight?

Mr. MAGRUDER. That is correct.

Dr. BERANEK. So you are not accelerating to cruise very long.

Mr. MAGRUDER. I want to make sure I don't mislead you. We are talking about what you can do to get environmental measurements. You can cruise the airplane in the prototype phase under certain conditions without the afterburner. If you load the airplane up to maximum weight and try to demonstrate the maximum emission you would use the afterburner in the prototype. It is on there to get enough thrust to do that. But I don't want anybody to leave here with the impression that the GE-4 production engine is considerably different from the prototype engine. As I said yesterday, it is basically the same gas generator. It is only scaled up 2 inches in diameter and is simplified by the elimination of a complex thing like the afterburner. It will be only slightly different. All you get out of a prototype is one big step closer to the final article. The engines that are flying today in the production subsonic transports are vastly different from the engines that went into service in 1958 and 1959, and this evolution continues on forever. They just keep getting better and better.

#### PROFESSOR EAD'S TESTIMONY

Mr. YATES. May I say what worries me is the past history that I am sure you are familiar with. Professor Eads, testifying before the Senate Appropriations Committee, said this:

The main areas that I see that would contribute greatest to solving this thing would be in work on engines. Contrary to what other witnesses have stated, you do not begin development of a prototype unless you have your technology pretty well in hand.

You don't put an engine in a plane, design the space that engine is going to fit into, including the thrust reverser and the noise suppressor, until you know how big the plane is going to be.

And he goes on to say:

Convair with the 880, for example, wanted to make a marginal change in the 880. They weren't selling very well, so they thought they would make some small changes. They put a different engine on it and put some speed pods.

Then they could sell some of these to American airlines who could then advertise they had the fastest plane in the air. It turned out when they made these minor changes they changed the entire character of the aircraft and Convair lost \$425 million on that project, simply because they tried to make changes in the prototype.

The point I am making is you speak of a small change in this engine, and you will probably correct me because you know so much more about this than do I, but it occurs to me that small changes in an engine or in other parts of a complicated machine like an aircraft may very well sometimes be the most difficult ones to find and you may spend days and you may spend weeks and a tremendous lot of money in perfecting it.

Mr. MAGRUDER. I would like to answer that question by saying that Professor Eads is a prime example of the problem of communications on the SST. He works in the economics department, has for 1 year, at Princeton. He has no engineering-technical training. I am intimately familiar with the 880 and 990. There is no relationship between the 880 and the 990. The 990 is a new airplane. Speed pods are not put on new airplanes as small improvements. That is a brandnew wing design, a brandnew fuselage design, a brandnew engine design, and that is in no way a small change. That is as different as the difference between a 707 and 747. Dr. Eads is testifying completely out of his element of expertise.

Mr. YATES. Let me go back to the thrust of my question then.

Mr. MAGRUDER. May I add one thing further, though? I submitted that testimony to many top experts in the U.S. airframe design industry, people like Kelly Johnson and Maynard Pennell who kicked off the jet age. There is not one expert in the U.S. aerospace industry, that I could find, who agrees with what Mr. Eads just said.

Mr. YATES. May I ask the question, then? I am sure that with your vast background of experience and knowledge, examples must come to your mind where a small change in an airplane or airframe or engine part may have been very difficult to attain and have resulted in tremendous expenditure of both time and money.

Mr. MAGRUDER. Well, I don't want to say that these changes don't cost money. They do cost money. It costs money to improve anything. The essence of that discussion is whether it is worth it. In the case of the SST going from the prototype engine to the production engine we will meet the new noise requirements. We are going to hang on, very importantly, to the airline economics of the basic airplane by reducing the maintenance costs. The most difficult part of a supersonic engine to maintain is the afterburner. By eliminating the afterburner and having a simple gas generator, only 2 inches bigger in diameter, we meet the noise requirements, maintain our payload range, and keep the operating economics down by improving reliability, lowering maintenance and spare parts consumption. This is a good economic tradeoff.

#### EFFECT OF ENGINE CHANGE

Mr. YATES. May I get back to Dr. Singer and the point he made about some of the scientists, and the original question I asked about some of the scientists not willing to accept findings in the absence of stratospheric flight with the engine that would be used in the fleets of SST's? The point I raise, is a complex one because we may start with the engine that is not in the prototype. We now have a first improvement made to reduce noise, and I am sure as planes advance in their evolution you will get other engines that will be developed, possibly more quiet, possibly more powerful. Certainly some day you will be

presented with the same question with the hypersonics. The question I raise is how much, therefore, can you give to the scientists who demand that you fly with this engine at this certain level, knowing that there are going to be changes in the engine, anyway and, as Dr. Beranek pointed out, this engine is going to change?

Dr. SINGER. As Mr. Magruder has pointed out, if you go to this engine you are taking a big step. The basic point that one needs to check if one doesn't believe in measurements on small engines is to check a big engine. The basic parameter is the fuel consumption and, of course, this determines how much water vapor, and how much nitrogen oxide, and so on, is being put out. That is the major thing.

Mr. YATES. Water vapor and nitrous oxides?

Dr. SINGER. Yes.

Mr. YATES. You are not worried about the sulphuric particles?

Dr. SINGER. And the sulphuric particles; yes. This you calculate and measure on the ground.

Mr. YATES. But you could get a fuel that disposes of the sulphuric particles, can't you, really?

Dr. SINGER. Yes.

Mr. YATES. So that isn't really your problem?

Dr. SINGER. I don't consider it very much of a problem. The SCEP people were extremely conservative and used a higher sulphur content than probably would be used in the SST. What I am trying to point out is that if the prototype is available, one certainly ought to make environmental measurements.

Mr. YATES. It will be available but it is going to fly, as Mr. Magruder says, approximately 20 or 25 hours. Will that be adequate for your purposes?

Dr. SINGER. Oh, yes.

Mr. MAGRUDER. Mr. Yates, may I add a point?

Mr. YATES. Certainly you may.

Mr. MAGRUDER. I am sorry the full committee is not here for what I am going to say. I think the exciting thing about the SST and the points you are driving at, which are extremely good and valid, is that this is not a one-time thing that never again are we going to take on technological development like the SST, that you simply gulp, look at, and say, "OK, forget it." This committee that we have formed that Mr. Ruckelshaus testified to the other day is going to keep right on monitoring so that as we evolve new and improved engines, the word "improvement" will mean not only efficiency and cost and payload and airline economics, but it is also going to mean lower engine emissions. It is going to mean that the petroleum industry is alert and aware of the need to get sulfur out of fuel. Sulfur is only in fuel because it comes out of the ground with the fuel. It hurts maintenance. It adds to pollution. We are going to improve everything we can. We are going to keep monitoring and keep on testing and every time we make a change we are going to retest and we will always be in a position to report improvement.

#### RESISTING TECHNOLOGICAL IMPROVEMENT

Mr. YATES. I am glad to hear you say that. That, of course, is my attitude, too, and I think that most of us who have opposed the SST have been accused, I think somewhat unfairly, as I think Dr. Singer

did yesterday, of resisting science and scientific and technological improvement. We don't resist scientific and technological improvement, and I don't think that the SST stands as a symbol of resistance to scientific and technical advance. We oppose such advances without counting the costs, the harms they bring.

It seems to me that you must add a corollary to that statement that the SST, at the present time stands as an example of science and technology that must be challenged because of the possible harm that it may bring to mankind. For example, if you had known what the possible consequences of DDT were likely to be you might not want to have used DDT even though it has certain benefits as far as the elimination of pests and insects. But the fact remains that we have reached a point in this country—I think Earth Day was significant, for example, when the people of the country said “We want to examine most carefully things that may pollute our atmosphere. We don't think we ought to rush headlong or pellmell into everything that is designated ‘progress’ or ‘advance.’” We must look at it, even if it is branded “progress.” That is part of the challenge that we are raising to the SST.

I think that Mr. Magruder has done an outstanding job in marshaling the arguments in support of his undertaking. I think by bringing you in and bringing Dr. Beranek in he has attempted to blunt the argument that many of us have been making over the years. That is only one of the arguments we have been making, of course, and we will go into some of them in a short time, but I wanted to make that point because as I listened to your testimony yesterday you said that it seemed to be a symbol of opposition to science and technology. Dr. David has issued a statement which he has sent out to scientists all over the country, asking whether they agree that there ought to be money spent for scientific and technological investigations and experimentation, and, of course, they all wrote back and said yes. Science and technology must continue, but we must be wary of possible damage that may flow in consequence.

Mr. McFALL. Would you yield for just a moment?

Mr. YATES. Be glad to yield, Mr. Chairman.

#### SST AS A SYMBOL

Mr. McFALL. While we are discussing this, it seems to me that the SST has become a symbol of the need to improve our environment—

Mr. YATES. Right.

Mr. McFALL (continuing). And in a sense it is a fallacy.

Mr. YATES. Wrong.

Mr. McFALL. Because the SST is really not that important to the environment, but it has become sort of a rallying point for those who want to improve the environment.

Mr. YATES. Right.

Mr. McFALL. And I think that what we are finding out here is that we all agree that we want to make sure the environment is protected, but the SST, which is being used as a symbol of the need to improve the environment, really is not that important to it.

Mr. YATES. We don't know that yet. That is why we have Dr. Singer's committee and this is why we have Dr. Beranek's investigations. Until Dr. Beranek completed his initial task there were many who considered noise as something we ought to overlook. Now there

are many who will consider, and I will get to that in a minute, Doctor, there are many who think that you ought not to allow an airplane to be used in commercial service where its noise is so loud that it knocks people out of beds or does these things to destroy the quality of life in our environment. This case has had so much attention because Mr. Magruder, rightfully, has brought Dr. Singer and his committee in and has brought Dr. Beranek in, and we have brought physicists in. This is in that sense the symbol, how do we balance, how do we want to attain the peaks of scientific and technological achievement that have distinguished our country over the years and over the decades, at the same time retaining the kind of quality of life that our people want.

#### SST'S EFFECT ON ENVIRONMENT

Mr. McFALL. In that sense, it has become a symbol. Those who feel that we should continue with improvement in environment and defeat anything that would degrade our environment, think of the SST as the—here using a French word—cause *celebre*. They feel that they have to defeat this thing because if they don't then we will be going backwards in our attempts to improve the environment. I think one of the things we have shown during this hearing is that the SST probably will not degrade the environment.

Mr. YATES. You haven't shown that, Mr. Chairman.

Mr. McFALL. I think when we start discussing the environmental problems, we will see that the chances are small that the SST is going to harm the environment, and certainly the prototypes are not going to hurt the environment.

Mr. YATES. That is agreed.

Mr. McFALL. I think we may also be able to agree that the chances that the SST, or 500 of them, will degrade the environment are very, very small even at this point.

Mr. YATES. I don't agree with that. That is Dr. Singer's opinion. It wasn't the opinion of the others. It wasn't the opinion of SCEP. SCEP wasn't as willing to go as far as Dr. Singer is willing to go. What SCEP did was to raise a concern and said that it ought to be looked at.

Dr. SINGER. As Dr. Kellogg explained yesterday, SCEP is a committee, a committee which included people who were opposed to the SST for various reasons which have nothing to do with the environment. The committee attempted to write a position or a conclusion that was acceptable. This group was a committee, of course, and I think you gentlemen understand very well the subject of politics. The phrasing of a set of conclusions which satisfied every member of the committee is a difficult thing. You cannot commit yourself one way or the other as a committee.

Yet Dr. Kellogg, who was Chairman of that group, yesterday did commit himself and agrees with me in every respect.

Mr. YATES. Did he say that in his testimony? I didn't remember that he said that.

Dr. SINGER. Then I will add to what he said in his testimony what he told me last night at dinner. I said to him I was sort of forced into a numerical assessment of my confidence of what the SST is going to do. I said to him "How do you feel about it?" and he said "I would agree exactly with your number. This is my own personal conclusion."

## KELLOGG LETTER ON SCEP STUDY

Mr. YATES. I asked Dr. Kellogg that question specifically. I asked Dr. Kellogg that question specifically as to what SCEP decided and he did not say that he agreed with you. I thought you went beyond SCEP and I thought he said that you went beyond SCEP.

Mr. MAGRUDER. May I interject what Dr. Kellogg has officially told me as the Director of the SST program, I can get this in writing and we would like to submit it in writing so we have no difficulty with the record.

Mr. YATES. Yes.

(The information follows:)

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH,  
LABORATORY OF ATMOSPHERIC SCIENCES,  
Boulder, Colo., August 24, 1970.

Mr. WILLIAM M. MAGRUDER,  
Head, SST Program,  
Washington, D.C.

DEAR MR. MAGRUDER: The purpose of this letter is to clarify some of the conclusions of the report of the Study on Critical Environmental Problems (SCEP, commonly known as the M.I.T. Summer Study). This summer study has, of course, already gone to press, and therefore it cannot be changed—nor would I wish to change anything at this time. However, there are some aspects of the report relating to the possible effects of SST's on the stratosphere that you have asked me to comment on, and I am glad to do so.

It seems that one particular statement in our report has been misunderstood by the press, and I would like to make the record perfectly clear. We say in our report, after having discussed the various technical and scientific factors involved in the SST contamination of the stratosphere: "Therefore, we recommend that uncertainties about SST contamination and its effects be resolved before large-scale operation of SST's is implemented." We had in mind that, if we begin right away, it should be possible to forecast the effects of SST's on the stratosphere, and we understand that they will not go into full-scale operation before about 1985. (This is a chance for a major new technological development to be studied before it goes into full-scale operation, and we certainly should seize the opportunity. I understand that you agree with this point of view. Nowhere have we indicated that we believe the SST development should be held up or delayed pending the results of this study.)

I have read over the report of your office concerning your position, as of August 4, 1970 on the possible effects of SSTs on weather and air pollution, and I believe it states your concerns and the facts in the matter fairly. In particular, I would like to point to your statement which indicates that "present information indicates that projected SST operations are unlikely to cause significant climatic changes but \* \* \* we cannot express the desired confidence regarding the lack of climatic change." It is clear that you recognize the need for further research in this area, and this is what the SCEP has urged also.

In particular, I believe that research should concentrate on the study of particles in the stratosphere, their natural variability, and their sources and sinks. It appears that currently volcanoes are the main source of particles in the stratosphere, and we never know when nature will provide us with another experiment similar to the Agung eruption of 1963. We should be ready when and if it occurs to study what happens in the stratosphere. This point of view should be emphasized in any research program designed to predict the effects of SST's, and I think it is not sufficiently emphasized in the statements of your office concerning the research needed. This is an area where NCAR will continue to work also, in cooperation with the Air Weather Service.

Clearly, another subject on which we need further information is the exhaust products of the SST engine when this engine can be studied in flight. Every effort should be made to find out just what will be the constituents of the exhaust, and how they will be modified in the stratospheric environment. We assume that most of the SO<sub>2</sub> and the unburned hydrocarbons will be converted to particles, and this is probably a safe assumption. We assume that none of the NO<sub>x</sub> would end up as particles, and this should be investigated. I believe

that these aspects of the research should also be emphasized when you recommend a program.

Another set of questions centers around the effects of particles in the stratosphere on the temperature balance of the atmosphere. OUR SCEP report makes it clear why we expect some temperature change, by analogy with the changes following Agung. If our reasoning is correct, the stratosphere temperature would rise by a few degrees, and the surface temperature would fall by a very small amount. A surface temperature change following Agung was not actually detected, so it is possible that the effects of SST's on the surface temperature will not be detectable either. In any case, it should be possible to make a much better estimate of the temperature change in the stratosphere and troposphere to be expected from SST exhaust products, starting with first principles.

I hope that these additional comments will be helpful to you. I have made them in the hope that any use of our SCEP report will be with the proper understanding and interpretation of the rather complicated scientific ideas in it. This sort of study is, I am afraid, easy to misinterpret if one is not familiar with the atmospheric and physical processes involved. As the chairman of the working group on climatic effects for SCOP, I am most concerned that our conclusions are understood by all who are concerned with the SST program, and that we work together to obtain better information.

Sincerely yours,

WILLIAM W. KELLOGG,  
*Director, LAS.*

Mr. MAGRUDER. He has said to me on numerous occasions that he is very concerned with exaggerations and misinformations that have been perpetuated as a result of the SCEP report.

Mr. YATES. He expressed a concern about the SST.

Mr. MAGRUDER. All the SCEP report did was express a concern.

Mr. YATES. He said that.

Mr. MAGRUDER. He has further said to me that there are no facts in the scientific community that will say that two prototypes or a fleet of SST's will damage the environment significantly in any way. In order to increase confidence in that statement he has recommended to me that we do more research.

Now, I believe that Dr. Singer, Dr. Kellogg, and the SCEP scientists and all the members of the Advisory Committee are in agreement on that statement. We have been very careful in wording and in publishing that statement.

Mr. McFALL. That is on page 33 of your statement, and I have read it several times.

Mr. MAGRUDER. That is right.

Mr. YATES. He said that.

Mr. MAGRUDER. I think that should clearly be said for the record again, though.

Mr. McFALL. That statement is applied to the prototypes and fleets of SST's.

Mr. YATES. That is right; and he has made his position and you have put that into the record.

#### NEED FOR PROTOTYPES

Mr. MAGRUDER. It is very important that we in the Government who have responsibility, not get ourselves in the position of being damned if you do and damned if you don't. If we take on a research program we don't want people in the public, and especially in the news media who have been very unfortunate in their interpretations of

some of the scientific data, to assume because we are doing research, that we think there is a serious problem there. There is not. We must be free to do our research and increase our confidence to get that last 1 or 2 percent to assure that there is going to be no damage. If we don't do the research, then we will be accused of being irresponsible.

Mr. YATES. We are in favor of your doing research.

Mr. McFALL. If you don't build the plane, they are going to say, "Well, you know, if we had the plane it might be different. Your research is fine but"——

Mr. MAGRUDER. That is correct. I would like to relate to you a discussion I had this morning with the State Department because I think there is confusion about the requirement for the prototype. The State Department said very clearly that their position is and always has been that in the unlikely event that our scientists and their data indicate that we should go before the international tribunals to stop SST's, that the State Department would be in such a weak position they would not be able to sustain the U.S. position if we did not have full-scale prototype flying.

In spite of what Mr. Ruckelshaus said and Dr. Greenfield said, and we would agree that in a pure academic laboratory sense probably we could get some numbers that we could agree with, if the French, the British, and the Russians have not only the flight test, and the laboratory test, but also have 5 years of full-scale operation and, in the case of the Russians, fleet service over Russia and Siberia, we would be in an untenable position to win an argument and therefore there is a good environmental reason to have prototypes.

Mr. McFALL. You are saying they would say "You are just opposed to this plane because you don't have one."

Mr. MAGRUDER. Yes.

#### COST OF CONCORDE

Mr. YATES. May I suggest Dr. Singer ought to go over to France very quickly, according to the article that appeared in the New York Times this morning. I don't know whether you had occasion to read it.

Dr. SINGER. Yes. It is in the field of economics and that is not my specialty.

Mr. YATES. The field of economics may chop your field of experimentation right off.

The point I was making, was my distinguished colleague, Mr. Boland, who is chairing his own subcommittee this morning and, therefore, can't be here, called attention to an article that appeared in the New York Times the day before, by our distinguished writing friend, Chris Lydon, to the effect that the SST proponents seemed to be gaining an advantage. I am not willing to concede that and I think the article that appeared in today's New York Times indicates that part of the base for the proponents' case is somewhat eroded, I read from today's New York Times an article by Clyde H. Farnsworth from Paris, and it says this:

Costs of the Concorde program have gone from under \$400 million to \$2 billion since the British and French Governments decided to build the supersonic airliner in 1962.

The British and French airframe builders, in a joint statement today, attributed the rise to inflation and design modifications needed by airline companies.

Their statement came as debate sharpened in France over whether to go ahead with the program. The two governments, which are sharing the costs, will decide on March 29 whether the builders should proceed.

Sixteen airline companies have taken options on 74 Concorde's, but none have yet placed a firm order.

Antoine Pinay, one of France's elder statesmen, strongly attacked the project last night. "We are spending an awful lot of money simply to provide a way for American millionaires to cross the Atlantic faster," he said in Lyons.

And I will put the article in the record, if you wish, Mr. Chairman. (The article follows:)

[From the New York Times, Mar. 4, 1971]

#### CONCORDE'S COST NOW AT \$2 BILLION

##### AIRLINER PROJECT IS UNDER NEW ATTACK IN FRANCE

(By Clyde H. Farnsworth)

PARIS, March 3—Costs of the Concorde program have gone from under \$400 million to \$2 billion since the British and French Governments decided to build the supersonic airliner in 1962.

The British and French airframe builders, in a joint statement today, attributed the rise to inflation and design modifications needed by airline companies.

Their statement came as debate sharpened in France over whether to go ahead with the program. The two Governments, which are sharing the costs, will decide on March 29 whether the builders should proceed.

Sixteen airline companies have taken options on 74 Concorde's, but none have yet placed a firm order.

Antoine Pinay, one of France's elder statesmen, strongly attacked the project last night. "We are spending an awful lot of money simply to provide a way for American millionaires to cross the Atlantic faster," he said in Lyons.

##### MAN OF GREAT INFLUENCE

Although no longer in a position of power, Mr. Pinay has great influence in France. He was Finance Minister under Charles de Gaulle and is regarded by many as a symbol of the French bourgeoisier, or middle class.

He turned down an offer to become Finance Minister under President Pompidou, who, as did General de Gaulle, has put his personal prestige behind the plane.

The Concorde, which is designed to fly at slightly more than twice the speed of sound, would reduce the air time from Paris to New York 7 to 3½ hours. The plane is expected to be priced at \$25 million and 250 would have to be sold for the builders to make money. About \$800 million has already been spent on the plane.

The two manufacturers—the British Aircraft Corp. and the National Industrial Aerospace Co. of France (formerly Sud Aviation)—went into their experience over the last 17 months to explain the rising costs.

In this period the figures have ballooned by nearly \$250 million. The largest element—40 percent—reflects higher industrial prices and wages. An improved propulsion system was needed, and this took \$85 million. Other technical changes ate up \$50 million.

The new \$2 billion estimate covers the following: the British and French prototypes which are now going through a series of flight tests; a fuselage for endurance tests; 63 Rolls-Royce Olympus engines; the industrial hardware for assembly line production and the first three production models of the plane.

Mr. YATES. Second, Mr. Magruder, if I may say so, I think you fell into the same, and I am sure unintentional, trap that Congressman Brown fell into yesterday when you say that BOAC had repudiated or denied the first article. As I pointed out to Congressman Brown, the article which appeared in the Post for Sunday, February 21, said this:

The British Overseas Airways Corp. (BOAC) has told the British Government that BOAC sees no way of operating the Anglo-French supersonic airliner Concorde economically.

The BOAC verdict is bound to affect the government's imminent decision on the \$2.4 billion project, cancellation of which would cause an industrial crisis in Britain more serious than the collapse of Rolls-Royce earlier this month.

The article goes on, and you may have the article. I am sure you are familiar with it, but all that the denial said, Mr. Magruder, is this, and I have the denial here:

The British Overseas Airways Corp. yesterday denied weekend press reports that it had told the government it did not want to buy the Concorde supersonic airliner because it could not afford to use it.

The second article did not deny the statement that we attributed to the BOAC that both airlines calculate it will cost twice as much to operate per seat mile as the subsonic Boeing 747.

The point I am making is that I think all of us have to be careful with our interpretation of a newspaper article. The second article merely denied that the government did not want to buy the Concorde supersonic airliner, which wasn't a part of the first article at all. The only point of the first article was that the Concorde is too costly. There is nothing in the second article that relates to that point.

#### PROTOTYPE VERSUS PRODUCTION COSTS

Mr. MAGRUDER. May I answer those in two parts?

Mr. YATES. Sure; you may indeed.

Mr. MAGRUDER. On the first one you are making a point that there are some newspaper articles about the cost of the Concorde. I want to make it clear that in the experience I have had in the aerospace industry, and certainly the year that I have had in the SST program in Washington, the last place, the absolutely last place, that I would ever go for facts and figures on any program is to the newspapers, and No. 1 on that list would be the New York Times. I have never seen so many inaccuracies as have been published in that newspaper, and, with all due respect to Mr. Lydon.

I think that there is a reason to send some of their reporters to school. They don't understand, nor do you understand, what is going on in the Concorde case. You are seeing the argument of the SST in 1974. They are not arguing about production versus prototype. They are in production. We are talking about building two prototypes. We are on cost, on schedule, on performance. The difficulty always has been to overlap prototype or initial construction and building of the actual production article, and that is what the Concorde is doing. They are suffering from the same cost escalation problems that got Douglas into some trouble on the DC-8, got Convair into a problem on the 880 and the 990 airplanes.

Mr. YATES. And Lockheed on the C-5.

Mr. MAGRUDER. That is a different problem completely, but it is not really worth discussing in this context. There is no relationship between the C-5 and Lockheed 1011 nor any relationship between the overlapping of production and prototype because civil aircraft such as 707's and DC-8's did not have prototypes in the context we are talking, "fly before you buy." We have the ability to control costs because the only fundamental criteria we are up against is to produce an airplane that is economically viable, will meet airline requirements, meet noise and pollution requirements, and can fly in the present day air traffic control environment.

We have great latitude and flexibility in making changes in the contract to hold our costs as long as we don't violate those standards. I went to Wright-Patterson Air Force Base before I accepted this job and sent members of my staff there twice after I took the job to make sure that this program has the most flexible, fair, usable contract to hold costs, schedules, and performance that we have ever had in the Government. To my knowledge the contract does that.

That was not true of many of the military programs. That is the answer to the first question. You are trying to compare apples and oranges and a production and prototype program that does have cost problems that is not related to our program in any way.

#### BOAC PURCHASE OF CONCORDE

Mr. YATES. If I may interrupt you for a question, are you saying that this statement is attributed to BOAC respecting the operating costs of the Concorde—

Mr. MAGRUDER. You are on the second subject. I finished only subject No. 1.

Mr. YATES. You just want to go to what the article says?

Mr. MAGRUDER. May I go to that one?

Mr. YATES. I am sorry.

Mr. MAGRUDER. Your first subject was—

Mr. YATES. The first subject is that I have to go to school with Mr. Lydon.

Mr. MAGRUDER. I think it would be very wise to learn how you do costing in the airplane development business.

The second subject is that that article did indeed say, and I quote: "That the Concorde is uneconomical, BOAC says." Then it relates to the fact that its operating costs are higher than those of the 747.

Mr. YATES. Twice as high.

Mr. MAGRUDER. However, it was fortuitous, that I was in New York the next day and I happened to meet with Sir Anthony Wedgwood-Benn, a Member of Parliament. He gave me a complete file on all the responses to that. I want to read to you some quotes:

BOAC still wants the Concorde.

Quote from a British paper:

We want to continue to buy and fly the Concorde, a spokesman for the corporation said yesterday, and we are looking forward to the best ways of doing so.

What you are seeing in the newspaper for the first time is a negotiation of the sale of an airplane in the press. The press doesn't fully understand that. As a matter of fact, an outstanding writer that does understand this and works for the New York Times is Dick Witkin. He is the transportation editor and is a real pro. I have never seen him publish anything that inaccurate.

Mr. CONTE. May I interrupt there?

Mr. YATES. Do you want me to yield to you? It is my time. I will be glad to yield to you.

Mr. CONTE. No. I have heard you for 4 years. I will go and have a cup of coffee.

Mr. YATES. Have your coffee, and I'll be glad to yield to you.

Mr. McFALL. We got along real fine up to this point.

Mr. YATES. I will be glad to yield to you.

Mr. CONTE. You are not doing me any favor. Forget it.

Mr. McFALL. Go ahead, sir.

Mr. MAGRUDER. The point on operating cost—

Mr. CONTE. The only point I wanted to make—

Mr. MAGRUDER. I yield to Mr. Conte.

Mr. YATES. You can't. I'll yield to him.

Mr. CONTE. The only point I wanted to make is why even discuss this. The point is that BOAC is owned by the Government. British Aircraft, which is building the Concorde, is owned by the Government. I thought that story was stupid in the Post or the Times. Of course, they are going to buy the airplane.

Mr. YATES. They can't avoid it.

Mr. CONTE. It is just like saying you are not going to go to bed with your wife. I don't know why we are wasting all this time talking about this.

Mr. YATES. Except that Mr. Magruder is making a point that we are now seeing in the newspapers the negotiation of the purchase of an aircraft. The point you are making is that there is no negotiation; they have to buy it, anyway. Isn't that right?

Mr. CONTE. They are going to buy it.

Mr. MAGRUDER. Negotiation that is going on is negotiation of the price.

#### CONCORDE COMPETITION

Mr. McFALL. Let's get down to the point here. What you are trying to say about the Concorde, as I understand it, is that it is not really going to be the competitor that has been testified to, and therefore the Concorde is not a real reason for forcing us to go ahead with the SST. Isn't that the basis of what you are—

Mr. YATES. Mr. Magruder and Secretary Volpe have come in here, Mr. Chairman, and said that the British and French and Russians are breathing down our neck.

Mr. McFALL. Right. So what you are saying is that the Concorde is not going to be economical. Therefore, it is not the threat that they have been telling us about. That is the point of what you are saying?

Mr. YATES. That is the first one. The second point is if they want to lose their shirts operating the Concorde and TU-144 that is their privilege, but we don't have to necessarily do so in operating our plane.

Mr. McFALL. The British are going to go ahead with this thing and so are the French, whether it is economical or not, and I don't concede that it is not, so you are still going to have the competition of the Concorde.

Mr. YATES. Mr. Chairman, that isn't the only point I made. According to the article which Mr. Magruder isn't willing to accept, the French and the British are going to meet on March 29 to decide whether or not to finish the Concorde.

Mr. McFALL. That is an economic problem we are getting into, and we ought to try to get the environmental problem out of the way. Dr. Singer was supposed to leave at 11 o'clock.

Mr. YATES. I have no further questions for Dr. Singer but I do have questions for Dr. Beranek.

Mr. McFALL. Dr. Beranek is here until 12 o'clock. We have gone 10 minutes over your time.

Dr. SINGER. That is all right.

Mr. YATES. He is enjoying the show.

Dr. SINGER. I am learning something.

Mr. YATES. So are we all, Dr. Singer.

Mr. McFALL. I have got some questions for Dr. Beranek.

#### ENVIRONMENT QUESTION PUT TO REST

Mr. CONTE. I have some too.

One fast observation: I just want to commend Dr. Singer for his testimony. I think he has done an excellent job. I think that after 3 days of hearing, I only have to resolve one question. I think the environment question has been put to rest. I think that you and the other scientists that came here have definitely put to rest the environment question. I don't think it is there. I don't think the issue is there. I think the only issue left in my mind now is whether I want to go with the Federal subsidy for this airplane. I want to commend you. You have done a good job.

Dr. SINGER. Thank you.

#### SIDELINE NOISE

Mr. McFALL. We were discussing whether or not we could get some agreement or understanding on the issues with respect to the environment. Your point is a good one, and perhaps we might do this before Dr. Singer leaves. We could examine the problem, and perhaps narrow the issue to the point where we can see where the controversy may be. What are the problems? First of all, there is the noise of the engine on the takeoff.

Mr. YATES. That is the first one. The plane begins to take off.

Mr. McFALL. We are saying that with this new engine, that the sideline noise is now, on the drawing boards at any rate, down to 108.

Mr. YATES. EPNdB.

Dr. BERANEK. The regulation is for new subsonic jets, which includes all three positions.

Mr. McFALL. 108 is the target for subsonic planes that are flying now, and they are not yet down to 108 as I understand it; is that right?

