1
00:00:07,829 --> 00:00:05,829
good afternoon it's a pleasure to

2
00:00:10,150 --> 00:00:07,839
welcome you all to our session on flight

3
00:00:12,390 --> 00:00:10,160
test and flight research uh one of the

4
00:00:14,709 --> 00:00:12,400
critical areas in which the naca

5
00:00:17,670 --> 00:00:14,719
established a notable

6
00:00:18,950 --> 00:00:17,680
history and a legacy that we with today

7
00:00:20,790 --> 00:00:18,960
we have a distinguished panel of

8
00:00:22,630 --> 00:00:20,800
speakers here on various aspects of this

9
00:00:24,710 --> 00:00:22,640
question and i would like to begin with

10
00:00:26,630 --> 00:00:24,720
the first of them robert curry robert

11
00:00:29,349 --> 00:00:26,640
curry will be speaking with us on

12
00:00:33,030 --> 00:00:29,359
conducting research in flight he is a

13
00:00:35,110 --> 00:00:33,040

korea-dryden individual who has

14
00:00:36,870 --> 00:00:35,120
both functioned on the the practice of

15
00:00:39,270 --> 00:00:36,880
of aerospace engineering and in the

16
00:00:40,389 --> 00:00:39,280
history his findings on topics that

17
00:00:42,229 --> 00:00:40,399
include

18
00:00:44,310 --> 00:00:42,239
oblique aircraft ground effect

19
00:00:46,470 --> 00:00:44,320
hypersonic flight flight tech flight

20
00:00:48,869 --> 00:00:46,480
test technique development uh published

21
00:00:50,470 --> 00:00:48,879
in over two dozen reports and papers he

22
00:00:52,150 --> 00:00:50,480
served as chief of the aerodynamics

23
00:00:54,790 --> 00:00:52,160
branch of dryden and is director of

24
00:00:57,750 --> 00:00:54,800
airborne sciences before retiring in

25
00:01:14,550 --> 00:00:57,760
2014 as the center's chief scientist bob

26
00:01:18,310 --> 00:01:16,630
so testing has always been an essential

27
00:01:21,030 --> 00:01:18,320
part of aviation

28
00:01:23,270 --> 00:01:21,040
and it demands a lot of respect and a

29
00:01:25,590 --> 00:01:23,280
great deal of discipline whether or not

30
00:01:28,630 --> 00:01:25,600
you're engaging in flight tests to

31
00:01:31,590 --> 00:01:28,640
validate proper maintenance or to

32
00:01:33,670 --> 00:01:31,600
certify a new design or to demonstrate

33
00:01:35,510 --> 00:01:33,680
advanced technologies

34
00:01:37,270 --> 00:01:35,520
and most people when they think of nasa

35
00:01:38,469 --> 00:01:37,280
and flight tests will associate with the

36
00:01:39,749 --> 00:01:38,479
idea of

37
00:01:41,590 --> 00:01:39,759
advanced test

38
00:01:44,950 --> 00:01:41,600

technology demonstration and of course

39
00:01:48,149 --> 00:01:44,960
this is an important aspect of

40
00:01:50,310 --> 00:01:48,159
aviation and nasa naca and other

41
00:01:51,830 --> 00:01:50,320
research and development organizations

42
00:01:54,230 --> 00:01:51,840
performed that sort of flight

43
00:01:55,910 --> 00:01:54,240
demonstration but today i'd like to

44
00:01:57,749 --> 00:01:55,920
focus on another

45
00:02:00,469 --> 00:01:57,759
aspect of flight test that's a little

46
00:02:02,630 --> 00:02:00,479
more uniquely associated with

47
00:02:04,230 --> 00:02:02,640
with naca and nasa

48
00:02:06,389 --> 00:02:04,240
and that is the idea of conducting

49
00:02:08,550 --> 00:02:06,399
scientific experiments

50
00:02:11,589 --> 00:02:08,560
in flight in order to advance the basic

51
00:02:13,510 --> 00:02:11,599
understanding of aeronautics

52
00:02:15,190 --> 00:02:13,520
and admittedly

53
00:02:17,110 --> 00:02:15,200
the difference between

54
00:02:19,430 --> 00:02:17,120
fundamental flight research

55
00:02:21,110 --> 00:02:19,440
and technology demonstration and flight

56
00:02:23,750 --> 00:02:21,120
can be confusing

57
00:02:26,229 --> 00:02:23,760
and dwelling on subtle distinctions can

58
00:02:29,270 --> 00:02:26,239
seem a little pedantic in some ways but

59
00:02:31,270 --> 00:02:29,280
i think of this centennial celebration

60
00:02:31,990 --> 00:02:31,280
it's important to draw some attention to

61
00:02:33,670 --> 00:02:32,000
it

62
00:02:36,070 --> 00:02:33,680
largely because naca played such an

63
00:02:38,390 --> 00:02:36,080

important role in developing the concept

64
00:02:39,910 --> 00:02:38,400
and the methodologies and also i think

65
00:02:42,550 --> 00:02:39,920
the distinction is going to become

66
00:02:44,470 --> 00:02:42,560
important as we look forward into into

67
00:02:45,350 --> 00:02:44,480
future projects

68
00:02:54,229 --> 00:02:45,360
um

69
00:02:59,270 --> 00:02:56,470
fundamental flight research experiments

70
00:03:01,670 --> 00:02:59,280
is to advance basic understanding

71
00:03:04,390 --> 00:03:01,680
largely through the validation

72
00:03:06,949 --> 00:03:04,400
of design tools that are then applied to

73
00:03:08,390 --> 00:03:06,959
next generations of airplanes

74
00:03:10,470 --> 00:03:08,400
and so

75
00:03:13,670 --> 00:03:10,480
flight research is inherently a high

76
00:03:15,430 --> 00:03:13,680
risk venture from a business perspective

77
00:03:17,830 --> 00:03:15,440
but on the other hand that makes it well

78
00:03:20,270 --> 00:03:17,840
suited for government sponsorship in

79
00:03:22,869 --> 00:03:20,280
that the results are typically

80
00:03:25,750 --> 00:03:22,879
pre-competitive they generally serve to

81
00:03:27,350 --> 00:03:25,760
raise the understanding for the entire

82
00:03:29,670 --> 00:03:27,360
industry rather than benefit a

83
00:03:31,270 --> 00:03:29,680
particular company or segment of the

84
00:03:33,030 --> 00:03:31,280
industry

85
00:03:34,949 --> 00:03:33,040
and

86
00:03:36,149 --> 00:03:34,959
flight research is also characterized by

87
00:03:38,550 --> 00:03:36,159
the need for

88
00:03:41,190 --> 00:03:38,560

scientific rigor in the performance

89
00:03:43,270 --> 00:03:41,200
whereas technology demonstrations can

90
00:03:45,750 --> 00:03:43,280
largely focus on

91
00:03:47,990 --> 00:03:45,760
measuring the actual characteristics of

92
00:03:50,550 --> 00:03:48,000
a vehicle in flight the integrated

93
00:03:53,509 --> 00:03:50,560
characteristics of a vehicle in flight

94
00:03:56,229 --> 00:03:53,519
flight research requires understanding

95
00:03:59,429 --> 00:03:56,239
the underlying physical processes

96
00:04:01,670 --> 00:03:59,439
suitable for design tool validation

97
00:04:04,149 --> 00:04:01,680
and so between this uh importance of a

98
00:04:06,789 --> 00:04:04,159
scientific orientation and the

99
00:04:08,710 --> 00:04:06,799
management of high risk uh nacos

100
00:04:11,190 --> 00:04:08,720
particularly well suited

101
00:04:13,429 --> 00:04:11,200
for its uh development

102
00:04:15,990 --> 00:04:13,439
i'd like to uh give a few aspects of the

103
00:04:17,830 --> 00:04:16,000
x1 project by way of example

104
00:04:19,270 --> 00:04:17,840
it's a landmark airplane that we're all

105
00:04:20,150 --> 00:04:19,280
familiar with

106
00:04:21,909 --> 00:04:20,160
and

107
00:04:24,710 --> 00:04:21,919
although many people will always think

108
00:04:26,230 --> 00:04:24,720
of the x1 as a kind of technology

109
00:04:28,710 --> 00:04:26,240
demonstrator

110