Dr. BERANEK. The FAR 36 relates to new planes entering the fleet.

Mr. McFALL. True, but the subsonics that are flying now are not down to 108.

Dr. BERANEK. That is correct.

#### PRODUCTION ENGINE DESIGN CHANGES

Mr. McFALL. We may have a question later which says "well, that is only on the drawing board." How can we be certain? You are the noise expert. How close are we to this? Is this just somebody's fiction, or are you certain as a scientist that this engine that we have discussed will meet these requirements?

Dr. BERANEK. As I say, the committee had on it a group of men who were experts in various things, including, for example, Jack Kerre-

brock from MIT who is an expert on engines. One of the things that we as a group, and he in particular asked, speaking for the engine aspect in our meetings, with the engine drawings stretched out the length of the table and blown up to full size, was what each thing in that engine was. Is it something new? Is it something that has been thoroughly tried? Has it been thoroughly used. What in the engine is there a chance of trouble developing from? He took it from the beginning to the end. They are using bearings that are fully tested. They are using a bearing configuration in this engine that they feel even more confident about, than those that are on the prototype engine.

They have been increased in size, but very little. When you have something that is already almost 8 feet in diameter, and you add 2 inches to the diameter, you are not changing your system very much. The reduction of the high temperatures reduced the stress on materials. It cut down the danger that the engine will cause troubles or have high maintenance cost. He worked his way the length of the table on this, as our chief questioner, and got assurances at every point that satisfied him that there was not something that was new in the sense of being untried.

In fact, we, as a committee, viewed the thing as a minor modification to their technology, not as a new engine.

Mr. McFALL. But with enormous benefits.

Dr. BERANEK. But with enormous benefits.

Second, because they went to this change, and got rid of the afterburner, we could put on a different muffler. We were not completely happy with the muffler they talked about when the afterburner was on. In fact, the committee, I might say was astounded at how much new technology would have to be developed in a few years to get a muffler that would work at those high temperatures.

Once the engine people brought the temperature down, then we were in an area we knew more about. This is getting into an area which I know a great deal about, and two other members of the committee knew a great deal about. One of them was the Douglas representative who had worked through the whole DC-8 muffler attachment.

With that lower temperature, we are talking about mufflers that have been tried at those temperatures, have been tried repeatedly in actual flight, and we know there is no problem.

Then you come to the one point of the refined engineering changes we made. This aspect was being tested on an actual F-106J-85 engine combination. These engines were put on where the bombs hang normally on that plane, and tried out. Also the British-French Concorde was flying. These things assured us that the engineering methods we are talking about could be updated, and we got some gain out of that. It might have gone the other way, but it didn't. Again we looked at that backwards and forwards, and we even paid a small amount of outside money to get somebody to cross-check the figures so that it would not be just the committee. We wanted an independent engineering check on this thing. So we laid that down.

The last 1 decibel we got aerodynamically. They gave us all of the test figures from the NASA-AMES Laboratory tests. They looked reasonable, and it is only 1 decibel. We didn't go to NASA and quiz them on whether or not they did the job right. We assumed they did and it is not that big a number to spend a lot of time on.

## FAR-36 NOISE REQUIREMENTS

Mr. McFALL. So you can be satisfied that that engine is going to do the job, as far as the sideline noise, and, of course, community noise is a part of that problem.

Dr. BERANEK. Yes, and I really want to treat it as a package. We say FAR-36, not just some number here or one place or another. It is a package that is there for new subsonic aircraft.

Mr. YATES. Why are you so careful in avoiding the chairman's question about limiting this to 108 EPNdB, saying it is a part of FAR-36?

Dr. BERANEK. I am being careful about that because FAR-36 has in it one feature that we haven't talked about. That is, they state in FAR-36 that there is a little chance for engineering deviation at some one of the points, provided you do better at some of the others.

Mr. YATES. What does that mean in terms of what the chairman is trying to get at?

Dr. BERANEK. I am just saying that this gives the opportunity for some slight engineering variation.

Mr. McFALL. It might vary between 106 or 110, and FAR-36 might permit an average between 106 and 110.

Mr. YATES. Is that what you mean? You are interpreting FAR-36 to mean an average of 108?

Dr. BERANEK. No, it can't be an average. FAR-36 states that you can allow a level at one of their various positions, go up as much as 2 EPNdB, provided you write the sums down of the other positions by 2 EPNdB.

Mr. YATES. Does this mean, if I understand you correctly, if this takes over at 110 EPNdB, then in rising over the community it has a corresponding reduction of 2 EPNdB, that therefore it has met FAR-36?

Dr. BERANEK. It has to go down as far as 2.

Mr. YATES. It then would meet it?

Dr. BERANEK. Yes.

Mr. YATES. Even though at the time of takeoff the noise might exceed 108?

Dr. BERANEK. That is correct.

Mr. McFALL. That is what 108 EPNdB means as far as subsonic jets are concerned. That is the standard.

Dr. BERANEK. One thing further I want to say; and that is, of course, the FAA has the right to write a different regulation if that seems appropriate, but we have factored to the FAR-36. As an engineer, you think you have got to give a designer of any machine a little freedom for trade-offs. I didn't want, by my testimony, to tie down the situation so tightly that there would be no engineering tolerance.

Mr. YATES. Doctor, I am very grateful to you for having clarified this. I must confess that I conceived FAR-36 as requiring absolutely the 108 EPNdB as a takeoff noise limit at that particular point. Therefore, as I understand what you are saying, that the takeoff noise can be as much as 112 EPNdB—

Dr. BERANEK. No.

Mr. YATES. Wait a minute, let me finish my question.

Dr. BERANEK. You can't go up more than 2.

Mr. YATES. That is the top limit? It can't be up more than 110?

Dr. BERANEK. That is right.

Mr. YATES. The question I was going to ask is, suppose it goes up to 112, but you can reduce it by four points somewhere along the flight path?

Dr. BERANEK. Let me make it clear again. At any one of these points along this rectangle that surrounds the takeoff path, the runway takeoff path, the nominal number is 108. The FAA, in their wisdom, knowing how things can go a little bit wrong, because the measuring equipment might be a little bit wrong, permitted the number to go up at any one of those points; either the takeoff point  $3\frac{1}{2}$  miles from beginning of takeoff roll, or the landing checkpoint, a mile from touchdown, or along the sideline, checkpoint which is about a third of a mile to the side of the runway center line.

These are nautical-miles. They will allow the level to rise at two of those points not at all three, provided that at the other two the sum of the deviation is not more than three EPNdB and no greater than two EPNdB at any one location and if they exceed — are offset at other locations. Is that clear?

#### CONTRACT NOISE REQUIREMENTS

Mr. YATES. It is clear.

Mr. PARSONS, you were on the original contract, as I remember it, the one for the swing-wing, and Mr. Vierling was too at the time. What is my memory with respect to what the sideline noise limitation was then? Was it 93 EPNdB? It was much lower than 108 though, wasn't it?

Mr. PARSONS. Not for the production airplane; no, sir.

Mr. YATES. How much was it?

Mr. PARSONS. Around 122 EPNdB for the far measuring point.

Mr. YATES. For the production airplane?

Mr. PARSONS. Yes, sir.

Mr. YATES. This was the swing-wing?

Mr. PARSONS. Yes, sir.

Mr. YATES. FAR-36 is what the FAA has concluded. Do you consider this to be a fair standard of regulation, considering the state of the industry, and our attempts to reduce noise?

Dr. BERANEK. Yes, in the terms that I expressed yesterday; namely, that there is no magic number. You people serving in either the administrative or the legislative branch, have to serve as the arbitrators between what you might call the individual's rights in society and the maintenance of a healthy——

Mr. YATES. Industry.

Dr. BERANEK. Industry or security or whatever you consider aviation to be. This is not for a scientist to decide. We can give you facts, but you have got to draw those lines.

Mr. McFALL. Let's go on now to the other environmental problems.

#### HUMAN EAR RESPONSE

Mr. MAGRUDER. Could I help on one point, please, Mr. Chairman?

I think it would be worth making sure that Dr. Beranek makes the comment that if you change plus or minus two dB, would the human ear pick up that difference, do you think, on a 50 percent probability basis?

Dr. BERANEK. This is a very small change. A demonstration that was made up, actually Boeing made it up for the SST office and I was asked in to review it and make sure there was no hidden feature in it, shows that a 3 dB difference is hard to detect, so 2 dB certainly is hardly detectable. This is well known in the books.

Mr. MAGRUDER. The reason I brought that up is to point up that you wouldn't be able to distinguish the difference in this trade-off. The reason it is important to have this flexibility is because of what Mr. Yates was driving at a bit earlier. If you ever get so rigorous in contracts that, say for example you just simply cannot change the field length a foot, the approach speed a knot, the approach noise one db, that is when you start getting yourself into cost overruns and doing things that are economically stupid. We always have these small tolerances, tolerances that are not distinguishable to the ear, so that the engine designers and the air frame designers can maintain control over costs. That has not been true in many cases of the military programs, but it is true of every phase of this SST prototype program.

We have got these latitudes for changes, as long as we don't violate the fundamental goal, an economically viable airplane on present day air fields with present-day air traffic control that meets the noise and pollution requirements. That is the fundamental goal.

Mr. McFALL. What are the other environmental problems that we have? The next one comes with the flight of the aircraft, and that is sonic boom, is that right?

Mr. YATES. You go over the community.

#### SONIC BOOM OUTSIDE UNITED STATES

Mr. McFALL. Community noise. This is, of course, taken care of in our discussions of sideline noise and the meeting of the FAR-36 standards.

The next one then is the sonic boom problem. We can agree that the plane is not going to fly supersonically over populated areas of the United States. It is just going over water. Can we agree on what the effect would be on water?

Mr. YATES. May I ask a question on that?

Mr. McFALL. Yes.

Mr. YATES. Dr. Singer, you indicated that the administration's position is that the plane would not fly supersonically, and therefore generate sonic boom, over land. We know that it wouldn't do it over the United States. Do you know whether that prohibition extends beyond the United States?

Dr. SINGER. No; I do not. I haven't studied this matter. This is an FAA regulation. I think someone who is more competent than I should address himself to this.

Mr. MAGRUDER. We don't have control over the activities of other nations, except that we have banned, over any territory of the United States, flight that will allow sonic boom to reach the ground. That doesn't mean it can't fly efficiently over land, to inland gateway cities. It will fly 20 percent faster than present day airplanes and not make any boom. I think you folks have been the outstanding example in the environmental area with your thrust and your urgency of setting an example for the world. I think we have already done that.

Mr. YATES. Switzerland, Canada, Sweden, a number of them have said this, but I am thinking of islands in the Pacific and the Atlantic, for example. I am thinking of African lands, and also when I asked Mr. Vierling to lay out a flight supersonically from, I think it was, New York to——

Mr. VIERLING. May I answer that?

That map is on my credenza and has been there since you asked me. I called your office and told them I had it.

Mr. YATES. I never got the message. Why didn't you mail it or send it over?

Mr. VIERLING. I have it and I will be delighted to bring it.

Mr. YATES. Good. I will be delighted to talk to you, Mr. Vierling. You are one of my favorite people. I will even buy you a lunch.

Mr. VIERLING. I accept.

Mr. YATES. What we had talked about in an earlier hearing was flying over the neck that connects both Americas. Do you proposed to fly supersonically?

Mr. VIERLING. No, not over land.

Mr. YATES. What do you do on a flight, fly supersonically until you get 100 miles away from the neck, then slow down to a subsonic speed until you cross the neck for 100 miles and then go on supersonically?

Mr. VIERLING. What we were showing you at that time was a flight route to the Pacific which was proposed to go down the east coast of the United States supersonically, around Florida supersonically, across the Gulf of Mexico supersonically, going subsonic, as you approach the coast of Mexico, landing in Mexico, continuing subsonic to the west coast of Mexico, and then supersonic on out over the Pacific. This was a proposed route that was considered by Eastern Air Lines when they were applying for the Pacific routes a couple of years ago.

On such a flight they indicated you could leave an east coast city at 10 o'clock in the morning and arrive at Sidney, Australia, by that route at 12 o'clock local time. It would be the next day because you would cross the international date line.

#### SONIC BOOM OVER WATER

Mr. McFALL. Can we agree on what the sonic boom effect would be on water, since we are only flying supersonically over water? What is the sonic-boom effect on water and marine life? As I understand it, the sonic boom would not have any effect on anything below the surface.

Dr. SINGER. It would be rapidly attenuated, it would be reflected at the interface. Therefore the effects below the surface of the water would be very, very quickly reduced.

Mr. McFALL. At what altitude is it, 45,000 feet?

Mr. MAGRUDER. The cruise altitude is 65,000 feet.

Mr. McFALL. Can we agree on what the overpressure would be?

Mr. MAGRUDER. Yes; the overpressure is slightly over 2 pounds per square foot at the ground. You have on your bodies right now 2,000 pounds per square foot. If you were to open or close that door swiftly, or if you were to get into a Volkswagen and slam the door or if I go like that (clap), that is probably of the order of 3 pounds per square foot. I am sure if you were in swimming, and I did that (clap) and you

were under water you would not hear it nor the fish hear it nor would the algae or any little things that are in there be disturbed by it.

Mr. YATES. My goodness; if it is that minor, why do you have the prohibition?

Mr. MAGRUDER. We are not prohibiting it over water.

Mr. YATES. I mean if the reaction is that minor, why prohibit it over land then? Obviously, it isn't that minor.

#### SONIC BOOM OVER LAND

Mr. MAGRUDER. The reason for prohibiting it over land was that the burden of proof was on those that were proposing the program to show that it would not annoy people. Frankly, I don't think that you could prove that it wouldn't annoy people.

Mr. CONTE. Some of us—

Mr. McFALL. I am going down to the FAA installation in Oklahoma tomorrow. I understand they have a simulator there, and I am going to be subjected to the sonic boom.

Mr. BOLAND. Then you would agree that it was hardly noticeable, in company with Mr. Steed, who sits on this committee. We were subjected to the sonic boom.

Mr. CONTE. I was there too.

Mr. BOLAND. Then you would agree that it was hardly noticeable.

Mr. YATES. Let me say I have been hit by sonic booms. I was one who insisted on the ban on sonic boom.

Mr. MAGRUDER. I lived for 11 years at Edwards Air Force Base, as did my lovely wife, directly under the supersonic corridor. In spite of the fact that we lived there and had an awareness of it, we didn't notice it very much. My vote would be that we should not subject the citizens of the United States to regular sonic booms. We have done just that, and I think it is the right thing.

Mr. BOLAND. Do you know what effect it has on the gallbladder?

Mr. MAGRUDER. I am sure that would be well within the day-to-day variations.

#### CARBON DIOXIDE

Mr. McFALL. We are getting close on our time. Let's get to the next environmental effect, which is on the stratosphere; what it would do climatewise.

Dr. SINGER. Let me summarize them for you. I will be very brief. Stop me if you wish to.

Mr. McFALL. Let's see if we can get a summary that we can agree to.

Dr. SINGER. I will first talk about the immediate effects, and then I will talk about the long-range effects. We know the immediate effects much better than we know the long-range effects. The immediate effects are that fuel is burned, using the oxygen in the atmosphere. The exhaust gases are mainly carbon dioxide and water vapor. Carbon dioxide is not judged to be a problem because the contribution is minor compared to the carbon dioxide which is contributed by many other sources in the earth's atmosphere.

## NITROGEN OXIDE

Before I get to water vapor, there is a small contribution of nitrogen oxide. This is not judged to be a problem. Dr. McDonald, I believe, so stated, and I will accept the stipulation.

## WATER VAPOR AND PARTICLES

Now we talk about water vapor. The first question we have to settle is how much—not how much is injected; we know that—but how much will stay there on a long-range equilibrium basis. The only real answer is we don't know. The SCEP report gives the most conservative answer, as they should. They concluded that the water vapor will increase in concentration by two-tenths of a part per million.

Mr. McFALL. With the use of how many airplanes, 500?

Dr. SINGER. 500 airplanes flying on a regular basis, yes. It will increase from 3 parts per million to 3.2 parts per million, which is less than 10 percent. I am not saying that this is small; I am not saying it is large.

Mr. YATES. You are not saying?

Dr. SINGER. I am not saying, because I think that it will probably be less. The reason I think so is because I judge the SCEP report to be conservative. They have considered the stratosphere to be quiescent, but as a matter of fact, it is not. It is poked into by thunderstorms all the time.

Now Dr. McDonald is right when he says that thunderstorms don't add all that much water vapor, but they exchange water vapor. They put it in and they take it out again, and they will take out some of the water from the SST, because they don't know where it comes from. This is something we have to measure to be sure about, and I would at this stage take this two-tenths of a part per million as an upper limit.

Next we come to: Does increased water vapor increase cloudiness? I think we can stipulate that it will not. I will accept Dr. McDonald's word for this because he is an expert in the field. We do have some concern, however, in spite of Dr. McDonald, about cloudiness in the polar regions and are checking on that by means of flights that the AEC is making.

Let me sidestep for a minute and talk about particles. Part of the emissions from the SST will be sulfates, hydrocarbons, and soot. Hydrocarbons are simply unburned fuel. Soot is carbon which has accumulated into small particles. The more efficient the engine is, the less unburned hydrocarbons we will have. The SST has one of the most efficient engines we have come across yet, and it has been improved in this regard.

In the case of the sulfates, hydrocarbons, and soot, the SCEP report estimates the number of particles which will be produced. This estimate is ultraconservative, in two respects. It uses a high figure for the sulfur content; and it assumes that all the particles will be roughly the same size, and therefore they will all float in the stratosphere. In fact, of course, the particles will have a size distribution, and only the very small ones will float, and the large ones will fall down and won't stay up; but we don't know how many particles will

be large and how many will be small. This has to be measured; nevertheless, it is good to have a conservative estimate, and we do have this.

Now we come to the immediate effects of the water vapor and the immediate effects of the particles. The immediate effect of the water vapor will be to radiate away some heat from the stratosphere, and therefore, it will cool the stratosphere by a small amount. The immediate effect of the particles will be to absorb energy from the sun and heat the stratosphere. These two effects will tend to offset each other. The SCEP report doesn't point this out. I have pointed it out in my testimony, but I am not sure which will dominate. I am not sure whether it will get colder or warmer, nor am I sure which is bad, nor does anyone know, but since the two effects will offset each other, it is clear that the net effect must be smaller than either one of the effects of the water vapor or the particles. Therefore again you have a conservative factor added in the SCEP estimates.

#### SKIN CANCER

Now we come to the long-range effects. The first one has to do with the effect of water vapor on ozone, and in the testimony that Dr. McDonald gave, and I discussed yesterday, he ended up finally with the problem of skin cancer, 10,000 cases of skin cancer to be produced by the operation of an SST fleet.

I think I explained to you, and I would like to go over this once more, that he used here a chain of reasoning. The chain consists of four links, and if I want to address myself to this as a lawyer, I could say we could stipulate that three of these links are OK. They are all conservative. That is all right for our present discussion.

Link No. 3, however, is not conservative. It is actually unsupportable, so let me go over these very quickly.

Link No. 1 is that the SST fleet will put water vapor into the stratosphere. No question. We will stipulate this.

Link No. 2 is that the water vapor will remove some of the ozone. The 1 percent removal I would stipulate. It may be less, but we won't know until we have finished the research, but let's stipulate this.

The fourth step, which is that—

Mr. CONTE. The third step?

Dr. SINGER. I am saving that until the last.

The fourth step is that the solar ultraviolet radiation is related to skin cancer. I am not a medical expert, but I am willing to accept this. I think there is sufficient evidence, which is more than circumstantial, that solar radiation, particularly toward the ultraviolet end, that radiation which causes tanning of people, also causes skin cancer.

Mr. BOLAND. Would you like Dr. Singer to quit right there?

Mr. YATES. No; I will take my chances.

Dr. SINGER. Now we come to the really vital link, which is the third link, which is: Does the small decrease in ozone, the 1-percent decrease, produce an increase in the solar radiation at the surface of the earth sufficient to cause skin cancer? Now, the evidence that I saw presented here, for the first time, I might add, indicates that there is a north-south gradient in the occurrence of skin cancer. There is more in the south than there is in the north, and there is no question that it is due to sunshine.

Well, Dr. McDonald listed some of the factors. In the South you have more average annual numbers of hours of outdoor exposure. I am quoting him here. In the South you have more sunshine every day. You have decreased cloudiness. That is the second factor. The third factor is you have a larger elevation angle. That is, the sun is more nearly overhead, and therefore, very much stronger in the south than it is in the north. Also you have a somewhat smaller concentration of ozone in southern latitudes as compared to northern latitudes.

There is another factor, which is alluded to but not brought in here. We have genetic factors. We have the fact that people who should be living in the North are going to the South, and moving to the south all the time, getting sunshine. This will introduce an epidemiological bias, and tend to give you more cancer cases in the south.

Now I ask you to look at this as nonexperts, and ask yourself if sunshine is the predominant factor producing skin cancer, how much weight would you give to the fact that you have more sunshine in the South, more hours of sunshine, that you have more outdoor exposure, because people spend more time there, that you have less cloudiness, and that you have a higher sun angle. Yet when you look at Dr. McDonald's testimony, you see that he generously—I am being facetious now—allows 50 percent for all of these factors, and gives 50 percent to the ozone. There is nothing to support this at all, nothing at all, and this is why I believe that the whole argument will fall down.

However, it is a concern, and it has been brought to us here by a reputable scientist, and it is a new concern. It is a concern that the SCEP group did not address itself to. I believe that we should have an open mind on all of these concerns. Very fortunately I believe this concern can be addressed by a very simple measurement. All we have to do is measure the ultraviolet radiation reaching the surface of the earth at, say, two locations, in Arizona and in Chicago, for a few months during the summer, and correlate it with ozone. If the correlation is there, then we know that the ozone will have an effect on the ultraviolet. This doesn't prove all of the rest, of course, so it is a negative type of argument. If the correlation is not there, then I think we can throw the matter out and forget about it.

I propose that our committee will suggest to the DOT that we do this type of measurement immediately, and I hope that we can therefore meet the concern.

Mr. McFALL. Even if it is completely true, shouldn't we take into consideration Dr. Kellogg's statement about the effect of it?

#### CLIMATIC EFFECTS

Dr. SINGER. That is a separate argument. I still would like to go ahead with this measurement.

Now we talk about long-range climate effects. This is, of course, the most difficult subject to address. Here we can say the following: That the effects which are produced by the SST, the immediate effects of injection of water vapor, injection of particles, are well within the climatic variability, that is to say the water vapor varies by larger amounts from day to day and from place to place. The ozone varies by 50 or 75 percent from day to day and from place to place. The dust

content of the upper atmosphere varies by enormous factors after every volcanic emission.

We have not seen any upsets to the climate, any serious long-range upsets to the climate, as a result of this. However, in spite of this supporting evidence from natural occurrences, we believe that we have to do atmospheric modeling, to see, through a mathematical model, what effects would be produced, if these slight changes introduced by the SST were to occur.

Overall then, I would judge, and I would say to you, gentlemen, that the environmental effects, possible environmental effects of the SST, should be a minor consideration to you in your deliberations here. You have raised, of course, serious questions regarding the SST program. I cannot address myself to these questions. I can only address myself to the climatic, the weather modification questions. I do not consider those to be serious.

I think there are some serious climatic questions with other technological projects. I think the SST is a minor disturber of the environment, if you want to call it that, in relation to many of the other effects that we are producing on the environment.

I mentioned in my testimony that we are putting methane into the atmosphere which is also increasing the water vapor in the stratosphere. We are doing this in increasing amounts. Maybe that is something that we should be concerned about as well.

#### CLEAR AIR TURBULENCE

Mr. YATES. Mr. Chairman, may I ask one question?

Mr. McFALL. Yes.

Mr. YATES. You know it hasn't been discussed and I think it is within the province of your expertise. What about clear air turbulence? This also is a possible hazard within this part of the stratosphere, is it not, because of the speed with which the planes are flying? Will your study address itself to that at all?

Dr. SINGER. No. Our committee doesn't consider itself competent in this area which we regard as flight operations, and this is a matter that I would turn over to Mr. Magruder. In other words, we would say to him our committee is not competent in this area, but we do know enough about the stratosphere to know that this should not be a problem.

Mr. YATES. Will you tell me why it should not be a problem?

Dr. SINGER. Because the stratosphere is basically quiescent.

Mr. YATES. I see, and it is your knowledge or your opinion that there wouldn't be the type of severe up and down drafts that cause clear air turbulence in the stratosphere?

Dr. SINGER. If there were then you would have extremely rapid mixing and then all of these environmental concerns that have been raised here over the past year would disappear.

Mr. YATES. Thank you.

#### DR. RICKLE'S COMMENTS

Mr. McFALL. Do we have any other questions on the environment?

Mr. BOLAND. May I ask a question which pertains possibly to some

of the testimony that Dr. Beranek has given. The question is raised because of an article that appeared in the New York Times yesterday morning, March 3. Did you get into this?

Mr. McFALL. A little bit.

Mr. YATES. No; this is a different article, Mr. Chairman.

Mr. BOLAND. This is a different article. This is an article based on a letter by a Dr. Rickles, who is New York City's Resources Commissioner. Are you familiar with him? You have the article. That is fine. He made sure he gave the letter to the press before Mr. Ruckelshaus received it. He said that he was astounded and shocked to read of the Administrator of the Environmental Protective Agency supporting and defending the SST. He goes on to say that in his letter to Mr. Ruckelshaus:

Your arguments as reported in the paper were ridiculous, and your entire credibility in regard to the environmental field is destroyed, as I warned you it would be.

Of course it gets a nice play in the New York Times. I presume, because it is a local story. Mr. Ruckelshaus needs no defense from me. His dedication to his tremendously important post as Administrator of the Environmental Protection Agency is clear and impressive.

Now Dr. Rickles disputes the statements that the SST program could be stopped if dangers were found in the future. That, of course, is a decision for the Congress to make. I know if all these dangers were found to be true I know what my position would be, and I am confident also of what the position of the Congress would be. The program would cease for lack of support.

The article also indicates that Dr. Rickles characterized as "ridiculous" recent industry statements that new modifications of the SST would bring its noise level down to 108 decibels from 124 decibels," so he calls into question, of course, Dr. Beranek's expertise on this and also his testimony. Would you care to comment on that particular statement, Dr. Beranek?

Dr. BERANEK. The purpose of the committee that I head, with the expertise on it, was to develop the facts on this, and the purpose of this whole affair was to determine two things along the way. One was what levels should be the noise be brought down to, and then, was there some way to get there.

We made the recommendation in September to Mr. Magruder's office on where we thought the levels ought to be brought down to. Boeing and GE worked themselves as hard as they could go, and came up with a way to achieve those levels. We then examined their data with expert people to determine that, indeed, they could get there. Our expert opinion as a committee is that, yes, indeed, they can get there. I don't know where Dr. Rickles' expertise is, in this field.

Dr. SINGER. I can speak to that. I know Dr. Rickles as an expert in the recycling of waste materials. He has done a very good job in that field, and he owes me an article which he promised to write for me since I am editing a volume on the subject, and I haven't heard from him.

#### NOISE EFFECT ON HEARING

Mr. BOLAND. Dr. Rickles, the waste recycling expert, also indicated that 108 decibels, "still could cause severe hearing damage." Then he

goes on to say 85 decibels is the kind of target we should be choosing. What about that?

Dr. BERANEK. Congressman, you were here yesterday when I went through the hearing damage part of this. In my testimony yesterday, I brought out the basic evidence that exists, and this subject is very well understood and well written up in the literature. It exists in the form of regulations that were prepared for industry and stand out in the Walsh-Healey Act. I brought out the fact, based upon Walsh-Healey, and upon the literature, that 108 decibels constitutes no danger to hearing.

Now, in part he is confused on two kinds of decibels. Let's give him the benefit of the fact that one not an expert in the field can get confused on these decibels. The kind of decibels he is talking about, when he says 85, is a measurement made on a sound level meter on an A scale. It is commonly used in association with hearing damage. It is in the Walsh-Healey Act. It is a different kind of decibel than is used to measure community annoyance. You see, one was developed for damage to hearing. The other was developed for correlation with annoyance of people from aircraft type noise. The kinds of decibels we have been talking about are called effective perceived noise decibels. It has to do with the way communities react to noise.

Now in a crude way, and this isn't 100 percent accurate, the translation is that the EPNdB level is about 13 decibels higher than the db A, or decibels A that is in the Walsh-Healey Act. You would have to at least add 13 on to his 85 in comparing those numbers, which would bring him to 98. Then the difference, there is a 10 decibel difference, but in terms of damage to hearing, there is no danger from 108, anywhere around the community. The only place damage to hearing could exist is when the levels are higher on the ramps. As you know, if you travel on the airlines, all personnel are instructed to put protective cups over their ears when they are working around the planes on the ramps. The levels are higher there. They are much higher.

Mr. BOLAND. Thank you very much.

Mr. YATES. Mr. Chairman, I will have some questions of Dr. Beranek. Do you want me to finish them now or would you want to come back later?

Mr. McFALL. Mr. Magruder has a 2 o'clock appointment, and we still have some questions to ask him. I would like to get finished today. We also have some air transport people who have been sitting very patiently. How many more questions do you have of Mr. Magruder?

Mr. YATES. I have a number of questions which relate to the costs of the program, and I think those are important to this committee.

Mr. McFALL. Does anybody else have any questions they want to ask?

Mr. CONTE. Yes, I do.

Mr. McFALL. Of whom?

Mr. CONTE. Mr. Magruder.

Mr. YATES. I can finish with Dr. Beranek in 5 or 10 minutes.

Mr. McFALL. All right.

Mr. YATES. I think he has been very good.

Mr. McFALL. Yes, he has.

Mr. YATES. I want to clarify a few points.

Mr. McFALL. You can go, Dr. Singer. We have certainly appreciated your testimony and wish to thank you.

Dr. SINGER. I appreciate your courtesy.

Mr. BOLAND. Thank you very much.

Mr. CONTE. Have a good flight.

Mr. YATES. And good luck with your experiments.

Dr. SINGER. Thank you.

#### ENGINE NOISE REDUCTION

Mr. YATES. Dr. Beranek, you talked about laying out the blueprints of the new engine on the table, and going over them with whom, with General Electric and with the other members of your committee or only the members of your committee?

Dr. BERANEK. The members of the committee that went to this conference, five of the seven regular members. Of the two that didn't go one was Cliff Moore, who is the manager of Los Angeles airport. He didn't particularly feel he had expertise in this area. He is a very busy man. The other was Professor Raymond Bauer from the Harvard Business School. He also felt that on this particular issue he didn't need to be there.

Mr. YATES. Did every member of your committee agree with you? Was there unanimity of opinion?

Dr. BERANEK. Yes, there was.

Mr. YATES. On the testimony that you have given this committee?

Dr. BERANEK. That is right, and even the members who weren't there, we sent the testimony to them, so they could comment on it, and there was no disagreement.

Mr. YATES. Dr. Beranek, you have testified that this will happen. That as a result of the assembly of the parts of the engine, in the way that you consider them in your review, as a result of that review, you believe that it will produce an engine that will provide compliance with FAR-36.

Dr. BERANEK. That is right.

Mr. YATES. How do you know this? I know it is an opinion, but on what is this based? Is there a chance that you might be wrong? Is there a chance, for example, that this engine will not produce 108 EPNdB, but rather the minimum it will go down to will be, say, 115?

Dr. BERANEK. There is no chance of that. Let me again make it very clear. In the case of the larger engine, with the higher mass flow, no afterburner, and a lower exit velocity, there is no possible doubt in our minds about what the noise levels will be, the reason for that being that jet engines have just been around too long. We are measuring them all the time. This is the kind of engine now that we understand.

In connection with the muffler, they did have two alternatives there, you will remember. One alternative was that if that muffler didn't come up to the 10 EPNdB requirement that was needed, the one that is a simpler one to stow because it folds up a little easier, we have another one, the multitube one on which the operating range of effectiveness has been demonstrated to be in the range of 10 to 14 EPNdB. That is the range of uncertainty. We have got one that is on the high side of it and we have got one that is on the low side of it. We have a choice there. Naturally we prefer to have the one that is a little easier to stow. We are optimistic that that one will work out, but we have an alternate muffler in case it shouldn't be fully efficient.

There is a third possibility. There are some new things that are being worked on that have come out of some NASA-sponsored university research. They are in just very small scale models, which they have tried and looked very promising. I have not brought those up before because I have no way of assessing whether they will work out as well when you get up to full scale.

#### NOISE REDUCTION VERSUS ENGINE PERFORMANCE

Mr. YATES. You have testified all that will be required will be an expansion, I think, of a diameter by 2 inches, which will expand the size of the motor. You have also said that there will be no afterburner.

Dr. BERANEK. That is right.

Mr. YATES. And you have also said that there will be an increase in the weight of something like 50,000 pounds. Is that per engine?

Dr. BERANEK. No.

Mr. YATES. Or for all four engines?

Dr. BERANEK. The 50,000 pounds, and Mr. Magruder says that he feels confident it won't be that much when they finally get around to the commercial design. The 50,000 pounds was the total increase in airplane weight.

Mr. MAGRUDER. Takeoff gross weight.

Dr. BERANEK. That is the takeoff gross weight.

Mr. YATES. Takeoff gross weight as a result of changes in the configuration and makeup of the four engines, is that right?

Mr. MAGRUDER. Much of that will be fuel.

Mr. YATES. Of the weight will be fuel?

Mr. MAGRUDER. That is what I was going to get at. The 50,000 pounds is the total increase in gross weight. Say you add a muffler, that is weight added.

Mr. YATES. Did you come up with the figure of 50,000 or did Mr. Magruder?

Dr. BERANEK. I came up with the figure of 50,000 because that is what Boeing gave us in a book.

Mr. YATES. That is what Boeing indicated would result from the changes in this engine?

Dr. BERANEK. That is right, including the muffler that is put on it.

Mr. MAGRUDER. I think that is the maximum.

Dr. BERANEK. Mr. Magruder is saying he thinks when they work on this for awhile it won't be that much but I quoted it out of a book and that is what was shown to the committee.

#### NEED FOR PROTOTYPE

Mr. YATES. Do you need a prototype to test that engine, to see what the noise levels will be? Do you have to make it a part of a machine or can't you test it on the ground, without putting it on an airplane?

Dr. BERANEK. As far as the takeoff noise and landing noise and sideline noise is concerned. It is my belief that we won't have to have an SST to do that.

Mr. YATES. So you don't really need the prototype to test your new engine.

Dr. BERANEK. I am talking about noise only.

Mr. YATES. You are telling me on the production version?

Dr. BERANEK. I am talking about noise.

Mr. YATES. That is right, because that is what you are addressing yourself to.

Dr. BERANEK. That is right.

Mr. YATES. Is the fact that this committee and the public, and rightfully so, are worried about getting down a 108 EPNdB sideline noise level or FAR-36 noise level. It is not necessary to build the prototype to find out about that, is it?

Dr. BERANEK. That is my opinion; yes.

Mr. YATES. So that the testimony before us so far then is that we don't have to build a prototype to find out about the noise level, and we don't have to build a prototype to find out about the possible pollution of the stratosphere. That is correct as I understand it.

Mr. MAGRUDER. May I offer a comment on this. Dr. Beranek is speaking to this very precisely and scientifically answering your question, "Do you need the prototype airplane to find out how much noise the engine will make?" A total answer to that question is you do need the prototype to find out how much community and sideline noise the SST airplane will make. You have to load it up, fly and operate it in accordance with noise abatement procedures. Fly the approach utilizing procedures that involve the inlet, the weight, and the approach speed. It is only when you put that total package together that you really validate the estimated numbers that the engine people, Dr. Beranek, the airframe people, and GE, say the airplane will make. The total noise is the airplane operating in an airport environment. It cannot be done simply by testing it in a test cell.

Mr. YATES. Do you agree with what he just said?

Dr. BERANEK. Yes. I guess I should have qualified my remarks to that extent. There is very much more to the noise problem than just the things I have talked about. You have to worry about the handling ability of the airplane. An SST airplane of this size has not been handled before. We are told in the book that the plane will be flown in a certain way, and if the plane is flown in that way, with these engines and these mufflers on, it will do what I said. If they can't fly the plane that way, if there is some quirk in the SST, then obviously my conclusion has a fault in it.

What the prototype does is remove that uncertainty, or else let them fix it up so they can fly it that way.

#### PROTOTYPE VERSUS PRODUCTION ENGINE

Mr. YATES. I am still puzzled by your statement yesterday in connection with your statement now. You told us yesterday that the new engine wasn't going to be on the prototype at all but only on the production version. The new engine won't be flown during the prototype stage, will it?

Dr. BERANEK. Let us look at that question, "The new engine has to be produced"—

Mr. YATES. The new engine is the one not on the prototype.

Dr. BERANEK. That is right. It has to produce enough thrust to get the airplane off the runway, within the runway length that has been specified, and so does the other engine. Now it is the airframe that is

involved. We are saying the thrust is going to be adequate in both cases. We are getting into the flying part of it. Now the engine comes in as a matter of thrust. It comes in as a matter of part of the whole aerodynamic configuration. What the prototype is designed to do is test the aerodynamic configuration. I think there is no doubt in the engine designers' minds that the new engine will have the proper thrust. It is not going to be deficient in thrust, and it doesn't have to produce more thrust for takeoff. The prototype is designed to test aerodynamics, not just noise.

Mr. YATES. But that doesn't relate to your report really, does it?

Dr. BERANEK. No; the fact that the diameter is practically unchanged means you are not upsetting the size.

Mr. MAGRUDER. Two inches out of 90 inches.

Mr. YATES. And you don't know, from your study, what the loss in some other values of the plane are likely to be? For example, when you sacrifice the afterburner you sacrifice thrust, do you not?

Dr. BERANEK. No.

Mr. YATES. Why do you use the afterburner? I thought that was to give you an additional thrust.

Mr. MAGRUDER. By increasing the diameter you have gotten rid of the requirement for an afterburner by making the thrust level high enough by what is called a dry engine.

Mr. YATES. Have you lost anything by changing the engine in the operating efficiency of the plane?

Mr. MAGRUDER. Nothing that I know of. We have been told the actual fuel consumption efficiency is going to be better.

Mr. YATES. Because of no afterburner?

Dr. BERANEK. That is right. The difference arises, you see, because in one case—

Mr. YATES. I am trying to finish with you rather than Mr. Magruder, because I want you to be free to go.

Dr. BERANEK. The difference arises because with the afterburner you have a slightly smaller and lighter weight engine. That is what they strove for in the original design. They did not look at the noise problem in the way that we are looking at it today. They assumed 124 EPNdB sideline apparently would be all right. This is before Mr. Magruder's time.

Mr. YATES. You don't know what the additional costs for developing the engine will be?

Dr. BERANEK. I do not.

#### NOISE IMPACT ON PEOPLE

Mr. YATES. In your testimony yesterday, I noticed that you addressed yourself primarily to noise levels that injure people. You didn't speak of noise levels that people found obnoxious. Is that because this kind of a noise level varies with the person?

Dr. BERANEK. That was the import of my testimony, that we know that noise bothers people.

Mr. YATES. Except that you used the phrase, "injurious."

Dr. BERANEK. No, wait a minute. There are two parts to my testimony. One part was that I showed that the noise would not be injurious to hearing.

Mr. YATES. Yes; that is right.

Dr. BERANEK. Then I said that noise does annoy people, but there is no magic level where people don't complain and the only way we could arrive at a level is to have someone, the FAA in this case, draw the balance between people's comfort and the maintenance of an air transportation system, and they did it.

Mr. YATES. Thank you, Dr. Beranek.

Mr. McFALL. We have another change of signals here. We can eat lunch.

Mr. CONTE. Why?

Mr. McFALL. Because Mr. Magruder has scrubbed his 2 o'clock appointment. We can go have lunch, come back at 1:30 and finish this this afternoon.

#### WHITE HOUSE MEMO ON SST

Mr. YATES. Mr. Chairman, before you start, may I make a request that the Chair ask the Secretary of Transportation for the report that has never been made available to this committee of the Scientific Group. It has been interpreted by Secretary Volpe and others. The statement has been made that all the facts or all the data in that report have come out in one form or another. I think the committee is entitled to all information it can get on this subject. I would request that report be made available.

Mr. McFALL. I think we ought to discuss it, surely. It may not have any important information in it, but we may be faced with the allegation that there is information in it which has been hidden from the committee. As I understand it, it is a matter of executive privilege.

Mr. EDWARDS. Mr. Chairman, I think it is a cloud on these whole proceedings. We ought to have it and look at it and let it be explained.

Mr. YATES. That is right.

Mr. EDWARDS. I said that as a supporter of the SST.

Mr. YATES. I am glad to have that contribution from my colleague. I agree with you, everything that touches upon the SST has been made available to this committee or to the Senate. There is no reason why that report, which some say reflects on the economic validity of the SST should not be made available. I mean economic viability of the SST rather than validity.

Mr. McFALL. I agree that we should have some sort of reply from the Executive about this report. But I understand the matter of precedent is involved here.

Mr. YATES. The precedent has already been broken.

Mr. McFALL. The President would not want to give up interoffice memos. I think it might well be taken care of in some other way.

I agree, however, with both Mr. Edwards and Mr. Yates that this issue puts an unnecessary cloud on the hearings. But I cannot see how that report can have anything in it that would be up to date. Isn't that true, Mr. Magruder?

Mr. MAGRUDER. Yes; I think that is very factual. My own investigations of this in response to Mr. Yates, and I think Congressman Reuss, led me to have a meeting with Dr. Garwin very early in my career. As a matter of fact, Dr. Garwin sought me out and came to my house and spent 4 or 5 hours with my wife and me.

I am not privy to this report. I do not believe the Secretary is privy to this report. I did not hear anything in 5 hours of discussion with Mr. Garwin about the SST that led me to believe that he was either an expert on aviation, an expert on the SST, or in any way an expert on things related to aviation such as economics.

Mr. YATES. But you do know the Senate asked Dr. Garwin about the report and Dr. Garwin studiously refused to make it available on the ground he was not permitted to do it.

Mr. MAGRUDER. My investigations went on to further contact Dr. Dubridge and I satisfied myself that there really is no such thing as a Garwin report. There is a Dr. Dubridge letter report that says very specifically much of what we have said here. That is four, five, or six scientists had very narrow viewpoints as pure scientists might do. The overall context of the entire administration, the airlines, the Department of Transportation, the Cabinet members, and Dr. Dubridge strongly supported the administration's position. He made no bones about that to me.

Mr. YATES. Is this in that report?

Mr. MAGRUDER. No; I am talking about discussions with Dr. Dubridge in his office and a letter from Dr. Dubridge.

Mr. YATES. We are not asking for anything that is designated as a Garwin report. Garwin is a member of that committee and he has refused to tell either the House or Senate about that report on the grounds he is not permitted to do so. I do not know of anybody who has ever talked about the report.

Mr. MAGRUDER. To finish my statement, though, I am happy, personally, as the program director, with Dr. Dubridge's report and his written statements to me.

Frankly, I do not have any personal interest or professional interest as program director in getting down into each one of the individual scientist's individual opinion.

I do not believe it is proper for Secretary Volpe or myself to get in between President Nixon and his scientific adviser. I think that is strictly a matter between Mr. Nixon and his advisers. If this committee wishes to get that fully aired I would suggest that Dr. Garwin be asked to come here and fully testify. If you want to ask the administration for documentation that is within your right. I, as the program manager, have fully satisfied myself that there is nothing there, and that we have all the facts and figures and there are no secret documentations.

#### DR. GARWIN'S TESTIMONY

Mr. McFALL. We will communicate with the administration concerning the significance of this report. I have some questions about the testimony that Dr. Garwin gave to our committee last year. We asked Dr. Garwin to testify here in these hearings, and he was unable to do so. I don't know whether it would have served any purpose that he do so. There was no desire on the part of the committee to put pressure on Dr. Garwin. He came before the committee some time ago and gave a report. It is in the hearings and I have some questions about it. Perhaps Mr. Yates also will have some questions based upon some of the information that was in his testimony.

Mr. YATES. Mr. Chairman, you are not saying Dr. Garwin gave that report to the committee. He testified.

Mr. McFALL. No; I am saying that Dr. Garwin testified. Presumably he testified concerning the matters that he felt were important in that report.

Mr. YATES. Mr. Chairman, if I may say so, that is not a correct assumption, because he was asked that question specifically by Senators last year and they asked him to testify about the report before the Senate committee. He said he was appearing as an individual and he would not talk about the report because he was not permitted to do so. It was a privileged document.

Mr. McFALL. Then all we have is the testimony of Dr. Garwin before this committee.

Mr. YATES. That is correct. We can agree on that.

Mr. McFALL. Can we assume he is testifying to all the matters within his knowledge?

Mr. YATES. Yes.

Mr. McFALL. And that would include the report.

Mr. YATES. He is testifying as an individual without relation in any respect to that report. He specifically wanted the record to show before the Senate that he could not testify about matters in that report. I do not think it would be fair in his absence to assume that his testimony in any way related specifically to that report.

#### PRODUCTION FINANCING

Mr. McFALL. Let me ask some questions that will be concerned with Dr. Garwin's previous testimony before this committee. In our hearings last year Dr. Garwin testified that beyond the prototype design and construction stage an additional \$3 to \$5 billion will be needed to fund actual production through first delivery of operational aircraft. Under existing legislative authority, is the Federal Government authorized to finance the production of the SST?

Mr. MAGRUDER. The answer is "No."

Mr. McFALL. Do you have any comment concerning the additional \$3 to \$5 billion? We have discussed this earlier, but we might put it concisely at this point to make it complete.

Mr. MAGRUDER. I think I should say our existing authority is for development work and testing work and purchase of experimental aircraft and engines but not financial participation in the production of SST's for sale to the airlines.

We testified yesterday that in the production phase, I think we said in constant 1967 dollars, a number like two to two and a half billion dollars might be a reasonable figure. In escalated dollars a number like \$3 to \$5 billion might be a reasonable figure for the financing of the production phase. We have no intention and have never had any intention, nor is it the objective of the program for the Government to be involved in that phase. If we have a proven article in the prototype, and we have already demonstrated willing buyers, then as a team, the Government, the CAB, and other agencies of the Government, labor, industry, manufacturing, and operators, can work together to prevent from happening to the airlines what happened to the railroads. We would have a healthy, vigorous, profit-making industry. We should have private sector financing. You do not have to look much further than McDonnell-Douglas' statement

that they are \$1.25 billion in debt. I do not know about Lockheed. Boeing is about a billion dollars in debt.

Airlines had a growth of only about one and a half percent in domestic revenue passenger-miles this year, having their biggest recession in more than a decade, and yet the financing by the private institutions shows enough confidence in the aircraft and air transportation business that they are lending money to the tune of about \$5 billion to finance three major manufacturers of new jumbo aircraft of which only one is presently in service. I think today almost everybody in the aircraft industry, and especially in the lending institutions recognize that SST's are here. They are going to make a lot of money, at least \$50 to \$100 billion worth of business.

I do not think it is simple nor easy for a man like myself, or anyone else, to predict the health of that industry 4 years from now. I simply say that all of us—you as lawmakers, we as Government employees, and every citizen—have to do everything possible to keep this most efficient and cleanest method of short- and long-haul transportation ever known to man healthy. If we do not we are going to have the same problem in air transportation we presently have in other modes of transportation in this country, especially in the railroads.

#### SHORTER TRAVELTIME

**Mr. McFALL.** Let us go to another point in Dr. Garwin's testimony, which refers to the fact that the basic question of the preference of the public for shorter traveltime has not been resolved. Can you present any meaningful statistics which indicate the public's desire for a shorter traveltime?

**Mr. MAGRUDER.** I think the most meaningful one is commonsense. I do not see anybody asking for a return to the stagecoach. I do not see lines of people drawn up at buses or railroads except the faster Metroliners. I do see all over the world young people, surfers, old people going to reunions, family weddings, funerals, business traveling by air. Over 95 percent of the people that travel over 500 miles, travel by air for one reason. It is convenient and saves time. You and I have only 73 years as an average on this earth. Anything that we can do to cut out unproductive time—anything that keeps us from having to sit and read a magazine for agonizing hours such as going to Asia in 18 hours is an improvement in productivity. So the whole lesson of transportation is the diversion from the fact you have to sit there. That is why we have movies and stereos, drinks, and too much to eat. That is the whole purpose of the wide-body transport, to divert your attention from the lack of comfort while you are traveling enroute.

I would say all of history has shown if you put two modes of transportation side by side and one has a 10-percent speed advantage over another, everybody, not 50 or 20 percent, goes to the shorter time enroute method of transportation. The last U.S. passenger ship carrying a paying passenger to Europe is now retired. Nobody uses that mode of transportation any more.

#### SR-71 TECHNOLOGICAL FALLOUT

**Mr. McFALL.** Dr. Garwin also stated last year that with the SR-71 being a titanium and steel aircraft, the United States already has the

leadership in aviation that proponents of the SST want to spend billions of dollars to achieve. Would you comment on this? How much of the technology of the SR-71 can be applied to a commercial airplane?

Mr. MAGRUDER. I am quite familiar with the SR-71. As you know, practically everything is secret. I have flown the airplane. I have worked with Mr. Kelly Johnson for 7 years. That type of statement is typical of a scientist talking completely out of his area of expertise. Dr. Garwin is a very fine nuclear physicist, an industrial scientist, very high credentials. But he knows very little about aviation.

The SR-71 is a very unique airplane. It has specialized purposes. It flies much higher and faster than the SST will ever fly. It uses different structural materials, a different engine cycle, entirely different sealant, and entirely different instruments, all aimed at that very specialized purpose. That does not mean we did not learn a lot from it. I would like to pay a tribute in the record to one whom I think is one of the giants of the industry, Mr. C. L. "Kelly" Johnson.

Kelly Johnson with absolutely no remuneration from the Government, Boeing, or GE has made his time available since I have been on the program, to go to Seattle, make available information from SR-71 on fuel tank sealants, on thermal connectors, voluntarily, on a moment's notice.

To show you what kind of a man this fantastic man is, the day after his wife died he called me up and said "the only cure for this situation is work, what can I do to help the SST?" The next day that man was in Seattle helping us with an SST problem. We are getting a lot of fallout from the SR-71 in little areas. That in no way means that it eliminates the need for a prototype. It is a military airplane, different configuration, different engine, different technology, different metallurgy, but there are little things we can learn. In no way does that mean that to prove the airline economics and viability, noise, pollution control, sonic boom characteristics, and airport compatibility of an SST won't demand a prototype. They do.

Mr. McFALL. The titanium production abilities that we get from it—

Mr. MAGRUDER. A very key point. The SR-71 was built in the "Skunk Works." It was literally built on saw horses. I use that term as a colloquialism. It did not in any way generate the kind of tooling and mass production of titanium parts that will be available to the entire industry.

I do not know whether you know it or not, but the top of the Washington Monument was made of aluminum because it was a very precious metal in those days and did not corrode. It was extremely expensive. It weighs about 900 pounds. It was the aircraft industry that made aluminum so cheap that you use it in pots and pans. It is going to be the SST that will turn titanium into a common metallurgy for our entire society. You saw Mr. Parsons portray that fact just by showing what has been done on the SST so far. It made it possible for the entire landing gear main structural beam to be made out of titanium saving a lot of weight cost and adding efficiency to the Boeing 747.

## SIDELINE NOISE

Mr. McFALL. This question was asked and answered earlier, but I want to emphasize that it has been. Dr. Garwin testified that it is perfectly feasible to reduce the sideline noise to the same level as for the subsonic aircraft; unfortunately, the associated thrust loss to the engine and the excess weight of the noise suppressors would impair the economic utility of the SST, greatly reducing the payload or further increasing the required field length. To what extent have you been able to combat the sideline noise problem without impairing the economic utility of the SST?

You answered that this morning.

Dr. Garwin has indicated that since the SST was expected to produce as much sideline noise as some 50 simultaneous takeoffs of large jets of the 1978 era, that it would be unrealistic to expect the financial community and the airlines to take over the SST program after the prototype phase. I think we have answered that, too, this morning in our discussion with Dr. Beranek.

Mr. MAGRUDER. That is correct. The 50-1 noise simile that has been stated ever since I came on the program is technically, scientifically, and engineeringly plain incorrect. It is the mixing of physics with sound engineering with noise and acoustic engineering. That was just an unfortunate error on the part of Dr. Garwin.

## AIRPORT SUITABILITY

Mr. McFALL. Dr. Garwin also refers to excessive takeoff roll for the SST and alludes to its being acceptable to only a couple of airports because of that takeoff field length. How does the SST compare to the subsonic jets with respect to airport suitability? What effects will noise suppressors have on the SST and will they in fact make the takeoff roll too long for existing airports?

Mr. MAGRUDER. That particular statement is answered by pointing out that the large delta wing SST's with engine sized for transsonic acceleration and mach 2.7 cruise, dictate an airplane that has a shorter field length requirement than for DC-8's which dictated the field lengths of international airports the world over. There is absolutely no reason to believe that the SST will not be able to operate from any airport that can handle the 707-320B. The SST should have a shorter field length requirement. That is one of the bonuses mentioned earlier. It has sufficient takeoff speed and field length that you can throttle back a little bit and have lower noise.

I think another thing that ought to be recognized about these large delta wing, light wing loading aircraft. These airplanes do not have stall characteristics like other aircraft. Normal field lengths for subsonic jets are dictated by one of the most extreme flight test maneuvers you ever have to do as a pilot during the flight test phase. You have to actually stall those airplanes on takeoff. Airline pilots are allowed to take off about 15-percent faster during normal operations. That is what dictates the field lengths on subsonic jets. These delta wing aircraft are so safe that the true dynamic stall, where flight is no longer sustained and the airplane will drop through the air and pitch down, does not happen. They fly off rather dramatically. They are much safer, and have much more flexibility on airport field length.

They have much more flexibility on operational procedures for noise abatement.

The first paper airplane you made and sailed across the room was a delta. I would defy you to do so with a paper airplane that is swept wing. Delta wing airplanes are the safest, most flexible, quietest, and most adaptable to airports of any we have ever had. Boeing has gone one step further. They have built a delta wing airplane with a tail. That tail allows them to more effectively utilize trailing edge high lift devices. They have also increased the span of the wing more than is required for cruise. Both were done to accommodate airport characteristics and make them better than present-day jets and reduce noise. That does not seem to have been talked about by Dr. Garwin. I was very much interested when he came over to spend the evening with my wife and me. He doesn't understand these kind of things. Frankly, as an atomic nuclear physicist I would not expect him to. I think his testimony has gotten much more credence than it deserves. It certainly does not reflect a man who understands airplane design.

Mr. McFALL. What is your basis for saying these things about this airplane?

Mr. MAGRUDER. I can say it because I have flown most of the delta wing airplanes that have been built in the free world, including those in Sweden and France and Britain and this country.

They all have these fundamental characteristics I have just described in common. As a matter of fact, that is why the Swedes built both of their fighters of this type of delta wing so they can, with impunity and safety, fly them off highways in Sweden and hide them in the mountains. Any implication that these delta wing-type supersonic airplanes will have trouble flying off airports is flogging the fact. The Swedes fly them off the country roads. These are mach 2, 1,400-mile-an-hour airplanes that are the mainstay of the fleets of countries like Sweden. Our SST will be no different. It will just be bigger. We are not going to fly it off any roads, however.

#### FACILITIES DEPRECIATION

Mr. McFALL. Dr. Garwin stated that a substantial part of the contractor's 10-percent share of the cost has been in the utilization of his existing facilities. Is this a proper statement?

Mr. MAGRUDER. Facilities depreciation is one of the many elements in the overhead.

The cost share is not related to facilities, whether we pay 90 or 75 percent. The billing is audited by the DCAA.

#### WARPING ENVIRONMENTAL REGULATIONS

Mr. McFALL. Dr. Garwin stated that when conditions are ripe for a commercial program which can be accommodated without severe environmental penalties, U.S. industry and finance will rise to the occasion.

Government support before that time might result in great pressure to warp the environmental protection regulations to suit the machines and not the people. To what extent have environmental regulations been warped to suit the machine? How many severe environmental penalties are involved in this program?

Mr. MAGRUDER. No environmental requirements have been warped to suit the airplane. It has been the other way around. Where we can identify a hazard such as sonic boom or airport noise, or the amount of sulfur content in fuel, we have put the warping or the changing on the characteristic, not on the hazard. So the answer to that is none of those kinds of things have happened.

#### TECHNICAL PROGRESS

Mr. McFALL. In order to be fair to Dr. Garwin, his statements were made about an engine, and an airplane of a year or two ago. The kind of engine that you have discussed today which meets the 108 standard—I better say FAR-36 standard—is something that he did not know about. Perhaps some of his comment would be valid concerning an airplane which produced 124 decibels, but would not be valid as related to the engine that we have discussed in full here at these hearings; is that correct?

Mr. MAGRUDER. I think that is a fair way to assess Dr. Garwin. I do want to be fair to Dr. Garwin who is an eminent scientist, but in another field. The reason that we need the prototype is because of some of the uncertainties that Dr. Garwin has addressed. I think it would have been fair to say 2 years ago it would have been awfully difficult to see how we were going to make, with an economical machine, the noise criteria of 108 EPNdB. Nevertheless, there was hope for progress. There were avenues open in airplane modification and engine design and testing that have always led us to find solutions. The end result of all of that activity that says we now meet 108 EPNdB is really an element of faith in our technical progress.

I think a society such as ours has done more incredible things than that, such as the establishment of the whole atomic energy program, and maybe even just the establishment of our great society. Watching these hearings is an inspiration to me. I have never done this before. This free give and take of information that goes to the news and press is a miracle in our society. There is faith.

If one scientist chooses to say I don't have any faith and I do not think you will make it, that is well and good. He certainly has the right to say that. Those of us who are behind this program, and support it and feel strongly about it, have so much in our background and ability to overcome these physical, technical, and natural problems and we just know we can do it. I think the noise is a case in point. You heard a real expert, Dr. Baranek testify, today that after all of the work and research have been done we are going to make it.

That does not mean we are 100 percent sure we have proven that we have the economically viable, airport compatible, machine. That takes the prototype. I think it would be wrong to default the program on the basis of that kind of opinion.

Mr. McFALL. Thank you, Mr. Magruder.

Mr. Boland.

#### DR. GARWIN'S TESTIMONY

Mr. BOLAND. I do not know that Dr. Garwin's testimony is that old. He testified before this subcommittee last year and he testified before

another committee on the other side of this Capitol and he got more publicity out of this program than any other single individual in opposition to it. He is constantly being quoted by the Coalition Against the SST. The Coalition Against the SST in their brochure this year quote Dr. Garwin in some of the things that Chairman McFall has questioned you about.

I do not want to let him off the hook that easily, because it has not been a very easy task to carry the burden of the SST by your department or by some of the Members in the Congress who have supported this program. So I think the questions that have been propounded to you and answered by you in a very objective, I think, way, I think are needed on this record. As I understand it, and as I listen to your testimony, I take it that Dr. Garwin is really not an expert in the aviation field at all, and that about all he is an expert in is in the field of nuclear physics, which is a highly important and tremendous field. There is no question about that. I do not think anybody would doubt his credentials here. But when the opponents of this program constantly refer to someone who is not an expert in the field, I think it is incumbent upon those of us who support the program and those who are responsible for the program to have the opportunity to answer and to put his testimony in the right light.

Now, would Dr. Garwin compare in any way or to any degree with the ability of Dr. Beranek in the field of noise or noise abatement?

Mr. MAGRUDER. Absolutely not.

Mr. BOLAND. Would he in any way compare with Dr. Singer in the field of environment?

Mr. MAGRUDER. In my opinion absolutely not.

Mr. BOLAND. Does he compare with Dr. Will Kellogg?

Mr. MAGRUDER. In my opinion again, absolutely not.

Mr. BOLAND. So I am grateful to the chairman for asking these questions. They should be on the record because every time you listen to opposition they trot Dr. Garwin, and he has been trotted out on the other side of this Capitol for a long period of time. The public recognizes the fact that there is some difference in the testimony offered by experts in mathematics or physics, or experts in the environmental and experts in sound and noise abatement, and I think the public can make its own judgment then.

I hope that the public will read the record, and particularly those that oppose the program will read the record and find out precisely where the opposition comes from and the kind of opposition and whether or not that opposition really carries the credentials that they indicate they carry to oppose the program.

#### INFORMATION AVAILABILITY

Mr. MAGRUDER. I am glad you said that because I would like to say something to this committee about Dr. Garwin that I have never said before to anybody; and that is, if it is so important to the committee to read this so-called report, and you are going to make a request for it, and that is perfectly fine, then at the same time you do that, I would very much like for you to communicate to Dr. Garwin that I would like to tell this committee about my conversation with him in my house that night. He has sworn me to secrecy about that conversation. I

would like to be released to inform you of that conversation. I cannot do that now because Dr. Garwin has sworn me to secrecy. I would very much like to reveal the substance of that conversation at that time, if you can get him to release me.

Mr. McFALL. There are secrets on both sides, gentlemen?

Mr. BOLAND. That is one of the problems, Mr. Magruder. We are constantly charged with, or the Department is, or the Administration is, and I am not part of the Administration, with the secret report, a hidden report, and that you have obstructed the efforts of this committee or any committee to obtain the report, with the result that this conjures up some very serious things in the minds of the public. The only way that we have been able to get these studies and opinions by those in the Government, the only way we have been able to get them out of the agency, to dynamite them out. I heard some television program a couple of weeks ago—

Mr. CONTE. That is a dangerous word.

Mr. BOLAND. You have to dynamite. You have to explode them out. That is not so at all. It is nice to use those words. They are catchy words and it catches the headline. So the people who oppose the program, they are better at rhetoric than they are at facts, let me say.

Mr. MAGRUDER. I would like to say, at one time my office was accused of having some secret documents with respect to a Boeing document. This was from Congressman Reuss' office. In dealing with his aide, Mr. Verdier, I found I had no such document but Mr. Verdier does have some notes that he has never made available to my office. I would very much like this committee to ask Mr. Verdier to make available to my office the notes about that so-called secret document. I find that I have more trouble getting some of these documents and notes and things released than you do and as the Director of the program I would like to have all information made available.

Mr. YATES. Mr. Chairman, Mr. Verdier is in the audience. That is Henry Reuss' assistant.

Mr. BOLAND. I do not think we are interested in that. I am not.

Mr. McFALL. We are not going to put Mr. Verdier on the stand.

Mr. Conte.

#### PRODUCTION FINANCING

Mr. CONTE. Thank you, Mr. Chairman.

Let me start out by saying, Mr. Magruder, as I have congratulated the other witnesses, that I want to congratulate you on an outstanding job. I think you are an authority in this particular area. I met your counterpart over in England who thinks very, very highly of you, and is a test pilot for the Concorde. He feels you are one of the greatest experts in the world in this particular field. As I said earlier, I think a lot of my doubts have been cleared up in regard to the environment which is a real big concern to me, but I still am not clear on the financing.