00:04:31,189 --> 00:04:28,720
meant to prove that supersonic flight

111
00:04:32,710 --> 00:04:31,199
was possible i think most of us here

112
00:04:35,830 --> 00:04:32,720
recognize that the

113
00:04:40,710 --> 00:04:38,310

out of a already established

114
00:04:42,390 --> 00:04:40,720
research effort that included

115
00:04:45,030 --> 00:04:42,400
theoretical analysis ground

116
00:04:47,030 --> 00:04:45,040
experimentation and even observations

117
00:04:49,189 --> 00:04:47,040
from high-speed flight

118
00:04:50,390 --> 00:04:49,199
but research into the phenomena was

119
00:04:52,550 --> 00:04:50,400
slowed down

120
00:04:53,909 --> 00:04:52,560
by the recognized fact that wind tunnels

121
00:04:55,990 --> 00:04:53,919
of the day

122
00:04:58,310 --> 00:04:56,000
did not accurately simulate transonic

123
00:05:00,870 --> 00:04:58,320
conditions and so the motivation behind

124
00:05:03,909 --> 00:05:00,880
the x1 was not so much to prove

125
00:05:06,390 --> 00:05:03,919
supersonic capability but to provide a

126
00:05:08,710 --> 00:05:06,400
laboratory for

127
00:05:11,029 --> 00:05:08,720
understanding for conducting controlled

128
00:05:12,390 --> 00:05:11,039
methodical experiments much like you

129
00:05:15,430 --> 00:05:12,400
might have preferred to do in a wind

130
00:05:16,950 --> 00:05:15,440
tunnel had it been available

131
00:05:18,070 --> 00:05:16,960
so

132
00:05:20,390 --> 00:05:18,080
there are

133
00:05:22,230 --> 00:05:20,400
many interesting back stories behind

134
00:05:24,469 --> 00:05:22,240
almost all of the design decisions that

135
00:05:27,189 --> 00:05:24,479
went into the x1 but these have been

136
00:05:30,390 --> 00:05:27,199
detailed in uh in several very excellent

137
00:05:32,310 --> 00:05:30,400
histories and so i won't review uh

138
00:05:33,430 --> 00:05:32,320

the the in the ins and outs of the

139
00:05:35,670 --> 00:05:33,440
process

140
00:05:37,590 --> 00:05:35,680
but i'd like to emphasize

141
00:05:40,070 --> 00:05:37,600
that the final decisions were always

142
00:05:41,350 --> 00:05:40,080
based on optimizing the research

143
00:05:42,950 --> 00:05:41,360
capability

144
00:05:45,270 --> 00:05:42,960
of the airplane

145
00:05:48,230 --> 00:05:45,280
all of the participating organizations

146
00:05:50,390 --> 00:05:48,240
came to accept that the x1 would be a

147
00:05:52,469 --> 00:05:50,400
pure research vehicle and not a

148
00:05:55,909 --> 00:05:52,479
prototype or a pathfinder

149
00:05:58,629 --> 00:05:55,919
toward a operational airplane

150
00:06:01,189 --> 00:05:58,639
the x1 ended up with a rocket engine to

151
00:06:03,270 --> 00:06:01,199
assure that it had access to the entire

152
00:06:04,390 --> 00:06:03,280
flight regime of interest

153
00:06:12,070 --> 00:06:04,400
and

154
00:06:13,590 --> 00:06:12,080
maximize the amount of time it had on in

155
00:06:16,390 --> 00:06:13,600
the test conditions

156
00:06:19,350 --> 00:06:16,400
both these decisions clearly depart from

157
00:06:21,830 --> 00:06:19,360
fleet-like aircraft operations

158
00:06:24,070 --> 00:06:21,840
the decision to use an unswept wing is

159
00:06:25,670 --> 00:06:24,080
interesting because it came at a time

160
00:06:27,909 --> 00:06:25,680
when it was already clear that swept

161
00:06:29,510 --> 00:06:27,919
wings uh had a lot of advantage for

162
00:06:31,510 --> 00:06:29,520
high-speed flight

163
00:06:33,110 --> 00:06:31,520

but despite knowing that a swept wing

164
00:06:36,870 --> 00:06:33,120
might have increased the form

165
00:06:38,469 --> 00:06:36,880
performance of the x1

166
00:06:40,309 --> 00:06:38,479
swept wings were still considered a

167
00:06:43,189 --> 00:06:40,319
developmental technology

168
00:06:44,950 --> 00:06:43,199
and so thinking like experimentalists it

169
00:06:47,510 --> 00:06:44,960
made perfect sense

170
00:06:50,230 --> 00:06:47,520
to use a conventional or unswept wing

171
00:06:52,550 --> 00:06:50,240
for this initial transonic research

172
00:06:54,550 --> 00:06:52,560
rather than risk confusing

173
00:06:56,629 --> 00:06:54,560
the findings with uh with other

174
00:06:59,670 --> 00:06:56,639
uncertainties

175
00:07:02,070 --> 00:06:59,680
the decision to give over the entire

176
00:07:04,790 --> 00:07:02,080
payload to instrumentation speaks for

177
00:07:07,830 --> 00:07:04,800
itself as it precluded any other

178
00:07:10,469 --> 00:07:07,840
military utility uh demonstrations

179
00:07:13,029 --> 00:07:10,479
and the resulting instrumentation was on

180
00:07:14,710 --> 00:07:13,039
the order of 500 pounds clearly more

181
00:07:17,029 --> 00:07:14,720
than would be needed to safely fly the

182
00:07:19,350 --> 00:07:17,039
airplane or to or to demonstrate

183
00:07:22,950 --> 00:07:19,360
supersonic flight

184
00:07:24,629 --> 00:07:22,960
but the researchers realized that the

185
00:07:27,189 --> 00:07:24,639
but the researchers realized that it was

186
00:07:28,790 --> 00:07:27,199
these detailed flight measurements that

187
00:07:31,110 --> 00:07:28,800
were the reason for the project in the

188
00:07:33,270 --> 00:07:31,120

first place the flight data were

189
00:07:35,589 --> 00:07:33,280
available for validation of the first

190
00:07:36,550 --> 00:07:35,599
large-scale ventilated throat wind

191
00:07:41,029 --> 00:07:36,560
tunnel

192
00:07:43,350 --> 00:07:41,039
the next era and the payoff

193
00:07:45,029 --> 00:07:43,360
of the x1 was not in a near-term

194
00:07:46,629 --> 00:07:45,039
military derivative

195
00:07:48,869 --> 00:07:46,639
but instead it came in the form of

196
00:07:50,550 --> 00:07:48,879
validated design tools

197
00:07:52,550 --> 00:07:50,560
uh in reliance

198
00:07:54,469 --> 00:07:52,560
that enabled reliable development of

199
00:08:01,270 --> 00:07:54,479
high-speed aircraft for

200
00:08:01,280 --> 00:08:04,309
um

201
00:08:08,629 --> 00:08:05,990
in this flight test mentality this

202
00:08:10,950 --> 00:08:08,639
flight research mentality carried over

203
00:08:14,230 --> 00:08:10,960
for many decades and i've shown here a

204
00:08:16,550 --> 00:08:14,240
fairly crude and not comprehensive

205
00:08:18,710 --> 00:08:16,560
uh list of flight research projects

206
00:08:19,830 --> 00:08:18,720
since the x1 and i really i restricted

207
00:08:21,189 --> 00:08:19,840
the list

208
00:08:23,430 --> 00:08:21,199
to large

209
00:08:24,390 --> 00:08:23,440
and complex projects suitable for

210
00:08:25,830 --> 00:08:24,400
government

211
00:08:28,469 --> 00:08:25,840
involvement

212
00:08:31,270 --> 00:08:28,479
and more particularly to uh flight

213
00:08:33,350 --> 00:08:31,280

projects that involved a configuration

214
00:08:35,829 --> 00:08:33,360
a configuration that had no practical

215
00:08:37,909 --> 00:08:35,839
value other than to collect long shelf

216
00:08:40,230 --> 00:08:37,919
life research data

217
00:08:42,149 --> 00:08:40,240
as you can see it's a fairly steady

218
00:08:43,750 --> 00:08:42,159
stream of projects that fall into all

219
00:08:45,590 --> 00:08:43,760
flight regimes

220