I don't like it. I have been one of the leaders in the Congress fighting farm subsidies. To me this is no different. The possibility of getting this money—I am really scared listening to your testimony that the Government is going to be in here in the production financing.

I am really worried, and if the good Lord gives me health to be around here and my constituents keep electing me, I will see the day

when they are going to be up here asking for money for production of this airplane. Therefore, for that reason I have some grave doubts. I wish I was as clear on this thing as Mr. Yates is against it, and Mr. Boland is for it. I am not that clear either way. I think persons are making strong arguments both ways.

They are upset. They may have the same doubts I have. They are asking questions. Maybe they go off half-cocked on some things and say things they shouldn't. By the same token I have the organizational paper for the National Committee for the SST, and they can be pretty rough, too, in telling how to go about this. Let me say I am the type of legislator that takes a lot of this stuff with a grain of salt on both sides.

WHITE HOUSE MEMO ON SST

A lot has been said about Dr. Garwin. I don't know. I never met the guy. He has made statements and other people have made statements. I am glad the Chairman asked those questions because I was going to ask most of them. I have one more. They bring up his report to the President—no, to Dr. DuBridge, he submitted the report to DuBridge, as the President's science adviser—and this is what they say: the report allegedly labels the plane an "economic fiasco, an environmental disaster, a social outrage."

That is the end of the quote.

Those are strong words. He may be a nuclear scientist and may not know anything about this thing, but I will tell you I will not say that about the airplane, because I do not know enough about it. If a responsible man did say that, I think we ought to have something on this. Did he say those things?

Mr. MAGRUDER. I do not know.

Mr. CONTE. You have seen those reports.

Mr. MAGRUDER. I have seen that in newspapers. As I said before, I am very careful about taking at face value what I read in the newspapers, but I always read them, especially the funnies.

Mr. YATES. Especially the New York Times.

Mr. MAGRUDER. Yes; especially the New York Times. I would be very careful about saying that Dr. Garwin said that just because I saw it in a newspaper.

Mr. CONTE. We don't have time because of this gun that is to our heads that we have to act on this before March 30. It is unfortunate. I would like to have the guy come here and talk to us and find out if he said these things.

They are strong words. They are really strong words.

Let me ask a few questions now. What is the present deadline for Boeing and GE to submit plans for financing, certification and production costs?

Mr. MAGRUDER. I think it is 1972, June 30. That date—and I want it to be clear in the record—while it has moved it has always been approximately 1 year before the start of the production phase, the idea being to get as close as you can to where you have the proven article. That is the way you attract the private financing.

## EMPLOYMENT

Mr. CONTE. You stated on page 3 that 17,000 people are employed on this program. Could you break that down for me at Boeing and GE?

Mr. MAGRUDER. Yes; I will do that. I would like first to say that is a typographical error. I think that number was meant to be 13 or 14 thousand.

Mr. CONTE. You make it right and break it down for me.

Mr. MAGRUDER. I will. To make it right the 13 or 14 thousand are directly employed now by the contractors. Had we stayed on course on the \$290 million through fiscal year 1971, we would have been at 17,000 today.

We will supply for the record the breakdown of the employees that you have asked for. (See fig. 38, p. 279.)

Mr. CONTE. On the 50,000 people which you mentioned on page 3 that are working on the prototype—

Mr. MAGRUDER. That should be production.

Mr. CONTE. That is production?

Mr. MAGRUDER. Yes.

Mr. CONTE. Can you give me a breakdown on that?

Mr. MAGRUDER. Yes; for the record we will provide you with a breakdown.

(The information follows:)

<i>Function</i>	<i>Number of employees</i>
Research, design, and development.....	8, 000
Sales and service.....	1, 500
Assembly and fabrication.....	27, 500
Material procurement.....	1, 500
Facilities service.....	2, 500
Personnel services.....	750
Finance.....	750
Computing.....	1, 700
Quality.....	3, 800
General services.....	2, 000
<b>Total</b> .....	<b>50, 000</b>

## OVERLAND SUPERSONIC FLIGHTS

Mr. CONTE. You have answered most of these questions I was going to ask.

Some of the critics say that because of economics and other reasons there will be a strong push—you have heard them here—to rescind the order that this plane cannot fly overland supersonically. Outside of Congress passing a law, is there any way we can get a guarantee on this?

You could not rescind the rule.

Mr. MAGRUDER. I think a law is the best guarantee, and Secretary Volpe has written a letter to the late Senator Russell, supporting a congressional law on that.

Mr. McFALL. The regulations will be available in 60 days.

Mr. MAGRUDER. Within 60 days there will be an FAA rule that says exactly what you want.

## GOVERNMENT STAFF AT CONTRACTOR'S PLANT

Mr. CONTE. Last year we discovered there were only two staff personnel in the field. You remember I asked you questions on that last year.

Mr. MAGRUDER. Yes.

Mr. CONTE. We felt that this was inadequate to provide sufficient control of the SST program at Boeing. How many people do you have out there now? Do you feel we have enough?

Mr. MAGRUDER. I will answer that in the reverse order. That is an excellent question when you are trying to monitor a \$1.3 billion worth of Government money you certainly should be well staffed. We have increased our total staff approximately 10 percent. As I pointed out earlier, I have appointed Mr. Vierling who is going to be full-time helping me with what I think is the real big issue, financing the production phase, to make sure we reach that.

Mr. Parsons will be handling the internal side; program management, schedule, budget, and the field office. We put more cost analyst types in the Seattle office. After I heard you bring this up in this committee last year, we doubled the size of that office and put the right kind of people out there, people monitoring the costs.

I want a top-flight manufacturing man out there. I have such a man available. Frankly, I am having a very difficult time bringing top-level people on board while this uncertainty on the program exists. So while I have identified them, and have organized myself to man up to 117—I have 97 now—I am authorized 117 slots, I really cannot attract the right kind of talent until we resolve the funding difference. It is too short a term. I might bring somebody on board and relieve him in 30 days. I have a very strong office and a chief set up out there. I have more people available to augment it but I need this decision very badly as a program manager so I can do what you very properly have told me to do.

Mr. CONTE. The British Aircraft told me they were pleased when I brought that question up. They stated they would rather have more people of the British Government there on site because it cuts a lot of red tape when you can talk to a guy individually rather than going to the home office.

Mr. MAGRUDER. Yes. I am sure I should point out that is a completely Government subsidized program which is already into production. They authorized six production airplanes and some six test airplanes. So they have a different problem. Ours is to keep the Government's role minimized, monitor our pay-back, make sure we have a good prototype on schedule and then withdraw and get the private institutions in as quickly as we can after 100 hours of flight test. So there is a difference between the Concorde and the U.S. SST.

Mr. CONTE. Thank you, Mr. Director. As I say, I have eight pages of questions, but you answered most of them. Thank you very much.

Mr. MAGRUDER. Thank you.

## NOISE

Mr. EDWARDS. Mr. Magruder, one of your charts shows the production, SST noise objectives, where you bring the sideline noise and

the community noise down to 108 EPNdb. Do you recall that chart?

Mr. MAGRUDER. Yes, sir.

Mr. EDWARDS. I believe you said at the time you put that chart in the record that this would be quieter than the 747 and 707 and some of the other planes. Is that a fair statement?

Mr. MAGRUDER. That is correct.

Mr. EDWARDS. Would you put into the record a chart that would compare the sideline and community noise for the SST with some of the major jet planes?

Mr. MAGRUDER. Yes, I will certainly do that.

(The chart follows:)

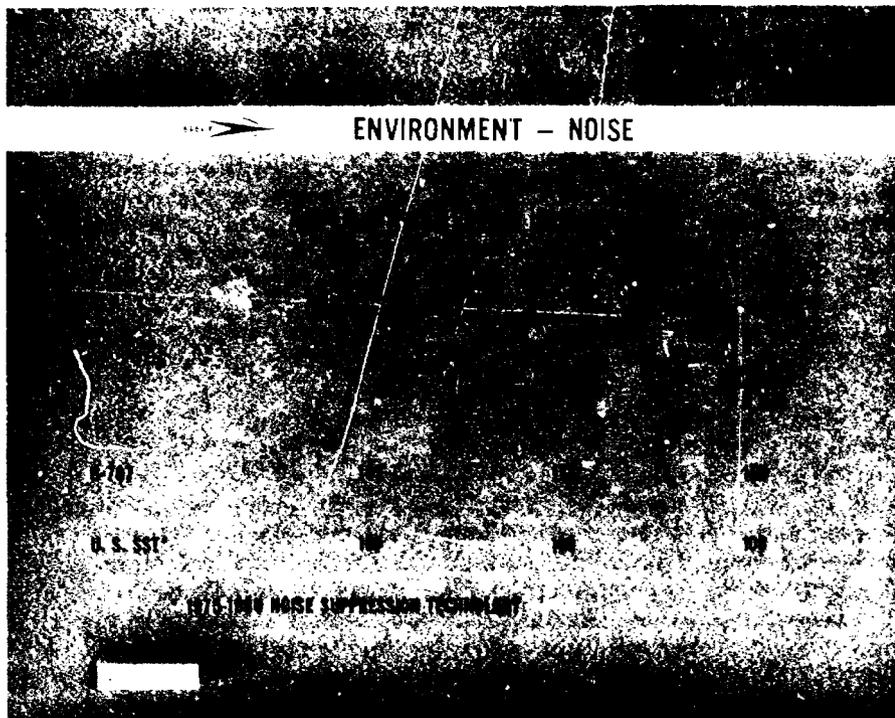


Fig. 60

Mr. MAGRUDER. That is a very interesting chart (fig. 60). As I have said it shows that out over the community our SST will make approximately one-half the noise of the 3,000 subsonic jets that are flying today. It cuts the noise approximately in half.

Mr. EDWARDS. As I understand it, twice 108 EPNdb is not 216 EPNdb.

Mr. MAGRUDER. That is correct. I am sorry Dr. Beranek is not here to answer this, because he is the inventor of the noise exposure index under the contract with the Port of New York Authority in New York City. If you add 10 db to 108, you go to 118, which will double your subjective response. If you subtract 10 db and run it down to 98, that will cut the noise and your response and you would say that is half as

annoying. That is based a lot on tests conducted by Dr. Beranek. His organization is the outstanding firm in the free world in this field.

Mr. EDWARDS. Thank you.

#### DR. GARWIN'S TESTIMONY

Mr. YATES. Mr. Chairman, I suppose this week could be called "Let Us All Jump on Dr. Garwin Week." Dr. Garwin came before our committee last year and I gathered the impression from members of our committee that he was a very good witness. He submitted himself to the cross-examination of the committee after the committee had been given the benefit of the testimony of the SST personally. So they had that background with which to cross-examine him. He submitted himself in the same way to the Senate. They had the opportunity to cross-examine him. So there was no concealment and there were no special favors that he was asking. His biography has been put into our record, and it is an outstanding biography. I do have the Senate hearings for last year and it appears at page 1622.

I must say that I am very much impressed with his background and his technical ability. Those of us who seek to obtain information opposing what the Government seeks to do, have difficulty in finding technical help. Dr. Garwin did help us. He helped a great deal.

While I consider Mr. Magruder to be a very able person, his desire is to help this program. He is going to do everything he can to see that the SST flies. I do not say that to condemn him in any way or say he is unfair. I think he is a partisan. He has a program to manage and he is going to manage that program. The point I am making is that, where does one who opposes this program go to get his advice or his assistance? I know, for example, as one who fought the antiballistic missile system, fortunately I was able to get advice from physicists at the Fermi Lab. They were able to explain technically how a missile is sought to be shot down by another missile.

I did not know Dr. Garwin until he came before our committee and I must say I was very much impressed with the testimony he gave us last year—I know from Senators to whom I have spoken. They were impressed with the testimony he gave them. So I do not think—and Dr. Garwin does not gain anything from coming before this committee. He is not paid for it. He comes in here for a public service and he performs one. I do not think that anybody who does what he has done ought to be attacked in the way that Aviation Daily jumped on him for example, in an editorial. Let's not indulge in personalities. Let us look at the testimony and let us weigh the testimony instead of indulging in rhetoric.

Mr. McFALL. If you will yield for just a minute, there was no intent on the part of the Chair to jump on Dr. Garwin. Certain questions were asked about his testimony because of the need to reply to some of the statements that he has made. But we asked Dr. Garwin to come. Of course, I am sure he had a very good reason for not coming.

Mr. YATES. I will tell you why he did not come. I asked him to come. He said, "I just can't because of the pressures that are being imposed upon me."

Mr. McFALL. That leaves us with no alternative except to try to lay out, as well as we can the principles that Dr. Garwin enunciated in his statement before the committee last year.

Mr. YATES. Mr. Chairman, I have no objection with what you did. You are perfectly right in submitting those questions to an expert, and he is an expert and asking his judgment and his comments on what Dr. Garwin said. This is a perfectly factual type of approach. You are entitled to your opinion by saying he is a fine nuclear scientist, But I do not think he is as informed in this field as he should be. I gather that is the impression you sought to convey.

Mr. McFALL. The facts have changed, in a sense.

Mr. YATES. All right. The point I am making is let us not jump on people but let's look for the facts.

Mr. MAGRUDER. I would like to say two things in rebuttal. First when I accepted this job I did not accept this job just to promote this SST. I spent 8 months looking very hard to see whether there should be an SST and if people wanted it.

Mr. YATES. I know what you did.

Mr. MAGRUDER. I want to be sure you know how I took the job.

Mr. YATES. I heard you before the Senate last year and a few days ago here, and you went through the whole story again of what you had done and I respect you for it. I thought you made a very comprehensive search of all aspects of the problem before you finally decided to take on the job. But once having taken on the job, I think you have become a very ardent and dedicated champion.

#### CREDIBILITY OF WITNESSES

Mr. MAGRUDER. I made the point very clear, I did not want to work for anybody in the Department except the Secretary, Mr. Volpe, because I did not want any bureaucracy standing in the way of the decision to stop the SST if the evidence said we should. I talked to hundreds of people and not just a few before I took this job. The evidence was preponderantly in favor of continuing to go ahead with the prototype, not that it is a sure thing. I want to caution the committee, it is important to look into personalities and the background of people.

I wouldn't believe in bringing a group of environmental witnesses in here who were not environmental experts. These people who testified before you today went through a most thorough scrutiny as to what kind of people they were, what kind of training they had. Whether they were on the SST pro or con made no difference to me. As a matter of fact, I think you heard Dr. Singer say today that as of a year or two ago he was fundamentally against the SST. I got the impression that he is sort of switching to a neutral position.

Mr. YATES. I asked him that specifically and he corrected me by saying he wasn't against the SST. All he said was that he was a member of a group that said they recommended against using the plane supersonically over the United States, so he did not say whether he was for or against it.

Mr. MAGRUDER. That is what he said, but I was referring to what he said in the early days of our negotiations and if you carefully look at the people on the Commerce Technical Advisory Board you will find some against it. They are only there for their expertise in the field. Dr. Garwin, in my opinion, is a perfectly dedicated public citizen. He is in no way, sense, or form an expert in aviation.

Mr. YATES. May I say that among Dr. Garwin's qualifications as it appears in the Senate hearings, this is what is said:

A substantial portion of his involvement for the U.S. Government over the last decade has been in the field of aviation, both military and civil. For example, he was a member of the jet aircraft noise panel of the Office of Science and Technology which in 1966 published the report on alleviation of jet aircraft noise near airports.

So, he has a background to give an opinion, an expert opinion.

Mr. Chairman, a few days ago I read from an airlines letter which was dated February 18, 1969, and I erroneously said that it was American Airlines. I used the name George Keck. As it happens, that was a United Airlines letter instead, and I would like the record to show this.

Mr. McFALL. When you get the record you can change it.

#### GOVERNMENT'S ROLE IN PHASE IV

Mr. YATES. OK. I was a little bit confused in your reply to Mr. Conte's question. I was under the impression in response to a question I asked you a few days ago that with the completion of phase III your job ended. I thought I understood you to say that. I thought that I understood you to tell Mr. Conte that you were going to work during phases IV and V, during the production versions of it.

Mr. MAGRUDER. No, I didn't mean to imply that. What I did say was that at the end of phase III the Office of Supersonic Transport Development as we know it now would be disbanded and that it would instead turn into a few people who are contract managers that would assure the Government got their recoupment money. There has to be somebody to make sure we get these royalties back, but a person such as myself would probably not do that. It would be a contracts and financing type officer.

Mr. YATES. I misunderstood you.

Mr. MAGRUDER. That was the point I was making.

#### SST IMPROVEMENTS BECAUSE OF CRITICISM

Mr. YATES. The implication I received earlier from you was that I certainly don't know as much as I should about the technical matters in the construction of aircraft, of problems of noise and problems of meteorology, and environment. That is true. That is one of the reasons I am asking the questions, because I am trying to learn.

Mr. MAGRUDER. I will be delighted to have you come to the Boeing plant and tour the whole facility.

Mr. YATES. I would be delighted to go there, and I am delighted, too, for the opportunity to ask you these questions and I think the hearings we have had have been very, very good ones as far as the committee is concerned. They have been very constructive. I believe that because of the opposition that some of us may have raised, perhaps your SST if and when it flies, if it does, it will be a better plane, a less noisy plane.

Mr. MAGRUDER. I think that is a marvelous statement. Please, in any of the things that I say that may sound defensive, I would like to put in the record that there is no such thing as unfair criticism because in our society the one element that leads us to greatness and ex-

cellence is criticism. I think you and the others on this fine committee have done an outstanding job of leading us to excellence.

Mr. YATES. I plead guilty to that. I have been critical.

Mr. MCFALL. I think the new engine design is an example of that.

Mr. MAGRUDER. It is a perfect example, and the environmental pollution program is another good example.

#### PRODUCTION FINANCING

Mr. YATES. Mr. Magruder, you were kind enough to invite me to go with you to the Chase Manhattan Bank and to the Bank of America, and was it the City National? Was that the third bank?

Mr. MAGRUDER. Yes.

Mr. YATES. And to meet some of the people who could tell me how the 707 was financed, and I think that might be a very interesting trip except I think it is more pertinent perhaps to try to find out how the SST is going to be financed, and I gather the impression that you had talked to them in sort of a preliminary way about the possibility of private financing of the SST. Is my memory correct?

Mr. MAGRUDER. I talk to them regularly because this is an evolving thing and it is a little too early for them or for me, the Boeing company or the GE company to say "This is how we are going to do it," but it is always necessary to keep reporting to the financial community the progress we are making in our talks with CAB, Labor, the industry, and the Commerce Department, on the current status of the industry. I think what they are presently doing is an incredible venture in financing and industrial enterprise in the wide body jumbo jets. During a temporary recession, here they are taking on \$5 billion worth of private financing in three major companies.

Mr. YATES. Are those trusts, are they debentures, or how are they being financed?

Mr. MAGRUDER. They are all kinds. It is comparable to the same sort of thing we are up against.

Mr. YATES. That you are hoping to get from them?

Mr. MAGRUDER. Yes.

Mr. YATES. Do you have any assurances from them as yet that they will undertake the financing?

Mr. MAGRUDER. No, sir. I think, as you probably well know, in the financial world there is no way to get assurance or proof or a guarantee until you have that proven article, you have the market there, and you have the profitmaking industry. Then you all sit down and make a deal. That, by the way, is why the date on the finance plan is tied as closely to the prototype airplane as it is. That is why it has moved as the delays in the construction program occurred.

Mr. YATES. May I ask why you are doing it rather than Boeing and General Electric?

Mr. MAGRUDER. Boeing and General Electric are responsible to do it, too.

Mr. YATES. Are they visiting with you at these offices, are they doing it themselves, or what are Boeing and General Electric doing to make provision for financing phases IV and V?

Mr. MAGRUDER. They are doing it independently of me, and I wouldn't have it any other way. I want a complete, separate, unbiased

plan from their standpoint, for they have different problems than I do, such as their relationship with the lending institutions; and they are doing that continually just as I am.

Mr. YATES. The last report I saw by Mr. Withington of Boeing was last year, when he said that Boeing was too small to finance production of the plane. The impression I got from reading that was he was going to look to Government financing. Did you get that impression, or has that changed?

Mr. MAGRUDER. I have no such information from the Boeing Co. Again, I would like to take you back to the 747. Financing is not extraordinarily different. They are a billion dollars, I believe, in debt on that score and in an era where the phasing out of 707's is quite severe. Their military programs are down, and the depression in the domestic air transport economy is quite noticeable; and yet they are not having any trouble financing the 747's. Everybody is saying there is going to be an upturn in domestic travel, and the air transport business is going to have a very healthy market, making a very dramatic recovery; but I think it would be premature to look 4 or 5 years ahead and ignore what is going on right this instant, which is almost as big a financing problem. In fact, if you take the 747, 1011, and DC-10, the financing is larger and it is being done.

#### PRODUCTION ENGINE IMPROVEMENTS

Mr. YATES. Dr. Beranek talked about the new engine going into the production version of the plane. Who is going to pay for that?

Mr. MAGRUDER. We don't know. I think I should answer that in two phases. First of all, there is no intention for the prototype program to put in this modified engine. I kept hearing the words this morning "new engine." That bothered me a little bit because the engine cycle is identical.

We are only increasing the engine diameter 2 inches out of 90 inches. We are deleting a very difficult part of the development in the afterburner, so what we are talking about is an evolution. We are taking the present engine, evolving it into the production engine for the production airplane. It would be our intention to have that done in the production phases, but it may be to our advantage if some work was done ahead of time in that regard under the title of development work if required to meet certification schedules.

Now, it is perfectly in harmony with the charter of NASA and others to do advance technology work on new engines and lower noise.

#### PRODUCTION AIRPLANE IMPROVEMENTS

Mr. YATES. I think that is a very important point that you raise, not only with respect to the engine but with respect to other parts of the prototype model as opposed to the production model. Previous testimony before this committee has indicated that the prototype model will not have the braking system that will be used in the production model, will not have the fuel sealant that is going to be used in the production model, that now we know you are going to get a different kind of an engine. Whether you say it is new or not, it is still different than the one that the prototype will have. There will be a different environmental control system in the production model. There will be

a different landing gear in the production model. A letter that I have from NASA indicates that you are going to have new wing configurations in the production version, and I read from a letter, dated February 12, from NASA. It says:

For the production version of the SST, Boeing is considering such aerodynamic improvements as increased strake size and leading edge sweep, increased sweep of outer wing panels, and optimum twist design of the horizontal tail.

#### IMPROVEMENTS AFTER PHASE III

And it raises a point that I think is very important, and that is where does the Government's obligation begin and end. It has been testified here that the Government's obligation begins and ends with the prototype phase, Phase III. Will you be doing the work and will the Government be paying for the changes that are going to be incorporated into the production version of the plane?

Mr. MAGRUDER. I think that you are laboring under a misconception and I appreciate your difficulty in understanding this because it is not an easy thing to even explain, much less to live with for very long. A prototype airplane is simply an evolving vehicle. We are going to move the Government out at the end of 100 hours but the manufacturers will continue to fly those prototypes, plus the production airplanes through certification. At the time when FAA will certify this airplane there will probably be not less than 4,500 hours of test time and those prototypes will be continually evolving during tests. Individual systems will be changed and that will lead into improvements in the production airplane. It will be a continual sort of evolutionary process until certification.

By the way, we stop at the end of 100 hours. The Government is not involved after the 100 hours ends. We expect to have proven the feasibility and the economic viability at the end of that time and, hopefully, attracted private financing.

Now, to put in perspective how serious this evolutionary thing is, I did most of the original development work on the DC-8. During the DC-8 delivery of just the first 30 or 40 airplanes there were four different engines on the airplane delivered to customers. There were three different wing tips, two different leading edges, four different wing flaps, three different brake systems, two different control systems, four different autopilots, and every cockpit was different. I don't know why that is but no two airplanes have the same cockpit and that may be a reflection on pilots in general. There were 48 versions of the DC-8 developed during the first 2 years. As if that weren't enough, in 3 years along came an airplane with a 40-foot longer fuselage, with bigger engines, another new leading edge, a different pylon, a so-called long duct nacelle, and the DC-8 is continuing to be developed even to this day.

The total development program of the 707's and DC-8's has utilized not less than 200 different airplanes to test improvements and that is why you and I and the traveling public get the safest, the cheapest, the most efficient, and the least polluting form of transportation ever known to man. Travel back and forth across the United States is 5 percent cheaper than 25 years ago in real dollars, and this fantastic industry does this on the basis of about a 2- or 3-percent profit on sales.

Mr. YATES. I don't understand your answer to my question.

Mr. MAGRUDER. My answer to your question is that evolution will go on after the Government is out. We are out after 100 hours of flight test. It will never stop. It hasn't stopped today on those airplanes I just mentioned.

Mr. YATES. I respect that answer. The point I am trying to make is there is a point of departure by the Government and you say that point of departure is after 100 hours of flight testing. The question I should like to ask you is whether within that 100 hours of flight testing there will be a new fuel sealant incorporated into the pane, whether, to use Dr. Beranek's term, a new engine will be incorporated into that plane, whether there will be a new configuration that NASA described incorporated?

Mr. MAGRUDER. I direct your attention back to all of those slides that I had Mr. Parsons show that were hardware formed by heating until they are red hot. The airplane is committed. It is being built. It may be wise to do some additional development work on the prototypes during phase III up to and including the 100 hours to demonstrate better the economic viability of the production airplane because when we finish with 100 hours we are going to have to take that prototype airplane and extrapolate it to the airlines, the marketplace, and say: "Based on this, we think with almost 100 percent certainty this is what you will get in 1978." They will have to evaluate it. We will bring NASA in. We will bring universities in. We will have an extraordinary team to validate that opinion. It will not be done by my staff. They will participate and guide it but I will have the best available expertise in the United States to help provide the validation. The end decision will be made by the airlines, the customers.

#### PROTOTYPE AGAINST PRODUCTION EFFORT

Mr. YATES. May I ask the cost of your engine program through phase III?

Mr. PARSONS. Our estimate is \$376 million.

Mr. YATES. The reason I asked that question is there is a comment in Aviation Week of February 22 which says:

Bigger scale version of the General Electric GE4 engine being considered for production models of the U.S. supersonic transport as part of a noise reduction program calls for an increase in first-stage compressor diameter of 10-15 percent. Design changes will enable the exhaust nozzle to remain the same size.

But then it goes on to say:

\* \* \* It estimates that the modifications will add no more than 10-20 percent in production engine development costs.

That is about another \$50 million, isn't it?

Mr. PARSONS. It could be.

Mr. YATES. Who is going to pay for it?

Mr. MAGRUDER. We have allowed for such changes in the phase IV, production development program.

Mr. YATES. We are trying to save taxpayers' money here. Have you defined what the Government is going to be responsible for and to pay for in what goes into the production version of the plane and what Boeing is going to be responsible for? I recognize the answer that you have just given me that it is difficult because of the gradua-

tion and development of the plane as it proceeds through various phases to give this kind of a definition but speaking as a lawyer rather than as an aircraft engineer you try to get—I would like to get a definition so that we would know what the liabilities and responsibilities of the other side are going to be.

Mr. MAGRUDER. I would refer you back to one of your early comments which was to try to relate the military program such as the C-5. The one thing about these programs that we must not dampen is that they have to be dynamic. I don't want the program office to nail in concrete today something that must be done for production tomorrow. As a matter of fact, an earlier attempt to do that in the contract is what got us into difficulty with the airlines. By not defining the production program precisely, but instead, shifting the precise definition to the prototype got us the 100 percent enthusiasm of the airlines. I must say this work that Dr. Beranek and the committee and Boeing and GE have done on noise has simply accelerated the airlines' enthusiasm for them, just as you and Mr. Conte and everybody else, had very much wanted to keep the airport noise down well below what they are having to do today with 707's and DC-8's. So the program has to be dynamic and I don't want to rigorously define time periods and definitions except on the basis of laboratory tests and data, until the last possible date to make it so the airplane is the best possible airplane.

#### SIMILARITY OF PROTOTYPE AND PRODUCTION

Mr. YATES. The first contract that was drafted between the Government and Boeing provided for, on page A4, that the contract airplane would be a four-engine land-based supersonic transport, and so forth, but it said this:

To provide a representative test airplane the prototype shall be designed to have the same aerodynamic configuration as the basic production airplane.

A few days ago I tried to get some information in my questioning by asking you the same type of question I am asking you now, and that is when does the prototype end and the production version of the plane begin? I thought that was what was intended in that first paragraph of that old contract. That has subsequently been amended, hasn't it? You no longer are required to provide the same kind of a plane in your prototype that will be the production version type airplane.

Mr. MAGRUDER. By definition, the prototype is the same type of aerodynamic airplane as the production airplane. However, if it were identical then it would be valueless because then the prototype would be the production and it would not serve the purpose of a production type airplane.

Mr. YATES. That is why I was puzzled when I got a letter from Professor Terman at Stanford University after I had written a letter to Professor Terman after getting a copy of the release by Dr. David about asking certain scientists to comment about the need for continuing experimentation, and I find Dr. Terman's reply a very interesting one and I thought it varied with what you told me and this is what he said:

This is in response to your recent letter to me (copy attached).

I must say that this letter is more than mildly irritating. In the first place, it expresses doubt as to whether I really believe the statement to which I subscribed, and in the second place there is the inference that maybe I didn't really subscribe to the statement anyway.

In the next-to-last paragraph of your letter, you first assert "The SST program is not an experimental program." And then state, ". . . it is true there is development work to be done . . ." one or the other of these statements is wrong since the experimental work is not over with until all of the development work has been completed, and until at least one prototype has been built that incorporates every feature called for in the product to be evaluated.

Every feature. I continue:

This is a lesson that I learned very thoroughly in World War II in connection with a war project at Harvard University that I organized and ran. This project was devoted to countermeasures against enemy radar (i.e., electronic warfare). It involved over 800 people in research and development, and saved the lives of several thousands of American boys flying bombing planes over Germany. One thing that was indelibly impressed on me by this experience was that experimental work is never completed until one has an exact working model of what is to be considered for production.

Mr. MAGRUDER. I see no contradiction.

Mr. YATES (reading):

There is no reason that the first SST should be an exception.

An example of failure to do the necessary experimental work first is provided by the Rolls-Royce fiasco. Again the price overruns in military procurement that have so bothered Congress and the public, are typically at least in part a result of making decisions before the development work (i.e., the experimental work) has been completed.

You asked that I give my views in order that you might use them in the current debate. You now have my views in the third, fourth and fifth paragraphs of this letter, and I assume you will follow through on the implied commitment you have made, and see that these views are introduced by you in the current debate.

Professor, wherever you are, I put your remarks into the record. The point I thought he was making in this letter was that you almost have to have the production model. The phrase he used was "an exact working model."

Mr. MAGRUDER. May I put that in context for you?

Mr. YATES. Indeed.

Mr. MAGRUDER. Where is Professor Terman from?

Mr. YATES. Professor Terman of Stanford University.

Mr. MAGRUDER. I agree with him completely.

Mr. YATES. He is provost emeritus.

#### PURPOSE OF PROTOTYPE EFFORT

Mr. MAGRUDER. Let me read to you the contract:

The prototype airplanes shall constitute the basis without construction of intermediate models for a safe, superior, and economically profitable production version of the SST. They shall provide direct evidence that a program could emerge sufficiently profitable to attract financing for certification in production program.

Now, that is the definition of a prototype airplane of our Government program through 100 hours. You notice a little while ago I made the comment that that is the prototype through 100 hours. That program is sufficient for us to attract private capital and the Government to move out. Remember, I made the remark that the program doesn't stop there, that Boeing and GE continue flying those two airplanes

plus models of the production airplane until they have 4,500 hours, and, Mr. Yates, the night before you get a certified airplane you will be up flying at midnight making changes in that airplane to get your certification. And you will be changing it every day down the line.

All the prototype does is take you far enough down that road for the airlines to say it is economically viable and for the private institutions to listen to the airlines and listen to the technical assessment and say, "Yes, it is well enough along for us to step in."

The process of experimentation does not stop there and the final experiment that Professor Terman is talking about is the certified airplane which comes out of experimental status where it has an NX on the wing. The night before you get your certification the FAA looks at the manufacturer and says "You complied with everything. You made all the changes. Change the NX to an N." That is the last experiment but you never stop. Our airplane is going to fly roughly 24 months from today. That airplane will be continually experimented with until the final test is done, the night before the certification. Then you truly have the final experimentation. You cannot just say that the prototype in the first 100 hours is it. We are only going a short step of the way. The rest is up to the industry, to the private financing, and to the airline.

#### NASA LETTER ON SST

Mr. YATES. Then I take it that your answer to my question about all the various things that I have indicated—you undoubtedly have a copy of the letter that NASA sent to Homer Skarin, the staff assistant, outlining various changes that are proposed between the prototype and the production versions of the plane, and as I understand your answer these are changes that the contractors will have to pay for in phases IV and V.

Mr. MAGRUDER. They may or may not. What Congressman Yates is referring to is the NASA documents that form the basis of Mr. Paine's endorsement to the President last summer—

Mr. YATES. Which has already been placed in the record.

Mr. MAGRUDER. You must be very careful when you read NASA documents. They are written by the greatest scientists in the world. However they spend very little time in discussing what is good in an airplane. If they did the volumes would fill this room. Their job in the aeronautical industry and scientific community is to seek out problems, alert the industry, and take you a little distance down the way and aim you toward the solution.

They are not there to decry the product or say it is good, bad, or indifferent. They say "Here is an area to work." It might be the engine, noise, structure, it might be anything. Always on the front they endorse this type of report with a letter "We think you can get there from here with the proper amount of effort and timing."

Now, we don't know how much of that is going to be done on the prototype and how much will be done on production, but I can assure you that all of it will be done and it will be done in a manner to make the certification date.

#### PRODUCTION COSTS

Mr. YATES. I must say, Mr. Magruder, I think that you are usually more precise in your answers than the one you gave respecting what

the production costs are likely to be in phases IV and V when you see that they are going to be anywhere between—what? \$3.5 billion and \$5 billion? There is quite a spread, isn't there?

Mr. MAGRUDER. It is a function of what the delivery rate of the airplanes will be. The function of escalation or abnormal or normal inflation is going to be, and it is obviously a function of what the final costs of the airplane are going to be.

The outstanding thing about the SST program, which is not characteristic of the Concorde in any way—I do not know of the Russian airplane—is the fact that the prototype is completely separated from production. We are going to build, test, and evaluate two airplanes, conduct static tests on the ground, look at what we have, and then make the decision on tooling, on final design configurations and added test. That is the way you keep your costs the cheapest possible.

Now, unfortunately, in the private enterprise system it has never been possible to have a prototype completely separate from a commercial airplane because the demand of the marketplace, the time interval between starting a program and payback are so great you can't get that kind of financing, so in the case of the 880, 990, DC-8 and 707 those airplanes went concurrently. The design, development, flight test, and building of the production airplanes were all conducted simultaneously. That is the expensive way to do this but in private enterprise, you simply cannot afford to let somebody race off with the market while you fiddle around with a prototype.

In the case of the SST, we are afforded a magnificent luxury. We can do it. We can keep our costs under control. But I would be less than honest if I didn't say my \$2 billion to \$2.5 billion—

Mr. YATES. I thought it was \$3 billion to \$5 billion.

Mr. MAGRUDER. In 1967 dollars. Then depending on the production rate, depending on the inflation rate, make it 3 percent per year, it might be between \$3 billion and \$5 billion including phase IV. I would like to be more precise than that but that is a fairly precise answer for this kind of a question.

Mr. YATES. It is the one we will have to accept, then.

Mr. MAGRUDER. Well, if you would like to tie down on the order of several thousand assumptions I can give you an explicit answer but I don't think the assumptions would be any more valid than the people who made the assumptions, so I think we are stuck with that kind of an answer.

#### NOISE SUPPRESSOR EFFECT ON PERFORMANCE

Mr. YATES. Dr. Beranek described a new engine. Ordinarily when you have noise suppressors of one kind or another there is usually a loss in either the range or the fuel consumption or in some portion of the weight of the plane; isn't there?

Mr. MAGRUDER. Yes, indeed. That is true of airplanes today that have sound suppressors.

Mr. YATES. As I understand your answer, this would not follow from this new version of the engine.

Mr. MAGRUDER. No; the same thing is true. If we didn't have to put the noise requirement in, and I think Dr. Beranek made that clear, we would probably go along with an afterburner and a smaller, noisier engine which would be cheaper.

Mr. YATES. Yes. What losses in operating efficiency will you suffer as a result of the new engine?

Mr. MAGRUDER. I think the engine will be slightly heavier, if you call that a loss. You can make up for that by taking the gross weight up with a little more fuel to cover your range, so now you have recovered it and what you have paid for is a little more takeoff weight which, by the way, is the cheapest you can do in an airplane. If you take the empty weight up that is very expensive. So this zero to 50,000 pounds is takeoff weight.

It is going to cost you in terms of the engine size; it is going to be bigger than it would otherwise have to be. That means it is going to be a little more expensive engine. Nevertheless, with this kind of payload range, with this kind of speed and productivity, and with the passenger capacity of 275 to 300 passengers, all those things I said about productivity and operating economics are valid. We still have an airplane that is half as noisy as the present day fleet. It will fly off of any airport that an international jet can fly off of and will triple the earnings of a DC-10, Lockheed L-1011, and double the earnings of the 747. This is the way we are going to mix the fleet in the 1980's and 1990's if we are fortunate.

Mr. YATES. Will the drag be increased as a result of the engine change?

Mr. MAGRUDER. Well, a 2-inch bigger diameter engine without any increase in length will probably be a few counts of drag and I think the increase in weight brings about a few counts of drag.

Mr. YATES. You don't feel this has significant effect upon the plane?

Mr. MAGRUDER. It is measurable but it does not significantly degrade the operating economics of the basic range, payload, and passenger capability. That is made up for by simply changing the takeoff gross weight. The first DC-8 that I certified weighed 260,000 pounds. That same model airplane is flying today at something around 365,000 pounds. I did the original phase testing of the B-52 airplane. That plane weighed 375,000 pounds and today B-52's are flying all over the world at 488,000 pounds. They are more efficient. They have better payload range and lower operating costs. I might also say they are also flying off of shorter field lengths. Even though the weight has gone up, by offsetting this with engine thrust, they are quiet and fly off of shorter field lengths. This is normal evolutionary development of airplanes.

#### RETURN ON INVESTMENT

Mr. YATES. You talked about the productivity and the return. As I understand it, the SST is targeted for 298 seats at the present time.

Mr. MAGRUDER. That is the present all tourist production version.

Mr. YATES. Did you testify that at 298 seats there would be a yield of \$13.4 million annually per aircraft on an investment of \$40 million or \$60 million?

Mr. MAGRUDER. I don't remember that number. I will get that number for the record. I don't recall that number offhand.

(The information follows:)

The expected annual operating profit for a \$41 million SST of 281 seats at 55 percent load factor would be approximately \$13-\$14 million per aircraft.

Mr. YATES. Well, suppose the price is as you have fixed it to be, \$51 million when the first plane rolls off. What would the return be on an investment of \$51 million and, assuming whatever figures you want to assume—what did you assume—50 percent occupancy or 60 percent?

Mr. MAGRUDER. International flights are usually 55 percent.

Mr. YATES. 55 percent.

Mr. MAGRUDER. I want to correct the 298. We use 281 for the study you are talking about.

Mr. YATES. All right. What would the return be on that investment?

Mr. MAGRUDER. If you are escalating the price of the airplane, and then we would assume you would escalate the fares equally, the return would not change.

Mr. YATES. How will the fares be escalated equally, in your opinion, or will they be advanced more?

Mr. MAGRUDER. I don't know, but I think it is only fair to assume if you are going to use escalation on costs you have to—

Mr. YATES. What is the present figure you would use for the price of your SST?

Mr. MAGRUDER. \$41 million.

Mr. YATES. Let's take \$41 million and take a 55 percent load factor and 281 seats. What is the return on that?

Mr. MAGRUDER. I don't know that number offhand.

Mr. YATES. I thought you had testified to it, but apparently I was wrong.

Mr. MAGRUDER. Whose return are you referring to?

Mr. YATES. To the airline, the one who is operating the plane.

Mr. MAGRUDER. I will supply that for the record.

Mr. YATES. Surely.

(The information follows:)

COMPARISON OF RETURN ON INVESTMENT 3,565 STATUTE MILES—INTERNATIONAL OPERATIONS

	SST	747
Number of Seats.....	281	384
Passenger miles (thousands):		
55 percent load factor.....	813,650	454,975
60 percent load factor.....	887,618	
Annual revenue (thousands)—5.60 cent yield:		
55 percent load factor.....	\$45,564.4	\$25,478.6
60 percent load factor.....	49,706.6	
15 percent surcharge—55 percent load factor.....	52,399.1	
Annual cost (thousand).....	32,551.4	18,462.2
Annual profit:		
55 percent load factor.....	\$13,013.0	7,016.4
60 percent load factor.....	17,155.2	
15 percent surcharge—55 percent load factor.....	19,847.7	
Rate of return on sales price:		
Sales price (millions).....	\$41.0	\$23.0
55 percent load factor.....	31.7%	30.5%
60 percent load factor.....	41.8%	
15 percent surcharge—55 percent load factor.....	48.4%	

Mr. YATES. Is this a valid question to ask you?

Mr. MAGRUDER. Oh, absolutely. Let Mr. Parsons come in.

Mr. YATES. OK; welcome, Mr. Parsons.

Mr. PARSONS. Glad to be here, sir. There are two sets of economic studies currently going on in the program. One is being conducted by Boeing that assumes there will be no surcharge on the SST at all. Using routes that the 500-aircraft fleet would fly, the return on invest-

ment to the airlines is in the neighborhood of 18 percent after taxes. As you recall, the original Government studies based on the IDA exercise, which is regularly updated, assumes a surcharge based on the value of speed. That assumes that the SST, due to the way the studies were run, if it were to have approximately a 26-percent surcharge the airlines would recover 30 percent before taxes. Both of these studies show a market of at least 500 aircraft for the SST. So to give you a precise answer as to what the return on investment to an airline will be is difficult because we don't know what the fares will be.

#### SST VERSUS SUBSONIC PROFITS

Mr. YATES. I guess it is difficult to assume a fare for an SST and compare it with a 747. I get the impression from computations that I make that an airline buying an SST at an advanced price of \$41 million and buying a 747 at—what? \$22 million? \$26 million? What is the price of the 747?

Mr. MAGRUDER. About \$23 million.

Mr. YATES. \$23 million. There is more of a return to that airline based upon its investment in buying a 747 than an SST.

Mr. PARSONS. Provided he gets passengers. If there is a speedier plane flying alongside of him, history shows the slower plane won't have passengers.

Mr. YATES. I assume the same sort of passenger percentage, 55 percent.

Mr. PARSONS. That is not a correct assumption.

Mr. MAGRUDER. That is like assuming if you put a reciprocating airplane next to a jet that the reciprocating engine plane would show the same return as the jet. The 747 is averaging a 65-percent load factor. The 747 is designed to cruise at nine-tenths the speed of sound. It is faster than the present-day jets. It will save 10 percent of the time, seven-tenths of an hour on a 7-hour flight.

Mr. YATES. I think you are making my argument for me because I think I would prefer the roominess of the 747 with a slower pace and the lower fare, may I say, to a surcharge on an SST which, as I get it, is still a streamlined plane.

Mr. MAGRUDER. We didn't say the surcharge was required. What we said was the reason we showed surcharges was to prevent early obsolescence of the older equipment. That has classically been true as was done on the jets versus the reciprocating engine planes. We had a 16-percent first class and 6-percent tourist surcharge on the jets to prevent people from just flooding over from the older equipment and having all those flights fly empty. In 1 year they were empty anyway. We put the surcharge on the SST for the same reason, because CAB and the airlines and others say that is probably a typical historical pattern.

#### CONCORDE VS. SUBSONIC PROFITS

Mr. YATES. It is reported in this BOAC article which has not been denied, even in this second article, has not been denied that it is calculated that the Concorde at least will cost twice as much to operate as the 747. I am not saying the SST will be as expensive to operate

as the Concorde. I hope it isn't. If it is, I am sure you will be disappointed. But the point I am making is that I am making an argument for the 747 I think for the airlines. I think the airlines are going to make more money with 747's than either with the Concorde—I know, I remember the charts (fig. 56, p. 288)—or with the SST.

Mr. MAGRUDER. I don't think the airlines will agree with that. The Concorde article that you referred to, and I never did answer that question because of a little play between your colleagues—

Mr. YATES. There is always some static up here.

Mr. MAGRUDER. The newspaper in effect said the operating costs of the Concorde were to be approximately double that of its subsonic jet counterparts. We have never said that the direct operating costs, if you want to use that parameter, cents-per-seat-mile, wouldn't be higher for a Concorde, but we have said that it is like looking at just a piece of the problem. The answer is that while it may be 30- or 40-percent higher in cents-per-seat-mile if you look at the earnings, if you look at the total operating cost, with a 75-percent load factor you are going to find that a Concorde with a 75-percent load factor has the same total operating profit as the 747. As I showed you before, with a 75-percent load factor, which isn't very many people in the case of a Concorde—it is like 80-some-odd people—you are going to have the same earning potential as the 747.

Mr. YATES. You have already put this chart in the record.

Mr. MAGRUDER. This chart (fig. 56) right here. You haven't seen this one.

Mr. YATES. I saw it this morning.

Mr. MAGRUDER. The total operating costs of a Concorde operating 55-percent full on our assumptions are midway between the 747 and 707 in 1975. The top line is a 707. It is quite a bit better than the 707 was. Somewhere in between the 747 and the Concorde are the tri-jets, the 1011 and the DC-10. So even at a 55-percent full Concorde, not even taking into account the attractiveness of the fact it is going to get across the ocean in 2 hours, 45 minutes, it would operate very close to the total operating cost of the trijets. If it does attract a bigger share of the market its operating costs or cents-per-revenue passenger mile are right on the 747 line in 1975.

If you will just flip the chart to the next one (fig. 8, p. 264), let's look at the earnings, annual earnings and profits, and you will look at the far right-hand side and you see a 75-percent full Concorde. In other words, there are just 81 or 82 people ready to go a shorter time against the 747 and compare that with the second column from the left and you will see the annual operating profit of the Concorde is as high as the 747.

Mr. YATES. If that is at a 55-percent load factor for the 747.

Mr. MAGRUDER. That is right.

Mr. YATES. But why shouldn't you compare apples and apples?

#### VALUE OF SPEED

Mr. MAGRUDER. Because you have an apple and an orange flying the Atlantic. You have a high-speed airplane that will get you there in 2 hours and 40 minutes against having the big 747 that takes 7 to 8 hours. You may like the comfort and distraction of movies. I would rather be

at home in my living room with my lovely wife watching television and talking to the kids than watching movies—

Mr. YATES. Oh, come on. Seeing Mrs. Magruder in the room, I can understand why.

Mr. McFALL. Can understand why, or why he said it?

Mr. YATES. Both. But let's talk about load factors for a minute. You had a calculation yesterday in which you had an IATA base and took a flight from that to 1985. What was that IATA figure that you used?

Mr. MAGRUDER. Well, it was 900,000 passengers on the North Atlantic in the summer of 1970.

Mr. YATES. Right. Does that break it down by classes of passengers, those using first class and those using economy fares, those using charter flights, those using special fare flights?

Mr. MAGRUDER. I do not have that with me.

Mr. YATES. Well, you will recall the figures I got from the Civil Aeronautics Board and they put it on the basis of miles, on the basis of the total passenger traffic of Americans flying in terms of miles it was something like 42 billion passenger miles. Of the 42 billion passenger miles, 2 billion was first class, only 2 billion out of that whole group.

Mr. MAGRUDER. Mr. Yates, we are not talking first class. This isn't first class.

Mr. YATES. The point I am making is that up to the present time without your supersonics at least Americans, by and large, are taking the economy flight rather than the first class flight. They are taking it in tremendous numbers and, as a matter of fact, Mr. Tipton will tell you that. He will tell you that international travelers would much prefer to save money on their flights, assuming the same speed, because the steerage gets there the same time as the first class gets there.

Mr. MAGRUDER. I think you said the key words, assuming the same speed.

Mr. YATES. That is right, but the question that you and I have to consider is how much of that is going to be changed by speed.

Mr. MAGRUDER. I think we have already been through that in the last 10 years. That history has been written.

Mr. YATES. I don't think so. I think if you compare a supersonic like the Concorde, for example, with a 747, I will fly the 747 because I have been in the Concorde. I have seen it and I have seen the discomfort of the Concorde. I assume the SST will be better.

Mr. MAGRUDER. The SST comfort will be as good as a DC-10, or 1011, or 747.

Mr. YATES. But as far as the Concorde is concerned, no. I am on my last line of questions, Mr. Chairman. I will be through in three more questions.

The point I wanted to make was that I think that you are placing too much emphasis on speed. I think the statistics that are indicated show that most Americans would want to save a buck if they are given a choice of flying overseas. You may find a movement to your speedy craft by first-class passengers who can pay a superfare but I don't think you will take away the extent that you think you will.

Mr. MAGRUDER. Now again, that is an opinion.

Mr. YATES. Of course.

## VALUE OF TIME

Mr. MAGRUDER. Therefore, I have to go to the top experts who study the value of time in this business and if you will read this chart (fig. 61 follows)—it is the economics of the value of time—you will see that the airlines who make their living out of this say that the response is two times earnings which says that they place a very high premium on the value of time.

(The figure referred to follows:)

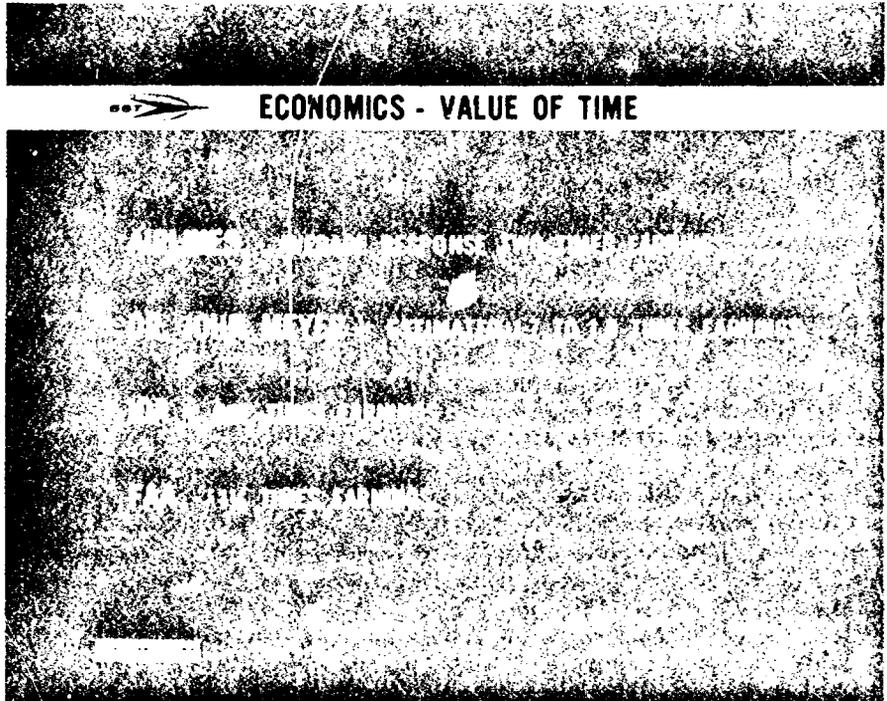


Fig. 61

Mr. MAGRUDER. Dr. John Meyer is an individual who is probably one of the top men in this field. He says it is 1.7 to 1.8. The FAA says about  $1\frac{1}{2}$ . It is true that in the IDA study they said it was one times the earnings. I think what these numbers tend to do is refute what you just said. People do place a high value on saving their time and that is why you don't take the bus back to your home State or the railroad train. You fly. That is why 95 percent of everybody that travels over 500 miles flies in an airplane. That is why the last U.S. steamship crossing the Atlantic with passengers is retired.

Mr. YATES. I must say that both of those statements make me very sad because of the fact that I like steamship travel and I like railroad travel and I think the railroad killed themselves in the way they handled their passengers, but that is something else again.

Mr. MAGRUDER. Maybe you have more time than I do.

Mr. YATES. No, it isn't that. Usually when I travel I have to watch the amount of money that I pay and that is why I am looking to saving money if I do travel, and I think most Americans do that, too.

Mr. MAGRUDER. Time is money.

Mr. YATES. No; most Americans who are flying aren't going for business reasons. They are going for pleasure or economy and are willing to take a little more time.

Mr. MAGRUDER. Once again, I make the point, you have 73 years on earth. If you are going to waste a lot of that time traveling from A to B, I would say you don't value your time very highly.

Mr. YATES. Mr. Chairman, I thank you. Mr. Magruder, may I say I have enjoyed our little session here very, very much. I have learned a lot and I want to say that I respect and appreciate the fact that you are suffering from a physical ailment, that you did come here to be subjected to the kind of grilling that we gave you, and you did very well indeed. You are to be congratulated.

Mr. MAGRUDER. Thank you very much.

Mr. McFALL. Thank you, Mr. Magruder. I just want to pass along to you a comment made by the chairman of the committee, who is one not without experience with congressional hearings. The other day he said he thought you were the finest witness he had ever seen.

Mr. YATES. And he has seen a lot of them.

Mr. McFALL. So we can start with the next witness, who is Mr. Karl G. Harr, Jr.

Mr. MAGRUDER. Mr. Chairman, while we are leaving Secretary Volpe wanted me to say these few words when I was talking to him the other night. I have only done this twice in my life I must say that I don't think there is anything that would make an American citizen feel any better than to have the opportunity to do what I have been doing. It is our form of government in action, pros and cons alike. It is a real inspiration to us.

Mr. YATES. May I say in passing, Mr. Magruder, that it was my amendment in the committee, incidentally, which was to open up the Appropriations Committee hearings to the press and to the public and I think the fact that we have the press and the public following these hearings very, very intently is an indication that I was right.

Mr. MAGRUDER. It is indeed. Thank you.

STATEMENT OF KARL G. HARR, JR., PRESIDENT, AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

Mr. McFALL. Mr. Harr, we are glad to have you before the committee.

Mr. HARR. Mr. Chairman, thank you. I sat here for two and a half days listening to the committee and the witnesses, and it has led me to three conclusions, if I may. The first one is I would like to amend my statement to say that I am Dr. Karl G. Harr, Jr.

Mr. McFALL. We have that.

Mr. HARR. I didn't think that was very important until I saw the respect that the doctors were getting around here, and I knew I was going to need all I could get.

Secondly, and seriously, I have testified often and I have witnessed many committee hearings on various subjects that affect the aerospace

industry and I have never seen a more thorough, honest, and complete investigation by a committee and members of different points of view on a subject than I have seen so far in the course of these hearings.

Thirdly, that relates somewhat to the introductory remarks I would like to make, Mr. Chairman. The Aerospace Industries Association represents the major manufacturers of spacecraft, aircraft, missiles, and related components and equipment, and our major interest and desire with respect to this session of Congress was to see to it that the facts got surfaced. We had a tremendous feeling that there was a gray haze, perhaps, on different sides of various questions pervading the decisionmaking Halls of the Congress and also the media and that the most important thing was to cut through that with a thorough, comprehensive, and basic investigation of the facts. It was in that vein that I prepared my rather strong statement, which perhaps has some rhetoric in it because we wanted to fight to be sure to get the facts uncovered, and I must say they certainly have been thoroughly gone into by this committee thus far and I think a marvelous record for getting at the truth is being prepared. So if I may briefly skim through my statement, some of the adjectives are going to send Congressman Yates up the walls and one of the statements is going to make Congressman Conte think of chickens, but with those two caveats I will just do it because I think it is important that we state our position on this.

Mr. Chairman and members of the subcommittee: My name is Karl G. Harr, Jr. I am president of the Aerospace Industries Association, which represents the major manufacturers of spacecraft, aircraft, missiles and related components and equipment.

AIA conducts studies and research into problems confronting the aerospace industry and seeks to represent the industry's viewpoint on broad matters of interest to the industry generally. It carefully avoids comment on such matters as levels of spending for defense or the relative merits of a particular system or aircraft. AIA has been in existence since 1919 and that has been its constant policy.

My appearance today on behalf of the research and development program for a supersonic transport might seem to violate that principle, but it does not. The SST program is of such vital importance, not only to the entire aerospace industry but also to the technological leadership and economic health of the Nation, that our membership considers it a top priority. It is not just a product; it is the leading edge of this country's commercial aviation technology.

I must confess, Mr. Chairman, that I come here in a mood of uncertainty approaching complete frustration, although that statement now no longer prevails because of the facts uncovered largely by this committee. We were concerned in prior considerations in the public dialog, in the media, and to some extent in the Halls of Congress with innuendo, half-truths, untruths and nonsense against the SST which has so confused the facts about this sound, sensible, and feasible program, and I find myself almost as bewildered as some segments of the public had obviously become.

I certainly mean no disrespect when I say in our opinion some Members of Congress as well as the citizens of this country have been had, and badly had, by misrepresentations of what is a very straightforward program to test two prototypes of a supersonic transport. Also

many people in the media have been had. Frankly, Mr. Chairman, this may be in large part the fault of industry. Most of the charges against the SST have seemed so foolish to those of us with a partisan viewpoint in the industry that we have failed to respond appropriately. It was hard to believe anyone could take them seriously. However, obviously they were persuasive and we certainly cannot blame those who have been misled.

Perhaps some of our problem stems from the fact that the leadtime on something as sophisticated and advanced as the SST is such that the average man almost gets tired of hearing about it years before it's ready to fly. This circumstance gives those who are looking for some issue to embrace the time to marshal specious arguments to belittle the importance of the effort. Rather than a program to develop a needed advance in transportation, it becomes just a fast airplane—and who needs that? Indeed, how many men on the street think they need quicker transportation to London, or a communications or weather satellite, or a more efficient merchant vessel? Emotional charges, properly timed, can, and sometimes have, clouded all these issues. This, in short, it seems to me, is what the SST program is up against today.

So, all in all, it's difficult to decide what to say in this context. The facts have been stated time and again and, to my knowledge, not one—not one—sound and defensible objection has been stated by opponents of the program.

In contemplating the approach the industry would take today, it was tempting to speculate on the kind of reception I would receive if I were proposing the SST program for the first time. I wondered what the reaction would be if I proposed that private industry would undertake to build two prototypes of a new mode of transportation 100 times as productive as the DC-3, four times as productive as a 707 or DC-8 and twice as productive as the giant Boeing 747, a new kind of transportation that would have far less effect on the environment than any other envisioned so that its use would actually reduce total air and noise pollution. And, finally, that the taxpayers were to have an opportunity to invest in the program so that, in the long term, it would be a direct benefit to the taxpayer instead of an expenditure.

#### IMPACT ON THE ECONOMY

I would go on to explain its favorable impact on the economy of the United States, an impact of several tens of billions of dollars by 1990. I would point out that productivity of any means of transportation is a product of capacity and speed and that only by moving on to supersonic aircraft could we keep long-distance travel within the means of the many. I would explain the tremendous significance of maintaining this Nation's technological momentum, its leadership—and the fact that once the flow of scientific and technological advance is turned off, it is difficult indeed to turn it back on again. The knowledge and teamwork that goes into one end of the R. & D. pipeline sometimes doesn't come out the other end, where it can be used, for many years. If we shut off the input valve, that empty space in the line will haunt us for decades—perhaps forever. Meanwhile, the flow goes on uninterrupted in the R. & D. pipelines of our competitors.

I'm sure that such a new and challenging proposal would get further attention when I pointed out that, in addition to its crucial role in the balance of payments, the program would generate some \$6.7 billion in Federal and State tax revenues, and \$2.4 billion through direct royalty payments—that this is some \$1 billion more than the Government's investment—that some 50,000 persons would be employed directly in the program and another 100,000 indirectly.

It is hard for me to believe, Mr. Chairman, that such a proposal wouldn't be received enthusiastically.

#### ENVIRONMENT

Most of the emotionalism stirred up against this program—and this no longer is true, I suspect, after these hearings, centers on its effect on the environment. The fact that we've been living comfortably for many years with supersonic flights by military aircraft—and this is my apology to you, Congressman Conte—somehow gets lost in the discussion. When I say living comfortably I am not talking about sonic boom. I am talking about environmental effects.

The overwhelming consensus of respected scientific opinion is that the U.S. SST will pollute the atmosphere less than any other known means of transportation—which should be a net benefit as it replaces less advanced aircraft—and only one aspect of its engine noise—the so-called sideline noise—has been a problem up to now, years before the first research prototype is even scheduled to fly. However, even there, the engine manufacturer has just announced some modifications that indicate that the problem already is solved. Of course, you have heard in great detail about the implications of that. All in all, the American SST will be quieter than the jets flying today.

Those who value a continuing search for knowledge and support the SST prototype program have been scrupulously candid about the knowns and unknowns of the aircraft. I make this point because I think it is a very important one. I heard Mr. Magruder testify for 2½ days as I have heard him speak before. I have heard and seen statements and used material from statements by others who are involved in the program or who are supporting it and I would say the degree of candor and scrupulous candor about the limitations, the knowns and unknowns, has been a very important element in our ability to proceed on the basis we have been. Opponents tend to jump on admissions of limitations or admissions of unknown areas and argue that we should not proceed until the answers are known. But that is exactly the approach we are taking—the building of two prototypes, so that the last vestige of doubt about the most trivial problem can be swept away to the complete satisfaction of all. This is not a new program. If you measure it from the date of President Kennedy's announcement in Colorado it is 8 years old. But frenzied opposition to it has developed only recently, fed by catchwords on priorities and ecology. The decision to take this next major step in air transportation was made in 1963 by President Kennedy. Since supersonic commercial travel would require development of a new technology, the very sound decision was made to develop two test prototypes to make sure that the aircraft would be economically and environmentally acceptable, before deciding whether to produce such aircraft

in volume. Both the economics and importance of the project were such that the Kennedy administration and the Congress felt it was essential and in the national interest to invest Government funds in the program along with those of private industry. This sensible approach has been endorsed by every administration since 1963, and despite some filibustering of the Senate late last year, by every Congress.

#### PROTOTYPE PROGRAM

The point is the program to build the two test airplanes is on its way to completion. We are almost in the last quarter. And those who wish to abandon it now we suggest are not supported by logic or are engaging in myth and fantasy.

If they seek to save money, they overlook the fact that we are so near completion of the prototype program that the cost of going ahead is about the same as the cost of stopping.

If they seek to divert the Government's investment to social needs, it seems odd that they would do so at the expense of a program that will benefit our balance of payments, provide jobs, improve commerce, generate new taxes, and, in fact, generate income from which social needs can be subsidized.