00:08:47,829 --> 00:08:45,600
if you study the details you'll see some

221
00:08:49,910 --> 00:08:47,839
of the projects were not led by nasa but

222
00:08:51,910 --> 00:08:49,920
most were and clearly the nasa

223
00:08:53,750 --> 00:08:51,920
aeronautics centers played a big role in

224
00:08:56,230 --> 00:08:53,760
all of these projects

225
00:08:58,150 --> 00:08:56,240
and this represents a huge body of work

226
00:08:59,590 --> 00:08:58,160
over the years

227
00:09:01,590 --> 00:08:59,600
before leaving the chart i'd like to

228
00:09:03,750 --> 00:09:01,600
point out that each of these projects

229
00:09:05,509 --> 00:09:03,760
became a flight experiment

230
00:09:07,590 --> 00:09:05,519
because there was some concern about

231
00:09:10,070 --> 00:09:07,600
whether ground facilities would provide

232
00:09:12,790 --> 00:09:10,080
misleading or erroneous results as in

233
00:09:18,150 --> 00:09:12,800
the case of the x1

234
00:09:21,110 --> 00:09:19,430
and

235
00:09:22,550 --> 00:09:21,120
it's important to recognize that all

236
00:09:24,470 --> 00:09:22,560
through this period

237
00:09:26,870 --> 00:09:24,480
wind tunnels have remained the preferred

238
00:09:28,949 --> 00:09:26,880

laboratory for aeronautics research

239
00:09:30,870 --> 00:09:28,959
after all they they offer the advantage

240
00:09:33,190 --> 00:09:30,880
of working with models that are smaller

241
00:09:35,430 --> 00:09:33,200
and simpler than aircraft and since the

242
00:09:37,430 --> 00:09:35,440
models are held fixed in the flow field

243
00:09:38,710 --> 00:09:37,440
it's much easier to isolate research

244
00:09:40,949 --> 00:09:38,720
variables

245
00:09:43,110 --> 00:09:40,959
however there are certain aspects of a

246
00:09:45,750 --> 00:09:43,120
full-scale vehicle in flight in the

247
00:09:48,710 --> 00:09:45,760
natural atmosphere that simply can't be

248
00:09:51,030 --> 00:09:48,720
replicated in any ground test facility

249
00:09:52,550 --> 00:09:51,040
and i'm not referring to unknown

250
00:09:55,590 --> 00:09:52,560
unknowns or

251
00:09:58,870 --> 00:09:55,600
uh debugging gremlins in the system but

252
00:10:00,150 --> 00:09:58,880
very specific physical characteristics

253
00:10:02,069 --> 00:10:00,160
and i've

254
00:10:04,470 --> 00:10:02,079
summarized some of them on

255
00:10:07,509 --> 00:10:04,480
on this chart here and i'd like to

256
00:10:09,350 --> 00:10:07,519
discuss these limitations briefly today

257
00:10:11,590 --> 00:10:09,360
not to diminish the importance of wind

258
00:10:13,750 --> 00:10:11,600
tunnels but because these limitations

259
00:10:16,470 --> 00:10:13,760
generally serve as a reason that some

260
00:10:18,310 --> 00:10:16,480
research topics simply require flight

261
00:10:20,790 --> 00:10:18,320
experimentation

262
00:10:23,190 --> 00:10:20,800
they may be negligible for some research

263
00:10:25,590 --> 00:10:23,200

topics but they are first order effects

264
00:10:27,750 --> 00:10:25,600
for others and in particular i think of

265
00:10:29,590 --> 00:10:27,760
flight dynamics into unusual

266
00:10:32,550 --> 00:10:29,600
configurations

267
00:10:33,750 --> 00:10:32,560
uh absolute aerodynamic performance

268
00:10:36,389 --> 00:10:33,760
predictions

269
00:10:38,470 --> 00:10:36,399
uh boundary layer characteristics

270
00:10:39,990 --> 00:10:38,480
phenomena that occur a long distance

271
00:10:42,150 --> 00:10:40,000
from an airplane

272
00:10:43,750 --> 00:10:42,160
and uh hypersonic flight

273
00:10:44,829 --> 00:10:43,760
especially when chemical reactions

274
00:10:47,269 --> 00:10:44,839
become

275
00:10:49,110 --> 00:10:47,279
significant but as i said these are

276
00:10:50,550 --> 00:10:49,120
recognized issues that have been studied

277
00:10:52,949 --> 00:10:50,560
for decades

278
00:10:55,190 --> 00:10:52,959
sophisticated test techniques advanced

279
00:10:57,269 --> 00:10:55,200
tunnel configurations and the use of

280
00:11:00,710 --> 00:10:57,279
numerical methods have been highly

281
00:11:02,710 --> 00:11:00,720
successful in addressing these concerns

282
00:11:04,949 --> 00:11:02,720
many years of experience in correlating

283
00:11:06,310 --> 00:11:04,959
wind tunnel and numerical predictions

284
00:11:08,470 --> 00:11:06,320
with flight data

285
00:11:10,310 --> 00:11:08,480
have been have resulted in a high degree

286
00:11:11,750 --> 00:11:10,320
of confidence in these ground-based

287
00:11:13,590 --> 00:11:11,760
design tools

288
00:11:15,269 --> 00:11:13,600

and this is proven by the efficiency

289
00:11:16,870 --> 00:11:15,279
with which modern aircraft are now

290
00:11:19,030 --> 00:11:16,880
developed

291
00:11:21,509 --> 00:11:19,040
but this confidence is only applicable

292
00:11:23,430 --> 00:11:21,519
to flight regimes and configurations for

293
00:11:25,430 --> 00:11:23,440
which considerable flight experience

294
00:11:27,990 --> 00:11:25,440
already exists

295
00:11:29,829 --> 00:11:28,000
and so as we consider future needs for

296
00:11:31,829 --> 00:11:29,839
flight research we should expect that

297
00:11:33,590 --> 00:11:31,839
the emphasis will go toward

298
00:11:35,590 --> 00:11:33,600
unconventional configurations and

299
00:11:37,030 --> 00:11:35,600
unexplored flight regimes

300
00:11:39,350 --> 00:11:37,040
and this of course still aligns

301
00:11:41,430 --> 00:11:39,360
perfectly with nasa's mission

302
00:11:43,670 --> 00:11:41,440
not so much to develop incremental

303
00:11:44,310 --> 00:11:43,680
improvements to the state of the art but

304
00:11:47,829 --> 00:11:44,320
in

305
00:11:49,350 --> 00:11:47,839
advancements

306
00:11:52,389 --> 00:11:49,360
and so i'd like to mention uh two

307
00:11:56,470 --> 00:11:52,399
research fields that hold great promise

308
00:11:58,150 --> 00:11:56,480
but which may be paced by access to

309
00:12:01,190 --> 00:11:58,160
reliable

310
00:12:05,750 --> 00:12:02,870
and the first is revolutionary

311
00:12:07,910 --> 00:12:05,760
advancements in space transportation

312
00:12:09,829 --> 00:12:07,920
starting in the mid 80s development of

313
00:12:12,470 --> 00:12:09,839

reusable single stage to orbit

314
00:12:14,710 --> 00:12:12,480
technologies and scramjet propulsion

315
00:12:16,389 --> 00:12:14,720
was a national priority

316
00:12:18,230 --> 00:12:16,399
but the focus of that attention was

317
00:12:19,389 --> 00:12:18,240
centered on

318
00:12:21,750 --> 00:12:19,399
singular

319
00:12:24,629 --> 00:12:21,760
all-encompassing flight demonstration

320
00:12:28,310 --> 00:12:24,639
projects in particular the x30 national

321
00:12:29,990 --> 00:12:28,320
aerospace plane and the x-33

322
00:12:31,750 --> 00:12:30,000
and this is where i believe it is uh

323
00:12:33,430 --> 00:12:31,760
still important to distinguish between

324
00:12:35,350 --> 00:12:33,440
the role of advanced

325
00:12:37,350 --> 00:12:35,360
technology flight demonstrators and

326
00:12:40,069 --> 00:12:37,360
fundamental flight research

327
00:12:41,990 --> 00:12:40,079
both the x30 and the x33 would have been

328
00:12:44,389 --> 00:12:42,000