If they wish to protect the environment, it seems odd that they would wish to stop a program designed to insure environmental safety in transportation.

If they have serious questions about any of these concerns, they should seek answers in hard-headed research and that is exactly what this program is—a research program in that context.

If they seek to delay the program until all the unknowns are solved, then they are wrong on two counts.

First, the program itself is a research program; if we delay the program we delay the acquisition of new and helpful knowledge.

Second, this is not a program we can safely defer. We are working toward meeting the transportation needs of the 1980's and the 1990's. Only the productivity of a good SST can best handle that projected market. The world's airlines want and will need the SST and they have invested some \$60 million in risk capital and some \$22 million for delivery positions for the U.S. SST alone.

The need can be foreseen. The market will not wait. The British, French, and the Soviets are already flying SST's. If our prototype program falters, we will lose the market; we will miss that critical point in time when airlines will have to buy someone's SST in order to meet transportation needs at a reasonable cost. We simply cannot put off until tomorrow what should be done today.

This is a point I want to make in my position as President of the Aerospace Industries Association, which, as you will recognize, embraces other important areas of interest besides commercial aviation. I think it is a key point.

You can defer a defense program. You can say, "We will take a little more risk. To save money we'll slow down." The writeoff would be whatever the intangible valuation by the Government is of the risk. You can do the same thing with the space program. With supersonic transport you can't do that, because its success or failure depends on its coming on the market at the right time and if it is deferred, significantly deferred, you lose the market and you lose the

very economic benefits that were the basis for your economic projection when you went ahead. All these things are obvious. All these things can be demonstrated. All of them have been said and said again and again.

I am somewhat bewildered when people say they want to prevent supersonic flight; it is far too late for that. The Soviet TU-144 and the British/French Concorde are in existence and they will go into commercial service whether or not the United States builds a competitive aircraft. The fact is that acceptance of the U.S. aircraft, built with strict regard for environmental impact, is far better from the ecological viewpoint than the widespread use of these less advanced foreign airplanes. I am afraid I do not understand the opposition on this point.

#### VENTURE CAPITAL

Mr. Chairman, the Government is asking the people of the United States to put up some venture capital—not a subsidy but venture capital—for what it feels is a most excellent investment in the future. The industry has given responsible answers to all questions and will continue to do so. And we hardly know what more to say to get that across. For that reason, I am making a relatively brief statement in the hope the committee will ask the questions it has in mind.

I have always believed strongly in the fact that the American people want to do the right thing and that if they are given the facts they will reach sound decisions. They have been given the facts but they have also been given a barrage of emotional nonsense in opposition. In time, I am sure all the people will applaud the SST, just as they would later condemn those responsible if the program is halted. But we have very little time. A highly technical program such as this cannot be turned on and off at will without terrible costs in progress, time, and money.

The issue is a simple and narrow one. Given the fact that within a very short time the British, French, and Russians are going to have in operation, available for delivery to the world's airlines, equipment which will set the pace for air transportation over at least the next 25 years, should the United States now invest the final relatively small increment of development cost to satisfy itself as to whether or not it wishes to participate in this major element of future air transportation or abandon it to other nations.

That is the sole issue now before the Congress. We submit that, so viewed, the facts overwhelmingly dictate proceeding as planned.

Mr. McFALL. Dr. Harr, we thank you very much for a very fine statement. I would make one comment to you. Those who sat through all these hearings and drew the conclusion you stated, that a number of the doubts about the program have been allayed, may be right, but I think you must understand that there are relatively few people that have heard all of this testimony.

We had television coverage, but it really only covered the fact that we were here and we were having open hearings. I will agree that with the help of Mr. Yates and every other member of the committee, we have had a very fine discussion of all the issues. I hope that many of the doubts, suspicions, and fears have been allayed.

Dr. Harr, do you feel that a U.S. SST is inevitable?

Mr. HARR. I think the answer to that, Mr. Chairman, is that it has a timing basis. I think somewhere down the road, yes. I think it is absolutely essential if we are going to have it in the first generation of supersonic transports to move on it now. Inevitable is a word I find a little difficult to answer in a single sense. The world is going to have supersonic transports. If the United States does not have one, the United States will pay a terrible price down the road technologically and economically over the years. I can't really sit here and say it is inevitable now, because it could very easily be ended now, Congressman.

#### ABILITY OF PRIVATE INDUSTRY TO CONTINUE RESEARCH AND DEVELOPMENT

Mr. McFALL. Do you think private industry would continue the research and development program to produce and sell an SST, if the Government would completely withdraw from the program?

Mr. HARR. No, sir.

Mr. YATES. Why not?

Mr. HARR. It is too expensive.

#### COSTS OF PHASES 4 AND 5

Mr. McFALL. If the Government continues with the research program and a successful prototype is developed, what do you estimate the cost of phases 4 and 5 would be?

Mr. HARR. I would agree with the figures that Mr. Magruder has given on that, about \$700 to \$800 million in phase 4, to two and a half—

Mr. McFALL. Do you think private industry will be able to finance those phases?

Mr. HARR. We are counting on it very heavily. We have a lot of good reasons to support that.

Mr. McFALL. Are there any questions on this side?

Mr. BOLAND. It would almost seem to me, Doctor, that if the Government stopped the program right now, that industry would be likely to go ahead with it. By so doing, they would be able to get off of the hook of paying some \$1 billion that the Government has invested in this research and development program. We only have about \$300 million more to go. I would think that Boeing and GE would love to get off the hook. They could probably go ahead with the financing of the R. & D., the flight testing of 100 hours and then they would be on their way into production. You will have a great machine, one of the finest machines that will ever have been built. But my position is that we have spent so much in this program now, we are practically up to the \$1 billion mark, that if we get out of it, with all of the penalties, we will have lost all of that. It will all go down the drain. The taxpayers will have lost everything.

Mr. HARR. The Government would pay a quick, immediate price as well as a long-range price if you canceled the program. I was saying for the private manufacturer to try to carry the rest of the research and development program through the prototype phase would not be done, I would think.

Mr. BOLAND. After fiscal 1972, you will only need about \$300 to \$350 million. As I say, I think it would be a bonanza for the people

who are involved in this program to take over the completion of the R. & D.

Mr. HARR. I can't speak for any particular company on this, you understand, Mr. Boland.

Mr. BOLAND. That is just an observation. I can understand the Aerospace's concern. I am delighted to know this, and I do agree that I don't think those who are involved in support of the program are doing as much as the opposition has done to advance the cause of the program. But now you are doing it, and the public is going to be better alerted because of the positions that your organization and others are taking, and I compliment you for it.

Mr. McFALL. Mr. Conte.

Mr. CONTE. I think every question and every answer has been said here for 4 days. No, thank you.

Mr. McFALL. Mr. Yates.

#### POTENTIAL MARKET FOR THE SST

Mr. YATES. I should like to ask the doctor a question, with due apologies and respect to Mr. Conte. Dr. Harr, statistics tell us that 1 percent of the American people have flown, only about 1 percent of the 200 million American people have used the airlines. Mr. Tipton can correct me if I am wrong.

Mr. HARR. I think he will.

Mr. TIPTON. Yes, sir, he will.

Mr. YATES. Is it 10 percent?

Mr. HARR. 50 percent.

Mr. YATES. Fifty percent of Americans have flown?

Mr. HARR. Yes.

Mr. YATES. The statistics I have seen weren't correct then. Only 10 percent of American air travelers fly internationally; is that correct, Mr. Tipton?

Mr. TIPTON. Yes, approximately.

(The following information was subsequently supplied for the record:)

In 1969, 7.2 percent of U.S. adult population (18 years and over) representing more than 9 million people indicated that they had taken an overseas trip by air in the preceding 5 years. (This includes air travel on scheduled and charter services.)

Mr. YATES. Ninety percent of American travelers fly domestically. The SST is not intended for domestic use, but for international use, and therefore, presumably will serve the 10 percent who want to fly internationally.

Secondly, the statistics that I have seen from the Civil Aeronautics Board indicate that a small fraction of the American people who fly internationally fly first class, a very tiny fraction. The SST, we are told, will fly with a surcharge. Every poll in the country that I have seen indicates the American people don't want the Government to subsidize the SST. Why then should the Congress approve it?

Mr. HARR. Can I answer in about five different ways? I would have to dispute your statistics from the point of view of our position quite seriously, but I think Mr. Tipton, who is in the operating business, has the statistics.

Mr. YATES. He is agreeing on the percentages of international travel, aren't you?

Mr. TIPTON. Yes, approximately 16 million people use the international service.

Mr. YATES. That is still 10 percent. Go ahead.

Mr. HARR. We are talking about the premium business. People paid a premium initially, you will recall, when there were both jet and piston aircraft in the same fleets. They paid a premium to fly jet for a while. The concept of a premium on the Concorde, for instance, is to protect the still-flying nonsupersonic aircraft in the fleet, assuming a preference for the timesaving involved in the higher speed.

The economic projections on the supersonic transport are not based on premium.

Mr. YATES. Another way of projecting your subsonics is by increasing their fare, isn't it, so that the differential isn't as great, and isn't this likely to happen?

Mr. HARR. I don't think so, sir. I think the whole justification for any upgrading, quantum upgrading of productivity capacity of a means of transportation, is that in increasing the productivity you maintain lower costs and lower prices. That is exactly the history of our aviation.

Congressman Yates, I have listened to quite a lot of details on this, and interesting and informative ones, as far as I was concerned; but the fact is that if the projections—that is all you can do is make the most sound, intelligent projections you can make—if the projections of the airlines, who will have to put up the money, of the manufacturers, of the Government in the program, are anywhere near accurate, you will have a fleet of aircraft flying in the world, a world fleet of aircraft in the 1985 era, in which supersonic aircraft, both ours and foreign ones, will comprise a very major portion, something like over 1,000 aircraft out of perhaps a fleet of 4,000 or 5,000.

Mr. YATES. That is 1985.

Mr. HARR. That is the era we are talking about.

Mr. YATES. Their prediction last year of what the traffic would be this year wasn't very accurate; was it?

Mr. McFALL. Let's hope this this doesn't go on for 8 years.

#### GOVERNMENT FINANCING BEYOND THE PROTOTYPE PROGRAM

Mr. YATES. One last question, Mr. Chairman.

You said that the aerospace industry could not afford presently to complete the prototype program, and you favor the Government subsidizing it. Suppose after the prototype program is completed there are not private investors who are willing to invest their money to produce the planes that will fly. Would you favor Government subsidization?

Mr. HARR. No, sir.

Mr. YATES. You would not?

Mr. HARR. No, sir. I will have to say this though for the record, if I may. The word "subsidization" goes down awfully hard for me in terms of this program. My concept of a subsidy hasn't been one in which there is a formula for return of investment plus interest.

Mr. YATES. Your statement indicates that the United States is going to come out even with the sale of 300 planes.

Mr. HARR. That is right, sir.

Mr. YATES. And make a profit of \$1 billion with the sale of 500 planes.

Mr. HARR. That is right.

Mr. YATES. How much will Boeing make?

Mr. HARR. I don't know.

Mr. YATES. Somebody has computed that Boeing's profit would be something like \$6.5 billion at that point.

Mr. HARR. I can't believe that.

Mr. YATES. I don't know whether that is true. Perhaps I shouldn't have mentioned that, but this was in a statement I saw in the Congressional Record.

Mr. McFALL. If we are going to get 50 percent of that, that is a pretty good deal.

Mr. YATES. We don't get 50 percent. How do we get 50 percent of it?

Mr. McFALL. Taxes.

Mr. YATES. I would suspect, Mr. Chairman, you will find that depreciation writeoffs and a number of other things will siphon off a great deal of income before anything finally gets into the Treasury.

Thank you very much, Dr. Harr.

Mr. McFALL. Thank you, Dr. Harr.

Mr. HARR. Thank you, Mr. Chairman.

Mr. McFALL. Mr. Tipton, you have been very patient.

STATEMENT OF STUART G. TIPTON, PRESIDENT, AIR TRANSPORT  
ASSOCIATION

Mr. TIPTON. Mr. Chairman and members of the committee: Before I start I would like to introduce Gen. Clifton von Kann, vice president, operations engineering of the Air Transport Association, who sits on my left.

I want to say at the outset that I think these hearings have been the best thing on the supersonic transport, and about the best thing I have seen done on any subject. I think your committee is to be congratulated on having done it, and I want to express our appreciation for your concern with the problem.

I would like to suggest this, Mr. Chairman, because the hour is getting late, that you receive my full statement in the record. I will read three or four paragraphs of it, and then touch on the very essential elements of the airline position. Then if I miss anything, the committee can extract it from me easily in questions.

My name is Stuart G. Tipton. I am president of the Air Transport Association of America, the trade and service organization representing virtually all the scheduled airlines of the United States.

Association members include the domestic trunks, the U.S. international airlines, the local service airlines, and Hawaiian, Alaskan and all-cargo air carriers which, together, form the backbone of the country's air transport system.

I will speak in support of the appropriation for an American SST, but I will not try to cover the full scope of the argument for it. Since I represent airlines, I will restrict my discussion to their interest in the program. Others have covered the more wide ranging effects of the decision to build or not build an American SST.

Our interests are clear and fairly simple. During this decade we

must acquire a large number of supersonic aircraft and operate them over the farflung international routes of the world. We would like to continue to operate American-built machines for several reasons:

(1) No other country can produce such reliable and economical aircraft as the United States.

(2) Our manufacturers can support us through spares and engineering service better than a European manufacturer can.

I think that is as concise a statement I can make of the airline interests and the airline position.

#### COMPETITIVE THREAT OF THE CONCORDE

We believe the Concorde will be produced, that it will be sold to the airlines of the world and that it will operate into the United States. We must act on the assumption that this will happen, if we wish to survive in the fiercely competitive international air travel market. If we were to assume that the Concorde would not be built and then later find that it is being built and foreign airlines are buying it, we would suffer a serious financial setback. If a U.S.-flag carrier failed to protect itself by buying aircraft with performance, safety, efficiency and service comparable to that equipment used by its competitors, the airline would be relegated to offering what amounts to a second-class service. Here are some examples:

New York-London: The U.S.-flag carriers would be offering 6½ hour flight by 747, in competition with 3 hours, 20 minutes by Concorde.

Los Angeles-Sydney, Australia: the U.S.-flag airlines would be offering a total time of 17 hours, 45 minutes by subsonic jet, against 9 hours, 35 minutes by Concorde. Both of these are total trip times, with two en route stops of 1 hour each.

Los Angeles-Tokyo: the U.S.-flag carriers would be offering subsonic jet service taking a total of 13 hours and 50 minutes with one en route stop. By contrast, the Concorde operators would be offering a trip of only 7 hours with the same stop en route.

No amount of sales effort can overcome the diversion of passengers from the slower jets to the faster SST's.

It will suffer very badly in competition with other carriers. It would be operating what we would have to regard as a second-class service, because of these flight times that I will just mention. We would be offering a service, 6½ hours, New York-London in competition with 3 hours and 20 minutes by the Concorde. Los Angeles-Sydney, Australia we would be offering 17 hours, 45 minutes against 9 hours, 35 minutes.

I think it is perfectly clear, based upon all the experience we have ever had, going back since the beginning of the industry, that the U.S.-flag airlines would lose out in competition, if they sought to avoid the acquisition of the available supersonic transport.

There has been some discussion that we have heard. There is a way by which the United States, by restrictive legislation, could keep a supersonic transport from serving the United States. We think that that kind of an effort to stop progress in the aviation field is quite unrealistic. It will not work. You can serve the United States from nearby ports of entry. We will meet the airplane on routes that don't touch

the United States. We will have to deal with those problems in those places.

Finally, such a restriction is contrary to the letter and spirit of the Chicago convention, so that we really anticipate the elimination of the Concorde from competition by action by the United States.

I think that we will be operating the Concorde for several years, before the American SST can be available. The very fact that the U.S. carriers will be in the supersonic transport business, with an airplane not nearly as efficient as can be built, places heavy emphasis on the necessity for going forward with the American supersonic program. The air transport industry is strongly in favor of that program.

I think that the emphasis must be laid here on two major factors, as far as the airlines are concerned and as far as the development of the American program is concerned. Our experience in rising productivity of aircraft has demonstrated the tremendous impact that productivity of an airplane can have on your ability to operate a good service, a better service at a price equal to or less than the price being available in slower airplanes, and I would just ask you to check on page 6 of my statement the experience the industry has had with respect to increasing productivity, winding up with the 747 at 2 million seat miles a day, the Concorde about the same, but with the American SST providing a really quantum leap in productivity, something that will permit us, as this airplane goes into service, and conducts its operation, an ability again to hold our prices down over the long term.

#### INCREASED PRODUCTIVITY

I think as far as productivity and its impact on airline operations is concerned, it is most dramatically illustrated—there are many examples in this statement of mine, but it is most dramatically illustrated—by our experience with the jet. When we put jets on the line in the 1960 era, our available ton-mile costs were 29.9 cents. That was in 1959. In 1968, our available ton-mile costs were 19.5 cents, a drop of 10 cents an available ton-mile in that period. During that period, as all of us very well know, the costs of everything else were going up. Our available ton-mile costs are going back up again now because our costs are going up. We have no additional surge of productivity that we can throw in.

#### FINANCING

Turning to the question of financing of this airplane by the Government, and that is obviously a major issue, whether the United States should continue to contribute to financing, we strongly support that continued effort, and emphasize the fact that this is not a new role for the Federal Government in terms of the development of transport airplanes. Virtually all the transport airplanes we have ever had have been based upon technology developed at Government expense for military craft. That was true of our DC-6 and the Constellation. It is true of the Boeing 707. Even the Boeing 747 has benefited from technology and financial contribution made by the U.S. Government.

Now financing of the production of these aircraft as far as airlines are concerned. We are in no position to contribute with respect to the

ability of manufacturers to finance the production. As far as airlines are concerned, as we look down the road to about the middle of this decade, when we will begin to have the necessity of financing the purchase of the Concorde and financing the purchase of the American SST, our forecasts are for very considerably improved financial position from the standpoint of the airlines.

Just to state it briefly, we would expect that by 1975, our gross will be something in the neighborhood of \$14 billion as an industry, that our earnings and depreciation taken together, which is the pool of money available to support financing of any equipment, would be about double the available funds experienced last year. The available funds experienced last year were entirely in depreciation. We had an actual net loss. However, we would expect during that period that through increases in volume, and improvements in our general financial situation, that we can finance these airplanes.

#### SHORT HAUL SERVICE

Mr. CONTE. I hope that you won't raise the fare so much that you make it prohibitive for us to travel. I remember using that Eastern shuttle. It used to cost \$15 and now it is \$27, with lousy service. I hope they are not doing this to buy 747's.

Mr. TIPTON. They are doing it to try to get back the costs of short haul service. Our short haul fares have gone up.

Mr. CONTE. They sure have.

Mr. TIPTON. Providing a short haul service is expensive.

Mr. YATES. It is the only short haul that gets the passengers today, isn't it.

Mr. CONTE. Yes, but I get whacked in the head because I have to use it every weekend.

Mr. TIPTON. That is right. I recognize that. We all recognize that. In the short haul areas our fares have gone up very substantially. In the long haul area they have not. Actually our total fares are less than they were, for example, in 1962. I think they are going to have to have to go up again, and they will have to go up this spring.

Mr. YATES. You are not contending to Mr. Conte that the shuttle service is not a profitable line?

Mr. TIPTON. In order to keep it profitable, it has been necessary to raise the fares.

Mr. YATES. I think probably his shuttle service pays for other short haul services, and possibly for some of the long haul service today.

Mr. CONTE. Those Miami runs, and all that jazz.

Mr. YATES. That is right, sir.

Mr. CONTE. For working guys like me, we are hit right on the head. They ought to take care of those vacationers down here.

Mr. McFALL. Let's not lose sight of our immediate objective. Go ahead.

#### ENVIRONMENTAL ISSUES

Mr. TIPTON. A final word on the environmental issue. It has been so fully covered here, and I won't try to fully cover it. Obviously airlines are deeply interested in the environmental impact of their air-

planes. We have been greatly encouraged by the testimony we have heard today as to the effect of the work in those areas that has already been done. It gives us even greater faith in the success of this program, and a greater support for the American SST.

Mr. Chairman, that covers, I am sure unduly briefly, but it covers the essence I believe of the testimony presented in my statement.

PREPARED STATEMENT OF STUART G. TIPTON

Mr. McFALL. We shall include the complete text of your prepared statement at this point in the record.

(The statement follows:)

**Statement of Stuart G. Tipton, President  
The Air Transport Association of America  
Before the Subcommittee on Transportation  
of the House Appropriations Committee  
March 3, 1971**

My name is Stuart G. Tipton. I am President of the Air Transport Association of America, the trade and service organization representing virtually all the scheduled airlines of the United States.

Association members include the domestic trunks, the U.S. international airlines, the local service airlines, and Hawaiian, Alaskan and all-cargo air carriers which, together, form the backbone of the country's air transport system.

I will speak in support of the appropriation for an American SST, but I will not try to cover the full scope of the argument for it. Since I represent airlines, I will restrict my discussion to their interest in the program. Others have covered the more wide ranging effects of the decision to build or not build an American SST.

Our interests are clear and fairly simple. During this decade we must acquire a large number of supersonic aircraft and operate them over the far flung international routes of the world. We would like to continue to operate American built machines for several reasons:

- (1) No other country can produce such reliable and economical aircraft as the U.S.
- (2) Our manufacturers can support us through spares and engineering service better than a European manufacturer can.

(3) Our investments will be very large and we would like to have them support the American economy, of which we are a part.

Whether or not an American SST is built, there will be supersonic transports operating on the world's air routes. Two different supersonic transports have already been built: the TU-144, which is Russia's bid for the world's commercial airliner market, and the Anglo-French Concorde. Two prototypes of the Concorde are already flying at speeds of Mach 2. These test flights have built a solid technical basis for production by demonstrating that the aircraft will meet its performance goals. Beginning this summer, you can expect the airlines and the manufacturer to be working out details concerning fares, daily utilization and design features for passenger appeal. All of these steps are part of the process that leads up to a firm contract for production aircraft.

We believe the Concorde will be produced, that it will be sold to the airlines of the world and that it will operate into the United States. We must act on the assumption that this will happen. If we wish to survive in the fiercely competitive international air travel market. If we were to assume that the Concorde would not be built and then later find that it is being built and foreign airlines are buying it, we would suffer a serious financial setback. If a U.S. flag carrier failed to protect itself by buying aircraft with performance, safety, efficiency and service comparable to that equipment used by its competitors, the airline would be relegated to offering what amounts to a second class service.

Here are some examples:

New York - London: the U.S. flag carriers would be offering a 6 1/2 hour flight by 747, in competition with 3 hours, 20 minutes by Concorde.

Los Angeles - Sydney, Australia: the U.S. flag airlines would be offering a total time of 17 hours, 45 minutes by subsonic jet, against 9 hours, 35 minutes by Concorde. Both of these are total trip times, with two enroute stops of one hour each.

Los Angeles - Tokyo: the U.S. flag carriers would be offering subsonic jet service taking a total of 13 hours and 50 minutes with one enroute stop. By contrast, the Concorde operators would be offering a trip of only 7 hours with the same stop enroute.

No amount of sales effort can overcome the diversion of passengers from the slower jets to the faster SSTs. The history of commercial aviation demonstrates beyond any doubt that the travelling public will always seek the fastest, most efficient service and will even pay a premium for the best service.

A carrier that does not acquire new technology aircraft when its competitors have done so will pay a severe penalty. The airline operating the new technology aircraft will attract passengers, increasing its share of the market at the expense of those competitors not operating the new equipment. For carriers without the new equipment, the resultant loss in share of market will adversely affect their financial position. Even a substantial delay in acquiring new technology aircraft will create an adverse financial situation

for an airline.

There has been some talk of adopting "it can't come in here" restrictions to bar SSTs from landing or taking off at certain U. S. airports, apparently on the theory that these restrictions might stop the airplane from being built and operated by the airlines. This kind of effort to stop progress is patently unrealistic. First of all, it cannot prevent SST operations from nearby gateways, such as Montreal. Secondly, even if the United States should succeed in keeping the SST out of American airports, we will still be meeting it and competing with it on the rest of the world's air routes. Finally, such restrictions are contrary to the letter and spirit of the Chicago Convention (Article IX) - the treaty that has made possible the growth of air commerce throughout the world over the past 25 years.

Any nation that seeks to impose operating restrictions on a specific aircraft type would unleash a chain reaction of retaliatory restrictions. The impact of this wave of new restrictions would fall most heavily upon the U.S. flag carriers because of their extensive global network of air routes. The past 25 years of growth of worldwide air service by U.S. flag carriers is based, in large part, on the freedoms provided by the Chicago Convention and efforts of the United States to protect these freedoms against attempts by other governments to impose restrictions. If the U.S. begins imposing restrictions, it is likely to set in motion forces that will profoundly alter the air commerce of the world - to the disadvantage of the U.S. flag airlines.

International competition on the air routes of the world is severe. The foreign carriers we compete with are financially backed, and in most cases owned, by their governments. In effect, we are competing with the governments through whose territories we operate. This requires us to stay ahead of our competition in terms of speed, convenience, safety and efficiency of our service.

The competitive threat of the Concorde compels the U.S. flag carriers to act to preserve their share of the market. Because of the lead time on delivery, a carrier has to act soon, in order to protect its share of market during the second half of the 1970s. We are compelled to buy the Concorde for short term survival, as we enter the era of supersonic air travel. Over the longer term, however, we look toward the second generation SST as the aircraft that will truly unlock the potential for greater productivity inherent in supersonic flight. It could be a follow-on Mach 3 Concorde, or the U.S. SST. We want an American machine, as I have stated earlier, because we believe it will be a better machine and because it will be better for the U.S. economy.

I would like to discuss the potential for greater productivity that is inherent in supersonic flight, because it is so very vital to the airline industry's fight to preserve the airline ticket as the best travel bargain available to the American people. In 1950, the average cost of air travel was 5.9 cents per passenger mile. In 1970, even after domestic fare increases of a little more

than 12 per cent over the previous two years, the average cost to the air traveller was still only about 5.9 cents per passenger mile.

During the same 20 year period, the cost of living has risen 50 per cent! The price of new cars has climbed 25 per cent, food nearly 50 per cent and rent about 55 per cent. The price of medical care has more than doubled.

The air transport industry has demonstrated a unique ability to hold down prices to the public for so long, in the face of inflation and rising costs. These costs have grown tremendously over this period and they are still rising. Labor costs, which account for nearly 50 per cent of airline cash operating costs, are a good example. Since 1950, labor costs to the airlines have tripled: the average salary per employee of the U.S. scheduled airlines for 1970 was \$12,000 - up from \$4,000 in 1950.

Aircraft costs have also risen, but in this case, a large part of the increased cost has gone to pay for higher speed and greater capacity. The investment in new aircraft has been an investment in productivity, or the amount of work an airplane can do per unit of time. A few examples will show the dramatic increases in productivity brought about by new equipment:

<u>Year of Introduction</u>	<u>Aircraft</u>	<u>Cost</u>	<u>Seat Miles Per Day</u>
1936	DC-3	\$100,000	28,000
1947	DC-6	\$600,000	138,000
1958	707	\$5,000,000	525,000
1970	747	\$22,000,000	2,000,000
1974-5	Concorde	\$25,000,000	2,000,000

When the U.S. SST is brought into service in the late 1970s, it will produce 3,500,000 seat miles per day, a 75 per cent increase over the productivity of the Boeing 747.

Just how well increased productivity has held down costs is shown by the trend in operating expense per available ton mile - operating expense being all operating costs, including wages, that go into moving the total plane load of passengers and cargo.

In 1947 when the DC-6 and Lockheed 749 Constellation first joined the airline fleet, the U.S. scheduled airlines had an operating expense of 35.8 cents per available ton mile. This declined to 28.4 cents in 1955 and then started back upwards. The upward trend continued until 1960 when the influx of jets began to turn the figure down from a high of 29.9 cents in 1959.

As jets replaced piston-powered aircraft on both long and short haul routes, operating expenses per available ton mile continued to decline until they bottomed out at 19.5 cents in 1968. The trend has been rising since then. Although the wide body jets will help slow this rise, the only way to prevent a sharp upswing in costs is with a major increase in productivity by the use of an SST.

As the airlines stand poised on the point of entering into the age of supersonic air travel, they face a situation quite similar to what they faced in the pre-jet era of the mid-50s. Then, as now, the opportunities for increasing productivity through improvements to the current aircraft types

have been virtually exhausted. The only hope for a significant increase in productivity lay in moving on to a new type of aircraft - then the jet transport, now the SST. Then as now, there were those who doubted the industry could afford, or that the airports could handle, the new aircraft.

The record is clear that without the introduction of the jets the average airline ticket price would have risen. Without the jets it is doubtful the airlines would have been able to introduce promotional fares such as youth, military, Discover Amercia, and family plan. If the jets had not been bought and put into service and the price of air travel had risen since 1960 only as much as the consumer price index, the average price to the air traveller would have been 7.9 cents per passenger mile in 1970 - instead of the actual jet-age price of 5.9 cents. Without the introduction of the SST, airline ticket prices will eventually rise far above the fare increases currently being foreseen.

If the U.S. does not enter this aircraft market, we will be leaving the field to the Concorde. Then there will just be one free world supersonic transport. This is bound to put us at a distinct disadvantage. When there are two or more suppliers, they create a healthy competitive climate which encourages the development and production of the highest quality aircraft at the most reasonable price. Competition also spurs the development of aircraft and engines that minimize noise and air pollution. Just as we believe that competition on the air routes brings the passenger the best

service. so we believe that competition among manufacturers is necessary to provide us with the best possible equipment so that we can continue to offer the travelling public the highest quality of service without serious degradation of the environment.

Let us turn now to the question of financing. The spending of government funds for development of the U. S. SST has been called a subsidy for the manufacturer, the airlines and the very few people who are presumed to want to cut their travel time in half, if offered the opportunity to do so. This simply is not true. The funds supplied by the Federal Government for the SST development are an investment in the technology needed to provide the increased productivity I have just described.

This is not a new role for the Federal Government: in the past, it has invested in the technology needed to increase productivity, largely by the development of the military aircraft from which civil air transports were derived. For example, the World War II C-118 and C-121 developments ushered in the post-war DC-6 and 749 Constellation. The first commercial jet, the Boeing 707, represented the commercial application of technology developed by and for the military, including both the B-47 and B-52 jet bombers. Even the Boeing 747 is based in part on government-funded development, because this first commercial wide body jet used technology developed by Boeing in a Government-reimbursed program

definition and design competition effort connected with the C-5 military transport competition.

What is different about the U.S. SST program is that the Federal Government's investment is to be repaid on a royalty basis, by the sale of production aircraft. No other investment in new technology - communications satellites are one example - has carried this payback feature.

We anticipate that SST financing will be available to the airline industry in the next several years, both for advance deposits and for final purchase payments of the aircraft. By the mid-1970s, when advance deposits may be required for the U.S. SST, the industry should be in a much better financial condition than exists today.

Except in a few situations, the airlines have generally arranged funds for their tremendous capital additions; however, this financing has not been easy to arrange, especially at reasonable costs during recent years. Our present financing problems result from a peak financing requirement during a downswing in economic activity accompanied by tremendous inflationary pressures.

The long-range picture is much brighter. With a recovery of the economy in 1971 and subsequent years, along with tighter cost controls and certain fare adjustments, we anticipate that airline earnings will begin to improve and thus substantial internally generated funds - provided by earnings, depreciation and deferred taxes - will be available for future capital requirements.