giant leaps forward

329
00:12:46,550 --> 00:12:44,399
by integrating multiple new and emerging

330
00:12:48,629 --> 00:12:46,560
technologies they were expected to

331
00:12:50,470 --> 00:12:48,639
demonstrate full envelope payload

332
00:12:52,470 --> 00:12:50,480
carrying capability

333
00:12:54,870 --> 00:12:52,480
in a form that would have had immediate

334
00:12:56,629 --> 00:12:54,880
and profitable applications

335
00:12:58,069 --> 00:12:56,639
but neither of these projects succeeded

336
00:13:00,310 --> 00:12:58,079
to flight

337
00:13:01,990 --> 00:13:00,320
instead there has been a gradual return

338
00:13:05,190 --> 00:13:02,000

to hypersonic fundamental flight

339
00:13:07,269 --> 00:13:05,200
research in the form of an a very of a

340
00:13:10,310 --> 00:13:07,279
boundary layer transition experiment on

341
00:13:12,949 --> 00:13:10,320
the wing of a pegasus and then the x-43

342
00:13:15,190 --> 00:13:12,959
and x-51 experiments scramjet

343
00:13:20,389 --> 00:13:15,200
experiments

344
00:13:21,990 --> 00:13:20,399
launched boosted by a rocket

345
00:13:25,269 --> 00:13:22,000
for expedience

346
00:13:28,150 --> 00:13:25,279
and they collected data in a restricted

347
00:13:29,670 --> 00:13:28,160
test envelope for a very short duration

348
00:13:31,269 --> 00:13:29,680
but they have provided the first

349
00:13:33,590 --> 00:13:31,279
scramjet

350
00:13:35,590 --> 00:13:33,600
data flight data suitable for

351
00:13:38,230 --> 00:13:35,600
design not for

352
00:13:40,470 --> 00:13:38,240
suitable not for validation of a

353
00:13:42,949 --> 00:13:40,480
practical hypersonic vehicle but for the

354
00:13:45,110 --> 00:13:42,959
design tools that will be needed to

355
00:13:46,550 --> 00:13:45,120
develop such a such a vehicle in the

356
00:13:48,230 --> 00:13:46,560
future

357
00:13:50,230 --> 00:13:48,240
and there are of course many uh

358
00:13:52,870 --> 00:13:50,240
important design problems still to be

359
00:13:55,110 --> 00:13:52,880
addressed before we have airplane-like

360
00:13:56,949 --> 00:13:55,120
space transportation

361
00:13:57,750 --> 00:13:56,959
but many of these problems continue to

362
00:14:00,389 --> 00:13:57,760
still

363
00:14:02,710 --> 00:14:00,399

depend on high enthalpy flow fields

364
00:14:05,590 --> 00:14:02,720
which cannot be fully replicated at

365
00:14:07,829 --> 00:14:05,600
sufficient scale or time duration in any

366
00:14:10,470 --> 00:14:07,839
ground test facility

367
00:14:12,629 --> 00:14:10,480
now turning from the hypersonic problem

368
00:14:15,750 --> 00:14:12,639
flight research may also be an important

369
00:14:18,629 --> 00:14:15,760
step toward performance breakthroughs in

370
00:14:20,230 --> 00:14:18,639
subsonic air transportation

371
00:14:22,710 --> 00:14:20,240
although conventional

372
00:14:24,150 --> 00:14:22,720
tube and wing airliners are amazingly

373
00:14:27,030 --> 00:14:24,160
efficient

374
00:14:30,310 --> 00:14:27,040
research led by nasa indicates that 50

375
00:14:33,110 --> 00:14:30,320
to 70 improvements in fuel use noise and

376
00:14:35,350 --> 00:14:33,120
emissions are still possible

377
00:14:38,150 --> 00:14:35,360
but these benefits are

378
00:14:40,069 --> 00:14:38,160
depend on commitment to revolutionary

379
00:14:42,069 --> 00:14:40,079
new configurations

380
00:14:45,030 --> 00:14:42,079
many concepts are on the table but as

381
00:14:48,389 --> 00:14:45,040
shown in these three examples

382
00:14:50,150 --> 00:14:48,399
all depart drastically from conventional

383
00:14:52,470 --> 00:14:50,160
aircraft design

384
00:14:54,230 --> 00:14:52,480
wing dominated configurations with thick

385
00:14:56,150 --> 00:14:54,240
transonic sections

386
00:14:59,509 --> 00:14:56,160
highly flexible wings and propulsion

387
00:15:01,189 --> 00:14:59,519
systems that have inlets embedded into

388
00:15:03,910 --> 00:15:01,199

thick boundary layers

389
00:15:06,230 --> 00:15:03,920
are all of issues that could be

390
00:15:08,470 --> 00:15:06,240
challenging to adequately represent in

391
00:15:10,790 --> 00:15:08,480
any ground facility

392
00:15:13,750 --> 00:15:10,800
of course before any of these concepts

393
00:15:16,310 --> 00:15:13,760
would enter airline service an optimized

394
00:15:17,670 --> 00:15:16,320
full envelope flight demonstrator will

395
00:15:20,710 --> 00:15:17,680
be needed

396
00:15:22,949 --> 00:15:20,720
but as in the case of hypersonics it may

397
00:15:25,350 --> 00:15:22,959
be premature to build such a complex

398
00:15:27,430 --> 00:15:25,360
prototype into a more fundamental flight

399
00:15:31,749 --> 00:15:27,440
research experiments have validated the

400
00:15:33,829 --> 00:15:31,759
underlying mechanics and design tools

401
00:15:35,749 --> 00:15:33,839
and so the need for flight research will

402
00:15:37,430 --> 00:15:35,759
persist into the future

403
00:15:39,350 --> 00:15:37,440
although such projects will come at a

404
00:15:41,829 --> 00:15:39,360
higher cost than similar wind tunnel

405
00:15:44,069 --> 00:15:41,839
tests i'd like to to wrap up on a more

406
00:15:46,230 --> 00:15:44,079
positive note and point out that

407
00:15:48,150 --> 00:15:46,240
well-designed flight experiments can be

408
00:15:50,069 --> 00:15:48,160
much more affordable than the

409
00:15:52,150 --> 00:15:50,079
comprehensive all-encompassing

410
00:15:54,790 --> 00:15:52,160
technology demonstrators that are

411
00:15:56,790 --> 00:15:54,800
typically envisioned rather than

412
00:15:58,550 --> 00:15:56,800
creating research vehicles that have the

413
00:16:01,430 --> 00:15:58,560

appearance and the full envelope

414
00:16:03,269 --> 00:16:01,440
capability of an operational airplane

415
00:16:07,030 --> 00:16:03,279
research vehicles can be configured

416
00:16:10,310 --> 00:16:07,040
specifically for experimental needs

417
00:16:14,389 --> 00:16:12,550
over the years naca and then nasa have

418
00:16:16,310 --> 00:16:14,399
exploited this fact to conduct

419
00:16:18,069 --> 00:16:16,320
lower-cost experiments largely by

420
00:16:20,069 --> 00:16:18,079
incorporating them onto existing

421
00:16:22,230 --> 00:16:20,079
operational aircraft

422
00:16:24,710 --> 00:16:22,240
high-performance military aircraft are

423
00:16:26,389 --> 00:16:24,720
particularly well suited to this purpose

424
00:16:28,870 --> 00:16:26,399
even for technologies that apply to

425
00:16:31,189 --> 00:16:28,880
entirely different flight regimes

426
00:16:32,470 --> 00:16:31,199
they are robust have a large control

427
00:16:34,470 --> 00:16:32,480
envelope

428
00:16:36,389 --> 00:16:34,480
their excess power allows them to

429
00:16:38,470 --> 00:16:36,399
parametrically vary flight conditions

430
00:16:39,430 --> 00:16:38,480
above and below the flight the design

431
00:16:41,829 --> 00:16:39,440
point

432
00:16:43,430 --> 00:16:41,839
and by operating at a variety of dynamic

433
00:16:45,829 --> 00:16:43,440
pressures in altitude they can even

434
00:16:50,470 --> 00:16:45,839
systematically vary the

435
00:16:52,470 --> 00:16:50,480
viscous characteristics of a problem

436
00:16:57,030 --> 00:16:52,480
air launch

437
00:16:59,749 --> 00:16:57,040
cost of flight experiments that naca and

438
00:17:02,710 --> 00:16:59,759

nasa have exploited for decades

439
00:17:04,710 --> 00:17:02,720
the x1 was air launched from a b-29 and

440
00:17:06,549 --> 00:17:04,720
a similar carrier was used to launch the

441
00:17:08,710 --> 00:17:06,559
d-5582

442
00:17:12,069 --> 00:17:08,720
and the x-2

443
00:17:14,549 --> 00:17:12,079
in the 1950s a b-50 b-52 aircraft were

444
00:17:15,669 --> 00:17:14,559
configured to air launch the x-15 rocket

445
00:17:17,909 --> 00:17:15,679
airplane

446
00:17:20,870 --> 00:17:17,919
and this one-time investment continued

447
00:17:23,669 --> 00:17:20,880
to pay off for decades as a b-52 was

448
00:17:26,549 --> 00:17:23,679
used to support dozens of other entirely

449
00:17:28,710 --> 00:17:26,559
unrelated flight projects

450
00:17:30,630 --> 00:17:28,720
air launch allows researchers to focus

451
00:17:31,750 --> 00:17:30,640
on the experiment in the flight regime

452
00:17:33,590 --> 00:17:31,760
of interest

453
00:17:35,510 --> 00:17:33,600
rather than work through the numerous

454
00:17:38,549 --> 00:17:35,520
and costly design details that are

455
00:17:41,270 --> 00:17:38,559
needed for conventional takeoff and safe

456
00:17:43,270 --> 00:17:41,280
reliable operation through a large

457
00:17:45,830 --> 00:17:43,280
flight envelope

458
00:17:47,110 --> 00:17:45,840
towing offers another option for air

459
00:17:49,029 --> 00:17:47,120
launch

460
00:17:50,070 --> 00:17:49,039
in 1948

461
00:17:55,110 --> 00:17:50,080
naca

462
00:17:56,549 --> 00:17:55,120
air launch an unpowered p-51d

463
00:17:59,110 --> 00:17:56,559

to study wind tunnel to flight

464
00:18:01,110 --> 00:17:59,120
aerodynamic performance relationships

465
00:18:04,070 --> 00:18:01,120
and towing may become a very uh

466
00:18:06,390 --> 00:18:04,080
important test technique in the future

467
00:18:08,230 --> 00:18:06,400
the b-52 was an excellent carrier

468
00:18:10,150 --> 00:18:08,240
airplane for dropping dense vehicles

469
00:18:12,070 --> 00:18:10,160
with high wing loading

470
00:18:13,909 --> 00:18:12,080
but it may not be so appropriate for

471
00:18:15,510 --> 00:18:13,919
launching research vehicles that need to

472
00:18:16,310 --> 00:18:15,520
look more like

473
00:18:21,270 --> 00:18:16,320
the

474
00:18:25,990 --> 00:18:23,029
airline airliner concepts that we

475
00:18:28,070 --> 00:18:26,000
mentioned a few minutes ago

476
00:18:29,830 --> 00:18:28,080
studies into the use of towing and other

477
00:18:31,669 --> 00:18:29,840
more affordable flight test techniques

478
00:18:33,830 --> 00:18:31,679
are in progress now

479
00:18:36,470 --> 00:18:33,840
existing jet transport aircraft have

480
00:18:38,470 --> 00:18:36,480
sufficient thrust to tow very large

481
00:18:40,710 --> 00:18:38,480
research configurations to transonic

482
00:18:42,950 --> 00:18:40,720
speeds and high rental numbers

483
00:18:45,350 --> 00:18:42,960
and recent towing tests with the c-141

484
00:18:47,190 --> 00:18:45,360
and f-106 have demonstrated that the

485
00:18:48,630 --> 00:18:47,200
operational aspects are also quite

486
00:18:49,909 --> 00:18:48,640
manageable

487
00:18:52,150 --> 00:18:49,919
development of a very large

488
00:18:54,870 --> 00:18:52,160

multi-purpose glider which can air

489
00:18:57,750 --> 00:18:54,880
launch larger rocket boosted payloads is

490
00:18:59,990 --> 00:18:57,760
also under study

491
00:19:01,590 --> 00:19:00,000
and so in conclusion flight offers a

492
00:19:03,909 --> 00:19:01,600
unique environment for conducting

493
00:19:05,830 --> 00:19:03,919
fundamental aeronautics research

494
00:19:08,070 --> 00:19:05,840
for certain problems there is absolutely

495
00:19:10,789 --> 00:19:08,080
no substitute for it and enabling this

496
00:19:13,190 --> 00:19:10,799
capability with scientific rigor and

497
00:19:15,270 --> 00:19:13,200
innovative test methodologies has been

498
00:19:17,669 --> 00:19:15,280
an important contribution of naca and

499
00:19:19,190 --> 00:19:17,679
nasa that will be needed as we pursue

500
00:19:27,029 --> 00:19:19,200
revolutionary advancements into the

501
00:19:30,789 --> 00:19:28,630
one of the real pleasures of a

502
00:19:33,350 --> 00:19:30,799
conference like this is seeing so many

503
00:19:35,590 --> 00:19:33,360
uh younger and newer scholars that are

504
00:19:37,590 --> 00:19:35,600
doing uh quite extraordinary work in the

505
00:19:39,909 --> 00:19:37,600
field and we're fortunate to have one

506
00:19:41,430 --> 00:19:39,919
right now dr jeremy kinney he's a

507
00:19:44,070 --> 00:19:41,440
curator right here at the national air

508
00:19:45,750 --> 00:19:44,080
and space museum he's curated numerous

509
00:19:47,669 --> 00:19:45,760
exhibitions and frequently lectured on

510
00:19:49,750 --> 00:19:47,679
aviation history and the history of

511
00:19:52,470 --> 00:19:49,760
technology in general his books include

512
00:19:54,710 --> 00:19:52,480
airplanes the life story of a technology

513
00:19:57,430 --> 00:19:54,720

alaska and the airplane

514
00:19:59,270 --> 00:19:57,440
and the forthcoming the power for flight

515
00:20:01,270 --> 00:19:59,280
nasa's contributions to aircraft

516
00:20:03,590 --> 00:20:01,280
propulsion he has been a collaborator

517
00:20:05,190 --> 00:20:03,600
with jim hanson on the wind and beyond a

518
00:20:07,190 --> 00:20:05,200
documentary journey into the history of

519
00:20:09,909 --> 00:20:07,200
aerodynamics in america he will be

520
00:20:12,149 --> 00:20:09,919
speaking to us on the naca the airplane

521
00:20:16,230 --> 00:20:12,159
propeller in world war ii

522
00:20:16,240 --> 00:20:20,470
thank you very much

523
00:20:24,630 --> 00:20:22,630
it's my pleasure to be here with you

524
00:20:27,669 --> 00:20:24,640
all today to talk about the naca the

525
00:20:28,630 --> 00:20:27,679
airplane propeller in world war ii

526
00:20:30,789 --> 00:20:28,640
during

527
00:20:33,669 --> 00:20:30,799
the world war ii america's arsenal

528
00:20:36,070 --> 00:20:33,679
democracy produced almost 300 000

529
00:20:38,070 --> 00:20:36,080
bombers fighters and trainers and other

530
00:20:39,430 --> 00:20:38,080
types of aircraft to fight a global war

531
00:20:41,190 --> 00:20:39,440
in the air

532
00:20:43,510 --> 00:20:41,200
the overwhelming majority of those

533
00:20:46,230 --> 00:20:43,520
aircraft relied upon propellers to

534
00:20:48,630 --> 00:20:46,240
convert the power of piston engines into

535
00:20:50,390 --> 00:20:48,640
thrust needed for flight

536
00:20:52,149 --> 00:20:50,400
overall american industry produced

537
00:20:55,190 --> 00:20:52,159
approximately seven hundred thousand

538
00:20:57,590 --> 00:20:55,200

propellers for those weapons of war

539
00:20:59,029 --> 00:20:57,600
as part of that production program the

540
00:21:01,029 --> 00:20:59,039
government civilian organization

541
00:21:02,710 --> 00:21:01,039