Additionally, higher earnings should improve the equity market situation and thereby permit favorable equity offerings.

By the middle of this decade operating revenues for the twelve major airlines could well be running at an annual rate of \$14 billion compared to \$8 billion in 1970. Also by this time it is not unrealistic to foresee earnings and depreciation amounting to more than double the \$700 million experienced last year.

With an improved cash flow situation, provided through increases in internally generated sources of funds as well as through the equity market, the balance of the SST financing should be available through normal debt and leasing markets.

Before closing, I should like to comment on the public's concern over possible effects of the SST on our environment. Let me say that we are not aware of any scientific data conclusively proving any of the adverse environmental effects charged against the SST. Rather, the public concern appears to be based largely on speculation about the possibility of adverse effects, in areas where not enough information is available to reach a definite conclusion. These uncertainties need to be faced, investigated, and resolved. We believe it is wrong, however, to use these uncertainties as reasons against proceeding with the prototype aircraft.

We are confident that the technological genius of this nation can resolve these uncertainties and find ways to make whatever changes may prove to be

necessary before production begins. One concrete example of this is the recent announcement of technological improvements that will bring the sideline noise of a U.S. SST within the 108 EPNDb limit set for all new subsonic jets.

For all these reasons, Mr. Chairman, the airlines support the appropriation of funds requested for the development and testing of two prototypes of the Boeing 2707 supersonic transport.

The question before this nation is not whether there will be supersonic air travel in the next decade. That is assured by the existence of prototypes of two different model SSTs already flying. Either or both of these will ultimately see service on the world's major air routes. The issue before this nation at this time is simply whether there will be an American SST, meeting American standards for preserving the environment, and providing jobs for American families, or whether the age of supersonic travel will provide jobs only in Britain, France and Russia - paid for in part with the U.S. dollars that buy airline tickets for American travellers.

## AIRLINE INTEREST IN SST

Mr. McFALL. Let me ask you two brief questions about some of the previous testimony that we had.

It has been stated the airlines do not want an SST, per se, they want one only if other airlines also have one, either a Concorde or a U.S. SST. To what extent is this true? How interested are the airlines in the SST?

Mr. TIPTON. The airlines are deeply interested in a SST. I have discussed this in detail with the presidents or the purchasers of the Concorde, and the American SST. They want the airplane. They particularly want the American plane. I think I have explained here the necessity of acquiring the Concorde because we need it to meet competition, but we particularly need the second generation SST that is coming up now.

Mr. McFALL. Yesterday in his prepared statement, Congressman Reuss of Wisconsin, quoted Robert Six, President of Continental Airlines as stating, "I don't think there is a rush for the SST". He also quoted former FAA head, General Elwood Quesada as saying, "There are a lot of people that say that the airlines wish the airplane would go away and I am one of them."

Would you comment on these statements?

Mr. TIPTON. Yes, sir. On Mr. Six's statement, Mr. Six is a strong supporter of the SST. I think he would agree that the SST has not been rushed, that we started on this program, as I recall, in 1958, the early studies of it. It is likely to go into service in 1978, so I don't think we have rushed. I think that the pace of the program has been a good one.

On General Quesada's comment, I discussed the supersonic subject, needless to say, with General Quesada many times. He also supports the SST concept, the necessity of moving forward in terms of speed and performance. His concern about the SST has been that he has believed, wrongly I think, that it should be financed by private interests, and we have not thought so. We have not thought that it was possible to do that, any more than it was possible for the Concorde to be developed by private interests. The money just was not there. Thus the comments of both of those gentlemen, I don't think, strike at the heart of the American SST program we have here, or in any respect should result in a lack of support for it.

Mr. McFALL. Mr. Boland.

Mr. BOLAND. As you indicate, General Quesada has favored the production of an SST, but he is a little opposed to the Government financing the R. & D. on it. I don't think, however, that he is opposed to the Government jamming Government tenants into L'Enfant Plaza when he has difficulty renting some of the space there.

Mr. TIPTON. I think that this is boiled down in many cases to a question of timing. If we could stand around on one foot and then on the other for another 15 years, it is possible that this would come. We can't stand around on one foot and then on the other on the SST. As far as the airlines are concerned, we will be operating that airplane in 1975, the Concorde.

## U.S. AIRLINES AND THE CONCORDE

Mr. CONTE. How many U.S. airlines have made a definite commitment to purchase the Concorde?

Mr. TIPTON. Can you answer that?

Mr. VON KANN. None have made a definite commitment. There are seven U.S. airlines that have options on the Concorde and will have to commit themselves rather soon.

Mr. CONTE. That option is up at the end of the month, is it, or it is pretty close?

Mr. VON KANN. We will check on that, but it is a matter of weeks or a few months at the most.

Mr. CONTE. Mr. Tipton, you state you don't feel the United States or individual States should outlaw the SST or the Concorde for certain airports, but you certainly wouldn't feel that way if they couldn't meet the current FAA noise level regulations, would you?

Mr. TIPTON. I think those State laws, Mr. Conte, are all invalid, the proposed State laws, by reason of the treatment of this particular issue, what airplanes come to the United States, in a treaty, the Civil Aviation Convention of about 1945 or 1946. In view of the treatment there, it is the U.S. Government, it is the Congress that has to deal with that particular problem, and of course the Congress has dealt with that particular problem, in enacting legislation dealing with certification.

## ECONOMICS OF THE CONCORDE

Mr. CONTE. On page 3, you anticipate that the SST passengers will definitely have to pay a surcharge over subsonic economy or first class fare.

Mr. TIPTON. I think with respect to the Concorde I would expect a surcharge, and if I were running one, I would impose such a charge, because by cutting time in half, you should be able to secure a surcharge, and with no substantial loss of traffic.

With respect to the American SST, it appears from the figures we have now that a surcharge will not be necessary. There again I would hope, however, that surcharges would be imposed for the purpose of having that much speed. It would seem sensible—this is 1978 and it is hard to talk this far in the future—if you are going to maintain both a supersonic and a subsonic pattern of operation, and I think most of our carriers would, a surcharge would be very appropriate for the faster airplane. It not only makes the faster airplane more successful, but protects your subsonic fleet.

Mr. CONTE. You are quite an expert in this field. You have seen the Concorde. The two are very similar. This has 98 seats and the Concorde only has 110 or 112. If I remember correctly there are only two lavatories and no place for a kitchenette. It has two seats on each side, and a very narrow shell. Do you think that plane is going to be economically feasible, outside of France and England? Do you think that will be a feasible plane for PanAm or TWA?

Mr. TIPTON. I think by the time the airplane is finished, at least for sale to U.S.-flag carriers, the amenities involved will be pretty good.

Mr. CONTE. I stated the picture correctly, didn't I?

Mr. TIPTON. As of right now, that is right. I would say that as far as U.S. carriers are concerned, with the surcharge, it will pay for itself in long-range operations. We have done our figuring mostly on the basis of 3,600 miles. Its costs are higher than the 747. There is no doubt about that. You will be able to sell that transportation. You will be able to sell it with great ease, because the speed is going to make all the difference, just as it has made the difference in the past, so that while it is not nearly as economical as the American SST will be, it will carry itself all right.

Mr. CONTE. It is going to be all first class most likely. I don't see how they could divide it off, because there are two seats on each side.

Mr. TIPTON. It has been contemplated in some configurations of the airplane that you would have a very high percentage coach and a few first-class seats which you would make saleable by more distance between the seats. How it will be configured, I won't guess.

Mr. CONTE. I just saw the mock-up. I saw the actual plane.

Mr. TIPTON. That is of course under study now as to how you do configure the airplane for not only passenger comfort, but also to provide a saleable product.

#### IMPACT OF SST ON TRAVELER COST PER PASSENGER MILE

Mr. CONTE. One last question, Mr. Tipton. On page 8, do you have any specifics on what effect the introduction of the SST will have on traveler cost per passenger mile?

Mr. TIPTON. The American SST, by reason of its greater productivity, should ultimately help us get our prices down, or hold our prices in line. It is hard to answer that question in an inflationary period. The productivity should result, as far as the American SST is concerned, in a better break for passengers, either permitting us to get our prices down, or hold inflation in line, as we have with the big jets.

Mr. CONTE. As long as I complained to you about that Eastern Air Lines shuttle fare going up to \$27, let me make one other complaint. They have started to sell booze on the airplane now and they get \$1.50 for one of those little bottles of booze, which I think is scandalous. You do a lot better than some night clubs, where you get a little entertainment.

Mr. TIPTON. My comment on that is that I don't think you would be selling booze on that particular service at all.

Mr. CONTE. I agree with that.

Mr. TIPTON. I think they were doing just fine.

Mr. CONTE. I don't know what possessed them to get into that.

Mr. TIPTON. I know why they got into it. It was because they were competing with another carrier that provided a liquor service. That is what causes competitors to move in some respects. They thought maybe on those evening flights, people going home after a hard day would prefer the other carrier than the shuttle.

Mr. CONTE. I'll bet those poor air hostesses don't appreciate it.

Mr. TIPTON. I'll bet they don't either.

## CONTINUATION OF THE CONCORDE PROGRAM

Mr. YATES. Mr. Tipton, you indicated in your direct testimony that you believe the Concorde will be produced, that American planes will operate it. Do you have better information than does the New York Times, which said in this morning's paper that, "The two Governments which are sharing the costs will decide on March 29 whether the builder should proceed."

Mr. TIPTON. My conclusion on whether the Concorde will be built is based upon this reasoning. I have been hearing, for the past 6 or 7 years, every so often that the British and the French were going to abandon the Concorde. Well, they haven't. They have produced an airplane that they are now flying and have flown extensively.

It seems to me virtually impossible that the two Governments will abandon that project right at the end of it. Sure they are going to meet and talk about it, but they have been meeting and talking about it for a very long time. I have the greatest confidence in the judgment I just expressed. It was a judgment—

Mr. YATES. You say the American companies will buy them and operate them. What if the operating costs of the Concorde are twice those of the 747?

Mr. TIPTON. They might well be. Let me explain why.

If the costs were twice the 747, the airplane would obviously be economically marginal. Nevertheless they would not be able to turn the traffic over to BOAC and Air France, who will surely buy the airplane. Actually the costs as we look at them indicate that the 747 is now running at about what, 2.5?

Mr. VON KANN. No, a little better than that, about 2.2, and we estimate for, say, the New York to Paris run as a comparison, the airline estimates run about 3.3 cents per available seat total operating costs, in other words, about 1½ times that of the 747.

Mr. YATES. I think that nobody would know the projected operating costs of the Concorde better than BOAC. You yourself saw the item, I am sure, in the newspaper that indicated that BOAC stated that the operating costs of the Concorde were going to be twice that of the 747. If as you say American airlines are going to buy the Concorde rather than the 747, knowing that they are going to operate them at twice the operating expense that they could have with the 747, I suggest to you that the American airlines are going to continue to have the same kind of a financial depression that they are in at the present time.

Mr. TIPTON. I think not. It wouldn't be nearly the financial depreciation they had if they got beaten on the North Atlantic, for example. I think the 747 obviously is a greater airplane and a very economical airplane, but the Concorde is going to be twice as fast, and it is going to cut 2½ hours off the trip.

All of our experience has demonstrated that people buy speed, and they buy it in vast numbers, and they are prepared to pay a premium for it. I think that that lesson of experience really is unassailable.

Mr. YATES. You mean there are no members of the public that are willing to pay less fares?

Mr. TIPTON. There will be members of the public.

Mr. YATES. The Concorde will be flying at a premium fare?

Mr. TIPTON. The Concorde will be flying——

Mr. YATES. And the 747 will be flying at costs lower than that of the Concorde, and will be giving its passengers much more comfort than the Concorde, and the airlines will be making much more money with the 747 than with the Concorde, and yet you believe the airlines will buy the Concorde?

Mr. TIPTON. I think they have to. I think they have to to maintain their position in international competition. You can't take a speed differential that great, and remain in effective competition.

#### ECONOMICS OF THE CONCORDE

Mr. YATES. Let's see what Mr. Six, President of Continental Airlines, says about that before the Senate Commerce Committee in response to a question by Senator Inouye and you were probably in the room when he said it.

(The information follows:)

Senator INOUE. It is possible by an act of Congress we will not be able to manufacture an SST, but we notice the British, the French, and the Russians are proceeding. If any of the Big Four decides to carry out their options and purchase the British and French job, would the airline industry be forced to purchase?

Mr. SIX. We all have optioned on the Concorde. That is the French one; I know of no options on the Russian aircraft. The Concorde, Continental was very early in that. We hope in 1973 to have delivery of the Concorde. Technically, in my opinion, the Concorde is a good airplane. I think the economics of it are poor at the present time. It escalated in price from \$13 million to a price unknown today, somewhere between \$20 and \$25 or even more millions. The economics are poor. Based upon present requirements, you can only fly over water in the case of Continental. It would cut the time about in half but you would have to have in the Concorde roughly 120 passengers on all first class superfare and I don't think we have that kind of a market in the Hawaiian market to stand that kind of a fare structure.

Does that indicate that Mr. Six is going to buy a Concorde rather than a 747, in order to fly between Hawaii and the United States?

Mr. TIPTON. I think that he will probably not buy one for operation between the west coast and Hawaii.

Mr. YATES. Yes, which is a logical run, isn't it, for the Concorde.

Mr. TIPTON. It is only within the United States, and I would think you might get by without utilizing that airplane on the Hawaiian market for some time. You can't get by with it for any length of time on the Atlantic or Pacific, and probably in Latin America.

Mr. YATES. Is the Asian market a more profitable market, or do you have wealthier people on the Asian market than you do in the Hawaiian market?

Mr. TIPTON. No.

Mr. YATES. So that the reason for having a Concorde on that run would be eliminated, wouldn't it?

Mr. TIPTON. The early use of the Concorde is inevitably going to be on the very long haul routes where the competition is most severe, and where that time advantage is most great. I would guess that probably the Hawaiian market will be the last of them.

On this cost problem, we have done some further work on this statement about being twice the costs. I was unable to confirm that statement, I might say, from BOAC.

Mr. YATES. BOAC didn't deny it?

Mr. TIPTON. I was unable to confirm it.

Mr. YATES. There was a later story, Mr. von Kann, which did not deny the high operating costs. It denied what hadn't been said; namely, that BOAC is supposed to have said it will not buy the Concorde. That is all that that second story said, but it did not deny the statement that the operating costs were twice as much.

Mr. VON KANN. Sir, granted that BOAC may ultimately have to buy the plane, they still have to go through negotiations, and what you are seeing in the newspaper, I think are negotiating gambits. Our airlines would sound just as bad to a Boeing salesman. But even accepting the premise that the Concorde would cost twice as much as the 747, I have just run out some figures which I will be happy to submit for the record, and even only picking up \$208, which is a straight tourist fare, and loading it 60 percent, you could make a small profit, not as much as we would like, but this is a rather conservative estimate.

Mr. YATES. How much would you make at 60 percent on a 747?

Mr. VON KANN. I would have to run that out.

Mr. YATES. But it would be much more, wouldn't it?

Mr. VON KANN. I would presume so.

Mr. YATES. The point is that I don't think the airlines are going to throw over the 747 for the Concorde so quickly, if they can make more money by operating the 747.

Mr. McFALL. Thank you, Mr. Tipton. Our next witness is Mr. John O'Shea, executive secretary, National Committee for the American SST.

#### STATEMENT OF DONALD J. STRAIT

Mr. O'SHEA. I am with Mr. Donald J. Strait. At the time we were asked to be heard it wasn't clear he would be here on hand for testimony. He is vice chairman of the National Committee for an American SST and co-chairman of the American Committee on Labor and SST and he has a statement which he will make on behalf of the committee.

Mr. STRAIT. Mr. Chairman, gentlemen of the committee, we are pleased to have this opportunity to express the beliefs of the great majority of American men and women in business, industry, professional associations, and private citizens who support an American SST program.

Our objective is to present the facts to the people across this Nation about the economic, technological, and social benefits to be achieved from an American SST program. We are primarily concerned with the best interests of the entire country.

We are concerned with what we consider to be the misconceptions, misinformation, lack of valid information, and lack of fair appraisal used recently to attack and subvert the continual development of our American SST.

We are deeply concerned with national priorities, the needs of our fellow citizens, improvement of the environment, problems of noise and pollution and we will address ourselves to all of these considerations as we present our judgments relative to our American SST program.

This program seems to have inherited the burden of a number of concerns which are troubling various segments of our American peo-

ple. They include Vietnam, inflation, high taxes, poverty, poor housing, welfare and health concerns the environment and a number of others. The national decision and policy to develop the SST was made years ago under President Kennedy and carried forward by Presidents Johnson and Nixon.

The decision to undertake the SST was reflecting a conscious potential, which would serve our people and people throughout the world, which would add to our technological growth, which would add to private employment through private investment for which Government would provide the seed energy and seed money—and make it work.

This effort is now within a few years of bearing fruition. This program is a work program designed to provide long-range production potential for a vast segment of our industry; provide training and retraining programs for semiskilled people who might otherwise join the ranks of the unemployed and unemployable.

When man has increased the speed of his transportation there has been a noticeable acceleration in the progress of his world. Even though modern vehicles and aircraft have represented the ultimate in speed and comfort at the time they were introduced, man's need, in our expanding world of communication, to increase his traveling speed has brought about even faster land, sea, and aircraft. Thus, today it is possible to ride on a modern jetliner and travel comfortably over the weather at more than 600 miles per hour.

During the development of turbojet transports in the 1950's dissidents raised essentially the same question as they do now about the SST: Who needs an airplane flying that fast? Isn't 300 miles an hour fast enough? Yet who today would trade the speed and comfort of a 600-mile per hour jetliner for an ox cart on a rainy day?

The goal of air transportation is the increasingly efficient movement of people, products and ideas over time and space. The SST is the next logical extension of present aircraft design and progress.

If we take our blinders off and look at other countries, we find they have already come to the same conclusion: An economically viable, productive SST will be built. The Soviet Union currently is test flying and marketing a supersonic transport and so are the British and French. There are SST's flying now. The question, then, is not so much whether an SST should be built, but rather, who is going to build SST's and reap the attendant benefits.

The growing thrust of other nations into markets where the United States historically has led is visible in a variety of areas—autos, textiles, steel, other industrial products, shipping, and so forth. This in itself is not bad; competition is the sparkplug of private enterprise, and has always brought out the best in Yankee ingenuity.

But we have to be willing to compete. Throwing in the towel before you have even taken the measure of the opposition is no way to win a fight. The SST prototype development program represents the willingness of the United States to compete against the nationalized efforts of other countries to unseat us from the position of civil aviation leadership.

These overseas developments pose some serious questions for the United States. Is America to give up its traditional lead in aircraft development and progress? Is the United States to defer to manufac-

turers from other countries and allow an already serious balance-of-payments problem to worsen? Is America to forget the progress and technological advancement which made its citizens enjoy the highest standard of living in the world and say we no longer wish to move forward?

Our Nation's economic base must be preserved and nurtured if it is to continue to support the many social programs sure to confront us in the years ahead.

I challenge those who would turn this Nation into a welfare state without any thought of where the money to pay the welfare bill is produced. As you and I know, these funds come from throughout the entire realm of our vast economy, including our corporate and personal income taxes from the builders of U.S. products, and from the export revenues on the sale of those products around the world.

The understanding that we cannot relax our production vigor is at the root of President Nixon's goal of a full-employment economy and his conviction that our country must have economic as well as social incentives—that the provision for human resources and the management of natural resources cannot be accomplished in an economic vacuum. The SST development program is an incentive—seed money toward a future harvest of profits of direct benefit to the Nation.

No statement from the National Committee for an American SST would be complete without reference to our appreciation and concern over the environmental aspects of the SST program. This committee is very much disturbed over the recent gross exaggerations and misrepresentations of scientific data regarding the SST's potentially harmful effects upon the atmosphere and man's environment. There may be gaps or uncertainties in our knowledge and available information, which require additional research to be resolved. These factors, however, do not argue against the construction of the two prototypes. Rather they emphasized their need. If the prototype is not carried through completion of the test phase these uncertainties may never be resolved.

There is no evidence in existing data that SST operations will cause significant adverse effects on our atmosphere or our environment. This is the considered opinion of the scientific authorities who have counseled the Government on these matters over the past 5 years, and their counsel is reinforced by developments in the past few months and weeks.

We urge Congress to examine the facts and support the administration's existing technological programs to resolve any questionable environmental issues through research, development, and experimentation.

We support a vigorous environmental research program in parallel with prototype construction because we believe in the ability of American scientists and engineers to apply their genius to the solution of any technical problems.

The American supersonic transport prototype development program is proceeding on schedule and approaching completion. This is not the time to quit; to abdicate leadership in world aviation to foreign nations. This is a program which will create work, not welfare. This is a program which will keep us ahead of the rest of the world in aerospace technology. There is no reason why we cannot or should not

meet and beat the competitors. We have a better airplane, larger, faster, more productive with greater long-term growth potential. We are 9 years into a 12-year development program, with a substantial national investment at stake.

Funding this program must be continued because it is an investment in the future of the United States, is the only way we can obtain the answers required to make proper judgments and decisions relevant to the future of this program.

This committee is a unique joining of hands of labor, industry, and all Americans who believe in the future of this great country. Congress is responsible not alone to those of the present generation, but to those who follow us as well. We urge the Congress to take the facts, evaluate them, and arrive at an objective decision unhampered by emotion and supersonic superstitions. Approached this way, the decision can only be to move ahead on an American SST program, a decision which can very well affect the posture of the aerospace industry and the vitality of this country for the next or three decades. That completes my statement.

Mr. McFALL. Thank you for a very fine statement.

Mr. STRAIT. We appreciate the privilege of presenting a statement, Mr. Chairman. Thank you, sir.

Mr. McFALL. Our final witness is Mr. David Fradin, president, Fly America's Supersonic Transport.

We appreciate your patience in sitting through all of this, and we will be glad to have your statement.

#### STATEMENT OF DAVID FRADIN

Mr. FRADIN. Thank you, Mr. Chairman. My name is David Fradin, national president of FASST. That's F-A-S-S-T, fly America's supersonic transport. I am here representing a lot of young people who want the SST. We're the ones who know that most of the anti-SST propaganda you've been hearing is an exaggeration or an out-and-out misrepresentation. Young people want the SST because it's so closely tied in with our futures. We want it because the SST and the world of aerospace mean so much to the achievement of our dreams of worldwide peace, a cleaner environment, and social progress. If the SST is killed here in Congress, you are going to be killing the hopes of a lot of young people.

Let me tell you about FASST. We started working right after the Christmas holidays, after the SST debates of December. We had little then—just a small group of us who had been following the SST actions in Congress and didn't like them. We got busy in a hurry. We now have over 20 chapters, at schools with a total of over one-half million students. We have sent out our literature to every Congressman and Senator here in Washington. Several of our chapters have already prepared ads to run in local papers, supporting the SST. The Michigan chapter alone has collected over 3,000 signatures on pro-SST petitions.

And we've been taking our case to all students. A lot of them came to our discussions thinking that the SST was a bad thing. But a lot of them come away wanting to sign our petitions. Let me tell you one example. A liberal-arts student, with a rather cynical look, came to one of our talks last week. As he sat there before we started, I could

hear him muttering about "hidden social costs" of the SST. When we finished, he had a very serious look. He wanted to know why he had been reading so much bad press about the SST, and why he hadn't heard the true story up until then. And he signed the petition. We've seen a lot more like him.

Our technical case for the SST is included in the documents presented to this committee. I just want to tell you about the young people who support the SST, and why we want it, and why so many of our friends and fellow students are coming to realize that it's not inconsistent with their goals and ideas.

We are members of the generation of Sputnik and Vanguard. We were in grade school when Sputnik went up, and we grew upon the science and math programs that were passed by Congress in the late fifties. Congress showed great foresight then, in adopting those programs, which set us on our present course. We now hope that Congress will show similar foresight by continuing the SST program, so that we can continue on this course.

We were inspired by the excitement, the adventure of flight and by the pilots who rode rocket planes to the edge of space and by President Kennedy who said: "We choose to go to the moon in this decade, . . . not because it is easy, but because it is hard." It was with this same spirit that Kennedy initiated the SST program some 9 months later.

We know that before we were born, test pilots were flying the earliest jet planes at 600 miles per hour. Today the public travels at 600 miles per hour. This is the real jet set—the American public. In our own lives we have seen supersonic flight and we have seen it first as a great adventure, a dangerous experience for brave men. Now it promises new advances in civil aviation—new comfort, new freedom from environmental contamination. We know that in terms of flight times, it will make the vast Pacific look like the North Atlantic—and the North Atlantic look like Chesapeake Bay. Who will travel on the SST? We will.

This is the SST. But in a larger sense, this is aerospace—that which has grown out of one of man's greatest dreams and wishes—the dream of flight. The expression of this dream has uplifted men's spirits as well as their bodies—and is very much a part of the world we live in. It is this world which is the focus of the hopes of young people—of hopes which the SST and aerospace have helped arouse, and which they can help to realize.

We all share a great hope—that our environment will be preserved. You have already heard how the SST is cleaner than any current mode of transportation.

We also share the dream of peace, of international cooperation. It is the jet airplane which has joined the world together. Nations need no longer live in separate worlds of their own, for now they are linked by air transportation. Above those roads along which the American pioneers of the west spent months, the jet now makes its way in an hour. And what the jet has done for the Atlantic community of nations, the SST will do for the world.

Yet there are those who would forestall this. They would kill the SST prototype program. They would then go on to kill many other aerospace programs, and sit back while our nation's aerospace abilities wither and die. Other speakers have noted the importance of the SST

to the continued health of this vital industry and national activity. Now I will note that there is one more great dream which we young people share—the dream of social progress, that our social needs will be met in full.

To realize our social goals will require revenues, and sufficient revenues come only from a strong economy. While we have led the world in successful application of advanced technology on which our economic progress during the past two decades has been based, in recent years the competition from foreign countries has become intense. First our maritime industry lost its competitive position in the world. Our auto, electronics, and other industrial products have similarly lost ground, while other nations surged ahead. Now there are those who want this to happen to our aerospace industry.

We are the serious students, we are the ones who go to class when others seek to shut down the school. We are the ones who work within the system, the ones who work to build what we believe in. We will not give up our dreams of peace, clean environment and social progress brought about with the aid of aerospace. We didn't drop out, and we didn't cop out either. But those Congressmen, and those Senators, who say that our dreams are "irrelevant" or that the SST is a "bad priority"—those people are copping out on us. And all I can say is: For God's sake, don't!

(The attachments to Mr. Fradin statement follow:)

**FASST FACTS**

This fact sheet is intended to deal with many of the most serious objections to America's SST program, and to review the factual basis for the program which has motivated four presidents to approve it. We of FASST welcome additional questions or comments, which are not covered in this brief paper.

Where does the program stand now? The program calls for the Government to spend \$1.283 billion to construct two prototypes, and to pay for the research and development required for their design. As of July 1, 1970, some \$708 million had been spent. Since then, continuing resolutions and use of unallocated funds have resulted in some \$200 million more being spent. Government cancellation could involve contractual penalties of up to \$161 million. Thus, the Government has two options: To fund the program according to plan, thus spending \$1.3 billion and establishing the capability for an ongoing, privately-funded, SST production program; or, to kill the program, spending \$1.1 billion and producing absolutely nothing.

The program now is quite far along. Next month, some 90% of the working blueprints will have been released. Some 2000 parts have already been fabricated, and in April the first major assembly-- the wing-- is scheduled for construction. The prime contractors--Boeing and General Electric-- have met their schedules and remained within budget. The Boeing program manager, H. W. Withington, has stated that "this is one of the best-managed experimental programs" he has seen, and attributes this to the close public scrutiny it has received.

But the recent Senate action, failing to fund the \$290 million Fiscal 1971 appropriation, has thrown a monkey wrench into the well-oiled management, disrupting the program. Managers now state that unless the Government adheres to its spending plans, the program must be stretched out and costs will rise. Thus, any reduction in programmed spending makes no fiscal sense. The government is left with the two alternatives: spend \$1.1 billion and get nothing, or spend an extra \$200 million and finish the program according to plan.

What about possible overruns? There are "suggestions" that the Government might have to put up another \$2 billion or more to complete the program. Such statements are, indeed, "suggestions". The manufacturers have been, and still are, below their budgets. Moreover, in any overrun their share of the costs would increase 150%, according to contract. Recently President Nixon has stated that he would request no further Government funding after completion of the prototype. Thus, there is no evidence to support these "suggestions."

ATTACHMENT 1How does this program fit in with the nation's other pressing needs?

It will help us to meet them. Far from representing a bad priority, the SST actually will help us meet other pressing priorities. Even the most desirable social programs represent outlays which are not recovered; such programs, moreover, do not improve our balance of payments. The SST will recover the government's investment and will create new revenues to be applied to social needs. It does this in three ways:

Balance-of-Payments: At present, some 85% of the world's commercial airplanes are American-built. This represents some \$2 billion in foreign sales annually. But this market faces a strong challenge by the Europeans. In addition to their own SST, Concorde, they have the A-300 "airbus" or jumbo jet, and the Mercure short-haul jet.

Why is this significant? Because airlines consider a manufacturer's "family" of aircraft in buying new planes. They would not buy subsonic jets from us and supersonics from Europe; they would instead buy a complete European line. Today, all manufacturers are building jumbo-jets because the airlines would not buy from a company that built only the smaller ones. In 1980, the same will be true for SST's.

Between now and 1990, the foreign aircraft market will aggregate some \$50 billion, including spare parts. This much foreign trade is not easily generated or maintained. Our SST represents a superior product, and will allow us to maintain this market--if we build it. If we do not, the Europeans will build a larger, more productive Concorde II, which is already under study-- and our aviation industry will suffer greatly. It is for this reason that the AFL-CIO Executive Council has endorsed our SST program.

Taxes: Some 50,000 people will be working on our SST, and these jobs will primarily be at the highest skill levels. Another 100,000 service jobs will be created through the multiplier effect. All these people will pay taxes. In addition, the strengthened aerospace industry will continue to pay its share of the taxes; the whole industry will benefit, and so will its tax-paying ability. The annual taxes will aggregate \$10.5 billion by 1985.

Royalties: Every plane sold will return a royalty. Already 129 are on order; these would suffice to repay 43% of the government's outlay. The conservative forecasts of Boeing show that 515 will be sold; these studies are not "iffy" but are conservative, since Boeing must stake its future planning on their correctness. Other studies show as much as 800 sold. Even if only 500 are sold, this would still net the government \$1 billion in clear profit. The SST program is thus a rarity: it will make money for the government, not take money from the government.

What's the status of the foreign competition? Some people have attempted to downgrade the competitive challenge of the Concorde. There is no basis for downgrading Concorde. E. H. Burgess, of British Aircraft Corporation (builder of the Concorde) gave a progress report in November to a group of aerospace experts in Washington. He reported that its manufacturers have begun building the seventeenth airframe. Developmental tests on the prototypes have led to a gain in payload of 4000 pounds, and sideline noise has been reduced by 5 decibels through these tests. Aviation Week has more recently reported that a decision to commit to full-scale production is expected shortly; that a decision to cancel the program would be supported by only 28% of the British public; and that BOAC will be placing its first orders for production aircraft on Feb. 15. The Concorde is here, and it will not go away.

How is private industry supporting the program? The Government is providing 90% of the developmental costs of the SST. But private industry has never paid for commercial airplane development on any major scale. The 747's development was largely paid for by the Air Force, since the 747 is a commercial version of Boeing's proposal for the C-5. The 707 grew out of developmental work on Boeing's jet bombers, also paid for by the Air Force. In the case of the SST, support comes not from the Air Force but from the Department of Transportation.