responsible for aeronautical research

542
00:21:04,710 --> 00:21:02,720
the national advisory committee for

543
00:21:06,630 --> 00:21:04,720
aeronautics the naca

544
00:21:09,590 --> 00:21:06,640
offered both fundamental and applied

545
00:21:13,510 --> 00:21:09,600
solutions to the increased aerodynamic

546
00:21:17,029 --> 00:21:14,710
and this will

547
00:21:18,149 --> 00:21:17,039
cover both the traditional model as well

548
00:21:20,950 --> 00:21:18,159
as the

549
00:21:22,630 --> 00:21:20,960
private public model of world war ii for

550
00:21:25,190 --> 00:21:22,640
the naca

551
00:21:27,190 --> 00:21:25,200
the allies on the axis fought world war

552
00:21:28,789 --> 00:21:27,200
ii with the modern airplanes that

553
00:21:31,669 --> 00:21:28,799
emerged on the aeronautical design

554
00:21:33,830 --> 00:21:31,679
revolution of the 1920s and 30s

555
00:21:35,270 --> 00:21:33,840
in the name of higher faster and farther

556
00:21:38,149 --> 00:21:35,280
an international community of

557
00:21:40,710 --> 00:21:38,159
specialists reinvented the wood strut

558
00:21:43,190 --> 00:21:40,720
and wire braced biplane of world war one

559
00:21:45,029 --> 00:21:43,200
into the all-metal streamlined monoplane

560
00:21:47,270 --> 00:21:45,039
probably most recognized in the form of

561
00:21:48,710 --> 00:21:47,280
the highly successful douglas dc series

562
00:21:52,149 --> 00:21:48,720
of airliners

563
00:21:53,190 --> 00:21:52,159

the dc3 of december 1935 carried 21

564
00:21:55,110 --> 00:21:53,200
people

565
00:21:57,029 --> 00:21:55,120
and became the most popular and reliable

566
00:21:59,909 --> 00:21:57,039
propeller driven airliner in aviation

567
00:22:01,669 --> 00:21:59,919
history the naca's influence on the

568
00:22:03,350 --> 00:22:01,679
modern airliner can be seen in its

569
00:22:06,390 --> 00:22:03,360
advanced wing airfoils and engine

570
00:22:10,950 --> 00:22:09,029
while the dc-3 is the iconic symbol of

571
00:22:12,390 --> 00:22:10,960
this revolution in the sky

572
00:22:15,510 --> 00:22:12,400
there was a simultaneous

573
00:22:18,149 --> 00:22:15,520
transformation in military aircraft

574
00:22:21,430 --> 00:22:18,159
the boeing b-17 flying fortress replete

575
00:22:23,990 --> 00:22:21,440
with naca airfoils represented new

576
00:22:26,390 --> 00:22:24,000
capabilities in strategic bombardment

577
00:22:27,750 --> 00:22:26,400
and what the bomber would do in future

578
00:22:29,830 --> 00:22:27,760
wars

579
00:22:32,149 --> 00:22:29,840
as the aeronautical community made the

580
00:22:33,190 --> 00:22:32,159
commercial and military airplane more

581
00:22:35,430 --> 00:22:33,200
modern

582
00:22:37,350 --> 00:22:35,440
one thing was certain united states

583
00:22:39,270 --> 00:22:37,360
the propeller combined with a piston

584
00:22:41,029 --> 00:22:39,280
engine was a central technology in the

585
00:22:43,190 --> 00:22:41,039
synergy of design

586
00:22:46,070 --> 00:22:43,200
so the question today is what was the

587
00:22:48,230 --> 00:22:46,080
extent of the naca's role in propeller

588
00:22:51,510 --> 00:22:48,240

development

589
00:22:53,830 --> 00:22:51,520
i would like to begin with what the naca

590
00:22:55,750 --> 00:22:53,840
faced in 1915 regarding the state of

591
00:22:57,909 --> 00:22:55,760
propeller development

592
00:23:00,390 --> 00:22:57,919
along with being the first successfully

593
00:23:02,149 --> 00:23:00,400
to develop a practical flying machine

594
00:23:03,669 --> 00:23:02,159
wilbur and orville wright were also the

595
00:23:05,350 --> 00:23:03,679
first to address the propeller from a

596
00:23:07,110 --> 00:23:05,360
theoretical and overall original

597
00:23:08,710 --> 00:23:07,120
standpoint

598
00:23:11,669 --> 00:23:08,720
the rights came to the conclusion during

599
00:23:14,710 --> 00:23:11,679
the winter of 1902 and 1903 that a

600
00:23:16,630 --> 00:23:14,720
propeller was a rotary wing or airfoil

601
00:23:18,310 --> 00:23:16,640
which generated aerodynamic thrust to

602
00:23:20,230 --> 00:23:18,320
achieve propulsion

603
00:23:22,789 --> 00:23:20,240
so the wright successfully designed two

604
00:23:24,950 --> 00:23:22,799
propellers for their 1903 flyer that

605
00:23:26,870 --> 00:23:24,960
were efficient enough to transfer power

606
00:23:28,549 --> 00:23:26,880
from their 12 horsepower internal

607
00:23:31,270 --> 00:23:28,559
combustion engine to achieve powered

608
00:23:36,310 --> 00:23:33,750
a propeller community existed since the

609
00:23:37,830 --> 00:23:36,320
early days of the airplane during the

610
00:23:40,310 --> 00:23:37,840
years proceeding and following the

611
00:23:42,149 --> 00:23:40,320
right's achievement at kitty hawk

612
00:23:43,830 --> 00:23:42,159
aeronautical enthusiasts experimented

613
00:23:45,190 --> 00:23:43,840

with a variety of propeller designs and

614
00:23:46,950 --> 00:23:45,200
materials

615
00:23:48,789 --> 00:23:46,960
the aeronautical community chose to

616
00:23:51,029 --> 00:23:48,799
focus on its improved version of the

617
00:23:53,990 --> 00:23:51,039
rights propeller which had a permanently

618
00:23:55,750 --> 00:23:54,000
set blade angle called fixed pitch and

619
00:23:56,950 --> 00:23:55,760
made from layers of wood

620
00:23:59,350 --> 00:23:56,960
it was cheap

621
00:24:02,230 --> 00:23:59,360
easy to manufacture fit well into the

622
00:24:04,070 --> 00:24:02,240
established design paradigm of keeping

623
00:24:06,549 --> 00:24:04,080
everything in an airplane as light and

624
00:24:08,390 --> 00:24:06,559
simple as possible and most importantly

625
00:24:11,830 --> 00:24:08,400
it worked for the thousands of airplanes

626
00:24:16,830 --> 00:24:15,110
at its first meeting in 1915 the naca

627
00:24:20,230 --> 00:24:16,840
acknowledged that more efficient

628
00:24:22,230 --> 00:24:20,240
propellers able to generate more thrust

629
00:24:23,990 --> 00:24:22,240
for a variety of flight conditions was a

630
00:24:25,510 --> 00:24:24,000
primary challenge facing american

631
00:24:27,430 --> 00:24:25,520
aeronautics

632
00:24:29,269 --> 00:24:27,440
as a result one of the earliest and most

633
00:24:31,110 --> 00:24:29,279
consistently funded programs was

634
00:24:32,789 --> 00:24:31,120
propeller research

635
00:24:36,070 --> 00:24:32,799
until the completion of the langley

636
00:24:38,710 --> 00:24:36,080
memorial aeronautical laboratory in 1920

637
00:24:40,630 --> 00:24:38,720
the naca concentrated its main effort at

638
00:24:42,789 --> 00:24:40,640

stanford university

639
00:24:44,789 --> 00:24:42,799
near palo alto california under the

640
00:24:46,630 --> 00:24:44,799
leadership of professors william f duran

641
00:24:48,789 --> 00:24:46,640
one of the committee members

642
00:24:50,870 --> 00:24:48,799
and everett p leslie

643
00:24:53,350 --> 00:24:50,880
duran and leslie's broad-based study of

644
00:24:55,830 --> 00:24:53,360
propeller performance and entitled

645
00:24:58,789 --> 00:24:55,840
experimental research on air propellers

646
00:25:00,549 --> 00:24:58,799
ran from 1917 to 1922.