On the other hand, private industry has supported this project on an unprecedented scale. In the early 1950's, Boeing spent \$16 million of its own money to build the 707--a huge sum for that day. Today, the airlines and manufacturers are putting up some 30 times that amount. The 129 planes on order represent unprecedented airline interest. At this stage in the development of the 707, none were on order; the first 707 was not ordered till its prototype was already flying.

What will SST operations cost the customer? There are those SST critics who have suggested that supersonic travel would be very expensive, or that it even would have to be subsidized through higher fares for subsonic flights. The facts are otherwise.

Our SST will be twice as expensive as a 747. But it will also be twice as productive, productivity being measured in number of seats times speed. Operating costs, in cents per seat-mile, will be intermediate between those for the 747 and those for the 707, according to Professor Wilbur C. Nelson of The University of Michigan. Thus, SST travel could be provided at today's fares, and certainly without increasing general air fares. But the airlines expect SST travel to prove so popular that they will impose an "SST surcharge", to prevent an exodus from their subsonic jets, in which they have a large investment.

This is the point today with another fallacy: that SST operations will cause a large drain on the world's oil resources. Some have stated that the SST would use one-third of the nation's fuel consumption by 1980. This illustrates the mischief of a misplaced decimal point. In 1990, all commercial aviation together will consume some 2% of the world's fuel consumption. The world's SST's will consume only a fraction of this. The true figure is not 1/3 the consumption but 1/300--and this fleet will carry some 80 million passengers per year.

Will the SST pollute the atmosphere? There is no valid evidence that SST operations will be environmentally offensive. There are theories that the SST may alter the weather or disrupt the stratospheric ozone layer which shields us from harmful solar ultraviolet. However, the weight of scientific opinion refutes such theories. The experience of twenty years of supersonic military flight also fails to give cause for alarm. At present, it cannot be proved conclusively that there will be no noticeable effect. But claims to the contrary are, in the main, mere speculation, lacking in foundation and in evidence to support them.

Nevertheless, it is necessary to conclusively settle this question. Thus, a research program is under way in the DOT. This program has the approval of the President's Environmental Quality Council, and is led by experts from ESSA, FAA, the Department of Commerce, and other agencies.

The question of atmospheric effects is difficult to answer conclusively because the pertinent quantities--mean temperature, rainfall, ozone content, and the like--fluctuate widely due to natural causes. These fluctuations are very difficult to predict, and they represent effects far larger than the SST would create. Thus, a single large thundercloud, common throughout the world, may inject more water vapor into the stratosphere than a fleet of SST's. Three volcanic eruptions in the last eight years have spewed more pollution (dust and sulfur compounds) into the atmosphere than have all the activities of mankind through history. Yet even these volcanoes do not appear to have caused climatic change. Thus, any SST effects may be very difficult to observe--much less to be identified as producing harmful effects.

One who shares these views is Dr. William W. Kellogg, who headed up the MIT Study on Critical Environmental Problems. The conclusions of this study, which pointed to the SST as a cause for concern, have been claimed by environmentalists to be a major reason for cancelling the SST program. But, Dr. Kellogg has stated that "nowhere have we indicated that we believe SST development should be held up pending the results" of studies such as that underway in the Department of Transportation.

What about sonic boom? The SST has been attacked on the grounds that if it operated overland, its sonic boom--produced by its supersonic speed--would prove a major nuisance and annoyance. But in 1964 the program managers committed the SST project to only over-water supersonic flight, with supersonic flight also permitted over the uninhabited wastes of the Arctic. The plane has been designed to operate efficiently while flying subsonically. Predictions of its profitability, and of the 500 or more planes to be sold, have been based on the avoidance of overland supersonic flight. In its operations, it will not reach the speed of sound immediately after takeoff, but will do so 100 miles off the coast, thus protecting most shipping and fishing from the annoyance of sonic booms.

Will this restriction on overland flight be lifted? The great concern the issue has received is ample evidence it will not. Neither the manufacturers nor the airlines need such overland flights, and the strong public reaction that would attend any such proposal will serve to maintain this position. Although this restriction has not been written into law, the manufacturers and airlines would welcome and support such a law, as an indication of the good faith they have shown over the sonic-boom issue.

Isn't the SST a very noisy airplane? There are two pertinent types of noise. "Community noise" is noise made while flying over the community during takeoffs and landings. In this category, our SST is only half as noisy as current jets. The reason is that with its powerful engines, the SST can approach or leave the airport at a steep angle of climb, rather than linger over the community as do today's jets.

"Sideline noise" is generally confined to the airport proper, and is emitted during the takeoff roll down the runway. Until recently, program managers have stated, with considerable candor, that they did not anticipate meeting FAA standards for sideline noise. The FAA standard is 108 EPNDB ("equivalent perceived noise-decibels", a standard measure of the psycho-acoustical annoyance of noise). This is about as noisy as a loud truck on the highway. These managers stated they could do no better than 112 EPNDB, and for this admission the SST was denounced as a noisy airplane. Sen. Proxmire proclaimed that failure to meet the FAA level would constitute cause for banning the SST from our airports.

But now the situation is entirely different. An intensive research program had been undertaken to lower the sideline noise without compromising the low community noise, and this program has succeeded. Through a judicious redesign of the engine, it will now meet a sideline-noise level of 106 EPNDB. This is significantly less than the FAA limit. The noise problem thus ceases to be a stumbling-block to the program.

ATTACHMENT 1

We of FASST believe that our SST program represents a timely and necessary effort. It will promote new revenues to help meet national needs. It will aid in maintaining our strong export market in aviation, and in maintaining the strength of the aerospace industry--the nation's largest manufacturing industry. Sonic boom has never been a problem, since all along it has been a thing to avoid; and noise now falls into the category of "problems solved". Environmental questions will be settled through a timely program of research, concurrent with future development of the airplane. It is a good program.

**Fly America's SuperSonic Transport**

2503 Student Activities Building  
The University of Michigan  
Ann Arbor, Michigan 48104

**WHO NEEDS THE SST?**

Airline travelers, for one, and quite a few of them too. If 500 SSTs make three flights a day, being only half-full, that's still 80 million passengers per year. That's no "jet set".

After all, in airline operations, speed is the name of the game. That's why people fly, when they could save money by taking the bus. That's why the early jets caught on so quick. The SST will cut flight times by half or more. That's three hours to Europe, instead of seven-- and less than ten hours to Japan or across the Pacific, instead of the better part of a whole day. It means, in flight times, making the Pacific look like the Atlantic-- and the Atlantic look like a river. Of course, you still have to take time getting to and from the airport. But plenty of people are working on that problem. That's why we have the new 12-year, \$10 billion program for mass transit.

People who live near airports will also appreciate the SST. One does the work of up to four conventional jets. This means airports need not expand to serve larger and larger airline fleets, gobbling up nearby communities in the process. Also, the SST takes off and lands at such steep angles that it does not linger noisily over the community, but instead is up and away, taking its noise along. Unlike current jets, the SST confines its noise mainly to the airport itself, where people in the community will never hear it. And even this airport noise will meet or better the new Federal standards, despite the critics who said "it couldn't be done."

Finally, people who want more social programs will (in time) see that they need it, too. These programs have to get revenues from somewhere. The SST is that "somewhere." The program needs about \$400 million more

ATTACHMENT 2

to get off the ground--and then every plane sold will pay the government a royalty. Eventually the government will get at least \$1 billion in pure profit on its investment. That's enough to build 100 large hospitals, 400 schools, 100,000 units of housing. And that doesn't even count the \$6 to \$10 billion in taxes generated by the SST program

For the SST will do even more. It will provide 150,000 new jobs--and every one of them means taxes to support social programs, rather than people needing help from these programs. And, it represents a product which foreign nations will buy--thus putting money into this country, and securing American jobs. If we don't build it, the airlines will buy foreign-built airplanes. And that means money flowing out rather than in, and European jobs being supported at the expense of American jobs. That's why the AFL-CIO has come out in support of the SST.

Who needs the SST? Well, who needs the aviation industry anyway? Who needs its fast travel, its jobs, its foreign trade? Why, no one would ever notice them. Unless they were gone.

Mr. McFALL. Thank you very much, David, for a very fine statement. We have been trying for the last 4 days to find out all the facts and all the arguments, and in a sense yours is a very fitting benediction to our efforts. Are there any questions?

Mr. CONTE. Yes. How many members are there in your organization?

Mr. FRADIN. We don't have members per se. We are more or less an ad hoc committee. In a period of a few months it is awfully hard to make up membership cards, and so forth.

Mr. CONTE. How many getting together?

Mr. FRADIN. We have got some 20 to 30 working on the project from the University of Michigan alone.

Mr. CONTE. Do you fly?

Mr. FRADIN. Yes, I do. I am a certified flight instructor.

Mr. CONTE. Do you belong to an aero club?

Mr. FRADIN. Yes, sir, I started the one at the University of Michigan.

Mr. CONTE. I sort of take issue with you. I think I have a little communication with youth. I have four of them myself, three in college. You toss around this copping out business. I think you are unfair. I don't know how I am going to vote in another 15 minutes, but certainly if I decided to vote against this it is because of deep convictions, not that I am copping out. I think this is an unfair condemnation of individuals, whom I am sure, hold sincere beliefs about this matter. As I said earlier, I wish I was convinced against the program as Mr. Yates, or as convinced for the program as Mr. Boland. They have no problem and maybe you have no problem, but there are a lot of people that have problems.

I am just a hawk here in the Congress when the Federal Government gets in and starts subsidizing things. I fight everything that is subsidized. I don't like it. I think if a thing has merit it should stand on its own two feet, that private industry ought to do it and not come to the Federal Government. I have got industries in my district that need money badly, that need help. They want to stay in the forefront in engineering fields such as electrical engineering. They don't come to the Federal Government and say, "Look, you build this for us. You build this heavy transformer for us. We want to stay in competition with the French and the British." They just go ahead and do it themselves. So people who oppose this program do so because they have real, deep-seated, sincere beliefs. They are not going to cop out on you or anybody else. That is all I have to say.

Mr. YATES. I have no questions.

Mr. McFALL. Thank you, David. That concludes our hearings. I think these hearings have been very beneficial to the committee and I would like to thank all the witnesses who appeared this week for their fine testimony.

#### STATEMENT OF CONGRESSMAN JOSEPH P. ADDABBO

Mr. McFALL. The committee is in receipt of a statement from Congressman Addabbo of New York regarding funds for the SST. It will be inserted in the record at this point.

(The information follows:)

## STATEMENT OF CONGRESSMAN JOSEPH P. ADDABBO

Mr. Chairman, as hearings on the Department of Transportation's budget request for fiscal 1972 begin, I want to take this opportunity to urge my colleagues on the Appropriations Committee to weigh very carefully the proposed funding of the supersonic transport project.

As the Representative of the Seventh Congressional District, New York, in which Kennedy Airport is located, I have followed this issue closely and have opposed all Federal funding for development of the SST. I have done so for several reasons, among them my conviction that there is no economic justification for the project; there are grave environmental problems connected with the program and few projects deserve lower priority.

In light of the recent public relations campaign in support of the SST, I also want to remind this subcommittee of optimistic statements in the past about the ability or willingness of the aircraft industry to control air and noise pollution and weigh this against the substantial costs involved and the number of Americans to be benefited. We should consider who will use the SST and the need for its development. We should consider not only our Nation's domestic priorities but those who need our help and those who do not.

No one disputes the fact that very few Americans will ever travel by supersonic aircraft. It is a luxury item we cannot afford—a luxury for the wealthy and a tax burden for Americans in middle and low income brackets. This is further brought out by a recent study. Those who support the SST tell us that fears about increased air and noise pollution are unwarranted. I remember when FAA officials told us in 1957 that jet aircraft at Kennedy International and other airports would be as quiet as prop aircraft. I have no reason to believe optimistic statements about the SST are any more accurate.

The SST poses a threat to the environment which we must resist and this threat includes operations at U.S. airports by foreign supersonic aircraft. Instead of worrying about whether France or the Soviet Union will capture the SST market, we should concern ourselves with procedures to protect our environment from the air and noise pollution which any supersonic aircraft will cause.

STATEMENT OF THE RAPID CITY CHAPTER OF THE IZAAK WALTON  
LEAGUE OF AMERICA

Mr. McFALL. The committee is in receipt of a letter from Mr. Mike Kasch, President of the Rapid City, S. Dak., chapter of the Izaak Walton League of America. It will be inserted in the record at this point.

(The information follows:)

IZAAK WALTON LEAGUE OF AMERICA,  
RAPID CITY CHAPTER,  
Rapid City, S. Dak., February 25, 1971.

Rep. GEORGE MAHON,  
Chairman, House Appropriations Committee,  
Washington, D.C.

DEAR SIR: This letter is to urge your committee to withhold any further funding of the proposed Supersonic Transport (SST) project.

The proposed SST appears to benefit only a few, and since research has already shown it will damage the environment, it will, in the long run be harmful to all.

Please acknowledge and enter this letter in the hearing records.

Thank you.

Sincerely,

MIKE KASCH, *President.*

## AMERICAN LEGION RESOLUTION

Mr. McFALL. The committee is in receipt of a resolution adopted by the 1970 National Convention of the American Legion regarding SST appropriations. It will be inserted in the record.

(The resolution follows:)

NATIONAL LEGISLATIVE COMMISSION,  
March 3, 1971.

Hon. JOHN J. McFALL,  
Chairman, Subcommittee on Transportation, House Committee on Appropriations,  
Washington, D.C.

DEAR CHAIRMAN McFALL: Enclosed is a copy of Resolution 584 adopted by the 1970 National Convention of The American Legion urging the Congress to accelerate all appropriate measures the development and production of an American supersonic transport aircraft.

It will be appreciated if you will include this letter and the resolution in the permanent record of the hearings presently being conducted by your subcommittee on continuing appropriations for the Department of Transportation, including funds for the SST.

Sincerely yours,

HERALD E. STRINGER,  
Director.

RESOLUTION No. 584

52D NATIONAL CONVENTION OF THE AMERICAN LEGION HELD IN PORTLAND, OREG.,  
SEPTEMBER 1-3, 1970

Committee: National Security.

Subject: Development of a U.S. supersonic transport aircraft.

Whereas, the development of a supersonic transport aircraft represents a major advancement in aviation technology requiring the development of large-scale fabrication techniques for the titanium structure, new materials with wide applications beyond aviation; very large and efficient turbine engines capable of generating nearly 70,000 pounds of thrust, and other major advancements in instrumentation and flight control systems; and

Whereas, the experience and technology developed in designing and producing the supersonic transport can be applied to future military aircraft: Now, therefore, be it

*Resolved, by The American Legion in National Convention assembled in Portland, Oreg., September 1, 2, 3, 1970, That we urge the Congress to accelerate by all appropriate measures the development and production of an American supersonic transport aircraft.*

STATEMENT OF THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

Mr. McFALL. The committee is in receipt of a statement from the National Society of Professional Engineers regarding the need to continue SST development work. It will be inserted in the record at this point.

(The information follows:)

STATEMENT OF THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS TO THE COMMITTEE ON APPROPRIATIONS ON DEVELOPMENT OF THE SUPERSONIC TRANSPORT, MARCH 1971

The National Society of Professional Engineers appreciates the opportunity to present views on continued Government funding of the supersonic transport development program. Our Society, a nonprofit organization headquartered in Washington, D.C., consists of some 67,000 individual members engaged in virtually every phase and aspect of engineering, including private practice, industrial, educational, and governmental employment. We offer several observations which seem paramount to us in consideration of the question of whether further Federal funds should be made available to complete the SST development program.

In the first place, abandonment of the program at this late stage would mean a waste of considerable funds already invested in the program and years of

precious time. As the committee is well aware, as of the beginning of this year, the Government investment in the SST to date totals \$813 million of an anticipated \$1.3 billion expected commitment. In addition, 9 of the 12 years involved in the contemplated completion of the program have already been consumed. The SST has now moved to the prototype construction phase with the first prototype flight scheduled for 1972. All of this money, time, and solid achievement to date will be completely wasted if the program were to be terminated at this point.

Equally important, perhaps, to engineers is the fact that the program's termination may well result in the dissolution of the engineering and technological work forces which have been put together in many plants across the entire country by numerous contractors and subcontractors engaged in one aspect or another of the project. Extensive engineering and technical expertise has been assembled and the experience of the 9 years of research leading to the present status of the program should not be allowed to be dissipated. If the United States is ever to answer a number of the problems being posed by this challenge, it is imperative that this expertise not be lost. Should the program be terminated or even deferred, the teams of experts simply cannot be put together again once they have been disbanded.

The aerospace capability of the country and the related research involved in expanding our knowledge of air transportation have been seriously disrupted by reductions in defense and aerospace allocations over the past year. The Nation's leading role in aircraft development and manufacturing will be further jeopardized by terminating the SST program at this time.

We are well aware that opposition to continuing the program has been expressed by those earnestly concerned with potentially adverse effects on the environment. There is little doubt that many questions which have been thus raised are presently unanswered. But no one will actually know the answers until, and unless, the prototype is in fact tested. Unless carried to a conclusion, the possible effects of the SST's operation on the environment cannot be known and adverse effects cannot be countered.

A considerable amount of the money already invested in the program, as a matter of fact, has been earmarked for purposes of insuring that this aircraft will be operationally compatible with the environment. This research will provide the answers not only with respect to effects produced by the SST, but also will aid in improving conditions created by other aircraft types already in use as well as nonaircraft-associated activities which also affect our environment.

The program envisions the construction and testing of two prototype aircraft and the effects of their use. These two airplanes will not menace the environment to the extent opponents predict. On the contrary, they will provide the answers necessary for an intelligent assessment of the program's future worth in terms of environmental effects. Should the concerns of the environmentalists be found still valid following this limited testing, the Congress, having full control over the plane's future production, can effectively prevent further development of the aircraft.

Although we have not discussed other benefits which proponents cite in favor of continuing the program, such as the need to maintain a favorable balance of trade position in the world, the potentials of tax revenues to State and local Governments as well as the Federal Government, the impact on U.S. aviation leadership, and the effects of losing a valuable market to the British, French, and Russians who are already flight testing their prototypes, we are not unaware of such factors. Our principal concern is the adverse effect abandonment of the program at this stage in development would have on the assembled engineering and technical expertise, the loss of time and money already invested, the need to prove possible environmental effects, and the worsening of the present economic climate which is so adversely affecting a considerable number of engineers at the present time.

We do feel such an important decision as abandoning this program should not be made without at least carrying it through the prototype construction and testing phase—particularly since the Congress has full control of its future at that point in time.

## LIST OF WITNESSES

---

	Page
Alderson, G.....	395
Beggs, Hon. J.....	1, 146
Beranek, Dr. Leo.....	395, 594
Boehner, W. R.....	1, 146
Brower, D.....	395
Brown, Hon. Clarence.....	395
Brown, R. A.....	395
Burton, L. J.....	1
Cohen, R. E.....	1
Dunlap, Miss L.....	395
Fradin, D.....	594
Harr, K. G., Jr.....	594
Kellogg, Dr. Will.....	395
Magruder, W. M.....	1, 146, 395, 594
McDonald, Dr. J.....	146
McLellan, R.....	1
Moss, L. I.....	395
O'Shea, J.....	594
Olsson, J. P.....	1, 146
Parsons, R. E.....	1, 146, 395, 594
Hon. Henry S. Reuss.....	365
Ruckelshaus, Hon. W.....	1
Singer, Dr. Fred.....	395, 594
Smith, F. E.....	395
Soucie, G. A.....	395
Strait, D. J.....	594
Tipton, S. G.....	594
Udall, Hon. S. L.....	146
Vierling, B. J.....	1, 146, 395, 594
Volpe, Hon. J. A.....	1
Von Kann, C. F.....	594
Yorke, D.....	395

## COMMITTEE ON APPROPRIATIONS

GEORGE H. MAHON, Texas, *Chairman*

JAMIE L. WHITTEN, Mississippi	FRANK T. BOW, Ohio
GEORGE W. ANDREWS, Alabama	CHARLES R. JONAS, North Carolina
JOHN J. ROONEY, New York	ELFORD A. CEDERBERG, Michigan
ROBERT L. F. SIKES, Florida	JOHN J. RHODES, Arizona
OTTO E. PASSMAN, Louisiana	WILLIAM E. MINSHALL, Ohio
JOE L. EVINS, Tennessee	ROBERT H. MICHEL, Illinois
EDWARD P. BOLAND, Massachusetts	SILVIO O. CONTE, Massachusetts
WILLIAM H. NATCHER, Kentucky	GLENN R. DAVIS, Wisconsin
DANIEL J. FLOOD, Pennsylvania	HOWARD W. ROBISON, New York
TOM STEED, Oklahoma	GARNER E. SHRIVER, Kansas
GEORGE E. SHIPLEY, Illinois	JOSEPH M. McDADE, Pennsylvania
JOHN M. SLACK, West Virginia	MARK ANDREWS, North Dakota
JOHN J. FLYNT, Jr., Georgia	LOUIS C. WYMAN, New Hampshire
NEAL SMITH, Iowa	BURT L. TALCOTT, California
ROBERT N. GIAIMO, Connecticut	CHARLOTTE T. REID, Illinois
JULIA BUTLER HANSEN, Washington	DONALD W. RIEGLE, Jr., Michigan
JOSEPH P. ADDABBO, New York	WENDELL WYATT, Oregon
JOHN J. McFALL, California	JACK EDWARDS, Alabama
W. R. HULL, Jr., Missouri	DEL CLAWSON, California
EDWARD J. PATTEN, New Jersey	WILLIAM J. SCHERLE, Iowa
CLARENCE D. LONG, Maryland	ROBERT C. McEWEN, New York
SIDNEY R. YATES, Illinois	JOHN T. MYERS, Indiana
BOB CASEY, Texas	
DAVID PRYOR, Arkansas	
FRANK E. EVANS, Colorado	
DAVID R. OBEY, Wisconsin	
EDWARD R. ROYBAL, California	
WILLIAM D. HATHAWAY, Maine	
NICK GALIFANAKIS, North Carolina	
LOUIS STOKES, Ohio	
J. EDWARD ROUSH, Indiana	
K. GUNN MCKAY, Utah	

PAUL M. WILSON, *Clerk and Staff Director*

### STAFF ASSISTANTS

WILLIAM GERALD BOLING	GARY C. MICHALAK	SAMUEL R. PRESTON
SAMUEL W. CROSBY	DEMPSEY B. MIZELLE	DONALD E. RICHBOURG
GEORGE E. EVANS	ENID MORRISON	EARL C. SILSBY
ROBERT B. FOSTER	ROBERT M. MOYER	G. HOMER SKARIN
JOHN M. GARRITY	PETER J. MURPHY, Jr.	CHARLES W. SNODGRASS
AUBREY A. GUNNELS	HENRY A. NEIL, Jr.	HUNTER L. SPILLAN
JAY B. HOWE	BYRON S. NIELSON	GEORGE A. URIAN
THOMAS J. KINGFIELD	ROBERT C. NICHOLAS III	EUGENE B. WILHELM
KEITH F. MAINLAND	JOHN G. PLASHAL	
MILTON B. MEREDITH		

### ADMINISTRATIVE SUPPORT

GERARD J. CHOUNARD	GEMMA M. HICKEY	DALE M. SHULAW
PAUL V. FARMER	LAWRENCE C. MILLER	AUSTIN G. SMITH
DANIEL V. GUN SHOWS	FRANCIS W. SADY	RANDOLPH THOMAS

# INDEX

---

A		Page
Advisory Committee on Environment.....		510
Advisory Committee on Noise.....		511
Air travel forecasts.....		30
Air travel growth rate.....		108
Aircraft weight.....		582
Airline interest.....		687
Airline support.....		562
Airport suitability.....		635
Appropriation Act, 1971, for Department of Transportation and Related Agencies.....		2-14
Armstrong, Neil, letter by.....		61
Atmosphere, effects of SST on.....	110,	594
Atmospheric physics.....		586
B		
Balance of trade.....	51, 94, 99,	107
Banning supersonic flight.....	144,	476
Benefits accruing.....		346
BOAC and Air France comments on the Concorde.....		490
Budget deficit, Federal.....		104
C		
Capacity of 747.....		412
Carbon dioxide.....		619
Chairman, Council of Economic Advisers, letter from.....		17
Clear air turbulence.....		623
Climatic effects.....	472,	622
Cloud formations.....		112
Coalition Against SST.....		354
Comments of Mr. W. M. Magruder.....		560
Commitment.....	33,	41
Community noise.....		583
Competition, foreign.....		348
Concorde:		
BOAC purchase of.....		611
Competition.....	32,	612
Continuation of program.....		690
Cost of.....		608
Economic threat from.....		98
Economic viability of.....	25, 491, 688,	691
Options.....		103
Probable commercial success of.....		392
Test data.....		39
Contract noise requirements.....		616
Contract overruns.....		54
Contractor viability.....		349
Cosmic radiation.....		593
Costs:		
Facilities and commercial.....		295
Overruns.....		492
Per passenger mile.....		689
Phase 3.....	293,	296
Phases IV and V.....		667
Sharing.....		237
Total.....	294, 296,	560
Credibility of witnesses.....		645

IV

D

Dr. Dubridge, position of.....	49
Dr. Garwin's relation to SST.....	28

E

Ecological questions.....	132
Economic concern.....	34
Economics of SST.....	83, 86, 345, 475
Employment.....	48, 53, 54, 349, 641
Engine change, effect of.....	602
Engine costs.....	650
Engine noise reduction.....	626, 627
Environmental issues.....	29, 52, 112, 144, 595, 597, 604, 605
Experimentation costs.....	598
Foreign research studies relating to the SST.....	142
Impact of current aircraft.....	115
Measurements.....	574
Prototype program.....	116
R. & D. funding.....	134
Regulations.....	636
Research.....	573, 585
Research data exchange.....	141
Research groups.....	577
Research, program delay for.....	291
Studies.....	118
Testing with prototype.....	600
Environmental Protection Agency, responsibility of.....	135

F

FAR-36 noise requirements.....	615
Financing.....	46
Alternate method of.....	26
Government, after prototype construction.....	493
Private.....	57, 93, 101
Foreign travel.....	98
Fuel consumption.....	418
Fuel requirements of fleet of 500 SST's.....	119

G

Government financing beyond prototype program.....	669
Government financing, need for.....	393
Government role in Phase IV.....	646
Government support during production.....	26

H

Human ear response.....	616
-------------------------	-----

I

Information availability.....	638
International agreements in supersonic operations.....	138
International air travel.....	87, 571
Investment returns.....	45

K

Kellogg, Dr. William, statement on SCEP.....	145
----------------------------------------------	-----

L

Labor union support.....	510
Legislative authority, limit of.....	26
Lindbergh, Charles A., letter from.....	59
Lockheed financial difficulties.....	347, 358

## V

## M

Market potential.....	668
McCracken, Paul W., memorandum of.....	89
McDonald study, origin of.....	300
McLellan, Robert L., statement of.....	94
Migratory birds, possible effect on.....	427
Military aircraft technology, benefits of.....	391

## N

Need for SST.....	28, 36
New York Times article on SCEP.....	572
Newspaper criticism.....	37
Nitrogen oxides.....	117, 620
Noise.....	28, 57, 642
Effect on hearing.....	624
Impact on people.....	629
Jurisdiction over.....	136
Reduction penalties.....	581
Suppressor effect on performance.....	654

## O

Oil reserves.....	570, 578
Impact on.....	120
Imports.....	118
Overland flights.....	52
Ozone reduction.....	331, 337, 341

## P

Particulate matter in the atmosphere.....	131
Peck, Merton J., letter from.....	85
Pollution.....	105, 110, 114, 137, 336, 579
Price per aircraft.....	296
Priority of programs.....	24, 30
Private banking support.....	101
Private financing.....	46
Production Aircraft:	
Costs.....	653
Decision.....	91
Engine design changes and improvements.....	613, 648, 649
Financing.....	88, 297, 632, 639, 647
Improvements.....	42, 648
Support.....	88
Productivity of SST.....	560, 561
Profits, Concorde vs. SST.....	657
Profits, SST vs. subsonic aircraft.....	657
Program completion vs cancellation costs.....	51
Program endorsements.....	202
Program management.....	34
Prototype aircraft:	
As research vehicle.....	574
Commitment of Federal Government to.....	360, 362
Compared with production version.....	353
Continuance of.....	359, 361
Cost.....	58
Flight hours.....	597
Impact on stratosphere of.....	472
Need for.....	339, 607, 627
Production similarities.....	651
Purpose.....	219, 652
Testing.....	49
Value of.....	220
Versus production costs.....	610
Versus production engine.....	628
Public information.....	35
Public relations.....	40

## VI

## R

Research Analysis Corp. study.....	415
Research program of DOT.....	580
Resolution of the American Legion.....	707
Return on investment.....	655
Rolls Royce bankruptcy.....	347
Royalties.....	426, 570
Russian competition.....	50

## S

SCEP study.....	327
Conclusions.....	588
Letter of Mr. Kellogg regarding.....	606
Science Advisory Group report.....	40
Seat-miles per hour—seat-miles per dollar.....	417, 419
Short haul service.....	673
Sideline noise.....	613, 635
Skin cancer.....	111, 575, 588, 592, 621
Smudge effect of pollution in the stratosphere.....	590
Sonic boom.....	590, 596
Outside the United States.....	617
Over land.....	619
Over water.....	114, 618
Studies.....	117
Soviet threat to U.S. aircraft industry.....	107
Spare parts, sales of.....	426
Speed.....	658
SR-71 technical fallout.....	633
Statements:	
Addabbo, Hon. Joseph P.....	706
Alderson, George.....	457
Arrow, Kenneth J.....	457
Beranek, Dr. Leo L.....	544
Brower, David.....	428
Brown, Hon. Clarence.....	479
Brown, Russell A.....	401
Dunlap, Louise.....	396
Fradin, David.....	695
Gailbraith, J. Kenneth.....	100
Harr, Karl G., Jr.....	661
Kellogg, Dr. William M.....	512
Magruder, W. M.....	147
McDonald, Dr. Janes E.....	302
Moss, Lawrence I.....	420
National Society of Professional Engineers.....	708
Parsons, R. E.....	146
Rapid City Chapter, Izaak Walton League.....	707
Reuss, Hon. Henry S.....	365
Ruckelshaus, Hon. William.....	109
Samuelson, Paul A.....	83
Secretary of Transportation.....	14
Singer, Dr. Fred S.....	527, 539
Smith, Floyd E.....	497
Soucie, Gary A.....	436
Strait, Donald J.....	692
Tipton, Stuart G.....	607, 674
Udall, Hon. Stewart L.....	342
Volpe, Hon. John A.....	14
Wiggs, Richard.....	460
Yorke, Duane.....	478
Stratosphere, effects on.....	584
Subsidies.....	55, 105
Supersonic flights over land.....	363, 471, 495, 641
Surcharge.....	52, 103

VII

T

Technical progress.....	637
Technological experimentation.....	129
Technological fallout.....	31, 44
Technological improvement, resistance to.....	603
Travel time.....	633, 660
TU-144 options	
TU-144 probable commercial success of.....	392
Turnaround time related to productivity.....	413, 414, 419
Unemployment in the aerospace industry.....	509
Unidentified Flying Objects.....	334, 592
Upper atmosphere characteristics.....	589
Water vapor.....	112, 576, 620
Weather radiation.....	99
White House memo.....	25, 630, 640
Williams College Seminar (SCEP).....	130