647
00:25:02,789 --> 00:25:00,559
this groundbreaking series of

648
00:25:05,269 --> 00:25:02,799
experiments established a standard table

649
00:25:06,710 --> 00:25:05,279
of propeller coefficients available to

650
00:25:09,669 --> 00:25:06,720
designers through mathematical

651
00:25:12,789 --> 00:25:09,679
calculation and wind tunnel studies

652
00:25:15,110 --> 00:25:12,799
noted aerodynamicist max monk asserted

653
00:25:17,350 --> 00:25:15,120
that the naca sponsored stanford

654
00:25:21,029 --> 00:25:17,360
university propeller study was the most

655
00:25:23,269 --> 00:25:21,039
perfect and complete one ever published

656
00:25:25,590 --> 00:25:23,279
as the engineers at langley designed and

657
00:25:27,909 --> 00:25:25,600
constructed the tools for continued work

658
00:25:29,909 --> 00:25:27,919
in aeronautics they were able to make

659
00:25:31,510 --> 00:25:29,919
their own investigations into basic

660
00:25:33,830 --> 00:25:31,520
propeller research

661
00:25:35,750 --> 00:25:33,840
early tests of propeller blade profiles

662
00:25:38,230 --> 00:25:35,760
in the variable density tunnel

663
00:25:41,590 --> 00:25:38,240

however proved unsatisfactory

664
00:25:44,230 --> 00:25:41,600
a 1925 nac report asserted that

665
00:25:46,870 --> 00:25:44,240
researchers could never rely absolutely

666
00:25:49,269 --> 00:25:46,880
upon model data until they verify that

667
00:25:51,430 --> 00:25:49,279
data through full flight tests

668
00:25:54,070 --> 00:25:51,440
the inadequacies of theoretical and

669
00:25:56,390 --> 00:25:54,080
model propeller testing convinced the

670
00:25:58,789 --> 00:25:56,400
committee that the hybridization of full

671
00:26:00,549 --> 00:25:58,799
flight testing with wind tunnel testing

672
00:26:02,950 --> 00:26:00,559
was necessary

673
00:26:05,029 --> 00:26:02,960
what the naca needed was the ability to

674
00:26:07,350 --> 00:26:05,039
test the aerodynamic properties of

675
00:26:09,510 --> 00:26:07,360
full-scale propellers which led to the

676
00:26:12,950 --> 00:26:09,520
construction and design of the propeller

677
00:26:15,669 --> 00:26:12,960
research tunnel in 1927 which became a

678
00:26:18,870 --> 00:26:15,679
seminal tool in propeller analysis and

679
00:26:21,590 --> 00:26:18,880
propulsion airframe integration

680
00:26:23,430 --> 00:26:21,600
now as the naca and its researchers were

681
00:26:25,350 --> 00:26:23,440
finalizing the methodology of the

682
00:26:26,789 --> 00:26:25,360
aerodynamic design and evaluation of

683
00:26:28,789 --> 00:26:26,799
propeller blades

684
00:26:30,390 --> 00:26:28,799
specialists working for other government

685
00:26:31,669 --> 00:26:30,400
research organizations primarily the

686
00:26:33,990 --> 00:26:31,679
army

687
00:26:36,630 --> 00:26:34,000
and industry reinvented the wood fixed

688
00:26:39,430 --> 00:26:36,640

pitch propeller into its modern form

689
00:26:41,269 --> 00:26:39,440
as early as 1918 william f durand

690
00:26:43,510 --> 00:26:41,279
advocated that the development of a

691
00:26:45,669 --> 00:26:43,520
workable variable pitch propeller

692
00:26:47,430 --> 00:26:45,679
capable of changing blade angle and by

693
00:26:49,190 --> 00:26:47,440
extension providing efficiency for

694
00:26:51,590 --> 00:26:49,200
different flight conditions like an

695
00:26:53,830 --> 00:26:51,600
automobile gear shift was of the highest

696
00:26:55,830 --> 00:26:53,840
order report of importance

697
00:26:57,669 --> 00:26:55,840
and outstanding as one of the appliances

698
00:27:02,230 --> 00:26:57,679
for which the art of aerial navigation

699
00:27:07,190 --> 00:27:04,149
the true innovations and propellers in

700
00:27:08,789 --> 00:27:07,200
the 20s late 20s and early 1930s were in

701
00:27:10,390 --> 00:27:08,799
the materials used for the blades

702
00:27:12,310 --> 00:27:10,400
aluminum alloys

703
00:27:13,269 --> 00:27:12,320
and the mechanism for changing blade

704
00:27:16,950 --> 00:27:13,279
pitch

705
00:27:18,630 --> 00:27:16,960
by 1937 hamilton standard and curtis

706
00:27:22,070 --> 00:27:18,640
offered automatic constant speed

707
00:27:24,630 --> 00:27:22,080
propellers to the aeronautical community

708
00:27:26,630 --> 00:27:24,640
so the naca's principal contribution in

709
00:27:28,149 --> 00:27:26,640
the late 1920s and 30s the same

710
00:27:30,630 --> 00:27:28,159
revolutionary moment for the variable

711
00:27:32,870 --> 00:27:30,640
pitch propeller was improved propeller

712
00:27:35,029 --> 00:27:32,880
efficiency at high speeds regardless of

713
00:27:37,510 --> 00:27:35,039

materials or mechanism

714
00:27:39,029 --> 00:27:37,520
as aircraft speeds increased shock waves

715
00:27:41,510 --> 00:27:39,039
and compressibility decreased the

716
00:27:44,389 --> 00:27:41,520
efficiency of the well-known and proven

717
00:27:46,950 --> 00:27:44,399
raf6 and clark wire airfoils at the

718
00:27:49,269 --> 00:27:46,960
blade tips and all along the blade

719
00:27:51,669 --> 00:27:49,279
the naca recognized that efficiencies

720
00:27:53,750 --> 00:27:51,679
dropped to 70 percent as speeds

721
00:27:55,430 --> 00:27:53,760
increased and made propeller development

722
00:27:57,510 --> 00:27:55,440
a major focus

723
00:27:59,350 --> 00:27:57,520
langley sponsored three programs

724
00:28:01,830 --> 00:27:59,360
addressing propeller efficiency

725
00:28:03,510 --> 00:28:01,840
conducted by eastman jacobs and the vdt

726
00:28:05,750 --> 00:28:03,520
fred wike and the propeller research

727
00:28:07,269 --> 00:28:05,760
tunnel on john stack in the 24-inch

728
00:28:11,350 --> 00:28:07,279
high-speed tunnel

729
00:28:12,789 --> 00:28:11,360
in 1934 the naca introduced the 24

730
00:28:15,430 --> 00:28:12,799
family of air force and provided

731
00:28:17,350 --> 00:28:15,440
efficiency at high speeds

732
00:28:19,909 --> 00:28:17,360
continued wind tunnel and flight tests

733
00:28:22,470 --> 00:28:19,919
revealed promising areas of research and

734
00:28:24,149 --> 00:28:22,480
expanding performance centering on blade

735
00:28:26,630 --> 00:28:24,159
air force sections that would offer

736
00:28:28,230 --> 00:28:26,640
higher critical speeds that is the point

737
00:28:30,710 --> 00:28:28,240
where the drag of the blade began to

738
00:28:32,070 --> 00:28:30,720

rapidly increase reducing propeller

739
00:28:34,310 --> 00:28:32,080
efficiency

740
00:28:36,789 --> 00:28:34,320
so the naca announced a new family of

741
00:28:39,590 --> 00:28:36,799
airfoils the 16 series

742
00:28:41,269 --> 00:28:39,600
in 1939 and john stack's important

743
00:28:43,590 --> 00:28:41,279
advanced confidential report that you

744
00:28:46,389 --> 00:28:43,600
see here tests of airfoils designed to

745
00:28:49,110 --> 00:28:46,399
delay the compressibility burble

746
00:28:50,950 --> 00:28:49,120
these thin airfoils facilitated faster

747
00:28:52,630 --> 00:28:50,960
and more efficient blades

748
00:28:55,430 --> 00:28:52,640
and the distribution of the report to

749
00:28:57,750 --> 00:28:55,440
the army navy and manufacturers ensured

750
00:28:59,909 --> 00:28:57,760
the 16 series became the new choice for

751
00:29:01,669 --> 00:28:59,919
high-speed propellers on aircraft

752
00:29:05,590 --> 00:29:01,679
designed for speeds approaching 500

753
00:29:10,070 --> 00:29:07,830
regardless of whether the blade profile

754
00:29:13,669 --> 00:29:10,080
was an raf6 a clark y

755
00:29:15,269 --> 00:29:13,679
or a 16 series naca researchers also

756
00:29:17,350 --> 00:29:15,279
work to refine the aerodynamic

757
00:29:19,190 --> 00:29:17,360
properties of a propeller blade along

758
00:29:21,430 --> 00:29:19,200
its entire length

759
00:29:24,070 --> 00:29:21,440
with airfoil sections called cluffs

760
00:29:26,230 --> 00:29:24,080
cuffs excuse me so what you see here is

761
00:29:27,990 --> 00:29:26,240
a propeller with our young pursuit pilot

762
00:29:29,830 --> 00:29:28,000
in the late interwar period with a

763
00:29:31,510 --> 00:29:29,840

propeller it's very round at the roots

764
00:29:33,190 --> 00:29:31,520
of the blades

765
00:29:34,630 --> 00:29:33,200
that's a compromise because you need

766
00:29:36,549 --> 00:29:34,640
that for structural strength not

767
00:29:37,430 --> 00:29:36,559
aerodynamic efficiency

768
00:29:39,669 --> 00:29:37,440
so

769
00:29:41,909 --> 00:29:39,679
covering that root

770
00:29:44,789 --> 00:29:41,919
with a structure that actually has an

771
00:29:47,990 --> 00:29:44,799
aerodynamic profile increases efficiency

772
00:29:50,470 --> 00:29:48,000
all along the length of the blade

773
00:29:51,350 --> 00:29:50,480
it also provides cooling for a radial

774
00:29:54,310 --> 00:29:51,360
engine

775
00:29:56,389 --> 00:29:54,320
beginning in 1939 as part of the overall

776
00:29:57,510 --> 00:29:56,399
drag reduction program in the full-scale

777
00:29:59,590 --> 00:29:57,520
tunnel

778
00:30:02,389 --> 00:29:59,600
researchers at langley found

779
00:30:05,669 --> 00:30:02,399
that a single-engine fighter that was

780
00:30:08,149 --> 00:30:05,679
theoretically capable 400 miles per hour

781
00:30:11,029 --> 00:30:08,159
could do so with a new blade cuff

782
00:30:13,510 --> 00:30:11,039
installation on that structure

783
00:30:15,510 --> 00:30:13,520
so fabricating cuffs secure covered 45

784
00:30:17,430 --> 00:30:15,520
percent of the structure the blade

785
00:30:19,350 --> 00:30:17,440
increased the blade area enabled a

786
00:30:21,590 --> 00:30:19,360
calculated 400 miles per hour from this

787
00:30:23,750 --> 00:30:21,600
airplane this is an earlier attempt at

788
00:30:27,510 --> 00:30:23,760

that in the full-scale tunnel with a

789
00:30:32,470 --> 00:30:29,669
also to increase thrust

790
00:30:34,149 --> 00:30:32,480
naca researchers investigated wider or

791
00:30:36,470 --> 00:30:34,159
paddle blade

792
00:30:37,350 --> 00:30:36,480
blades that featured a larger cord

793
00:30:39,029 --> 00:30:37,360
length

794
00:30:41,430 --> 00:30:39,039
from leading to trailing edge more

795
00:30:43,350 --> 00:30:41,440
surface area means more thrust

796
00:30:44,950 --> 00:30:43,360
and propeller manufacturers adopted

797
00:30:46,870 --> 00:30:44,960
these innovations as part of their

798
00:30:49,350 --> 00:30:46,880
contribution to the synergistic design

799
00:30:51,909 --> 00:30:49,360
of military aircraft during world war ii

800
00:30:54,070 --> 00:30:51,919
especially after late 1943

801
00:30:56,950 --> 00:30:54,080
the 400 mile per hour north american

802
00:30:58,789 --> 00:30:56,960
p-51 mustang fighter was a refined

803
00:31:00,870 --> 00:30:58,799
war-winning weapon capable of ranging

804
00:31:03,190 --> 00:31:00,880
deep into nazi germany or fighting

805
00:31:05,110 --> 00:31:03,200
imperial japan and china that relied

806
00:31:07,909 --> 00:31:05,120
upon both paddle blades and blade cuffs

807
00:31:10,230 --> 00:31:07,919
for increased performance

808
00:31:13,029 --> 00:31:10,240
cuff propellers also improved the rate

809
00:31:13,909 --> 00:31:13,039
of of climb and the cooling of radial

810
00:31:15,990 --> 00:31:13,919
engine

811
00:31:18,789 --> 00:31:16,000
designed such as the republic p47

812
00:31:20,789 --> 00:31:18,799
thunderbolt who gained an extra 400 feet

813
00:31:22,310 --> 00:31:20,799

per minute climb by the use of cuffs and

814
00:31:24,070 --> 00:31:22,320
paddle blades

815
00:31:26,710 --> 00:31:24,080
and also the boeing b-29 super

816
00:31:28,470 --> 00:31:26,720
fortresses of the 509th composite group

817
00:31:30,549 --> 00:31:28,480
the world's first atomic

818
00:31:33,110 --> 00:31:30,559
bombing force

819
00:31:34,870 --> 00:31:33,120
and their notoriously finicky r3350

820
00:31:37,350 --> 00:31:34,880
radial engines benefited from the use of

821
00:31:39,509 --> 00:31:37,360
cuffs during the war

822
00:31:42,070 --> 00:31:39,519
another innovation was dual rotation or

823
00:31:44,070 --> 00:31:42,080
contra rotation the use of two sets of

824
00:31:46,389 --> 00:31:44,080
propellers connected to one engine and

825
00:31:48,389 --> 00:31:46,399
rotating in opposite directions that

826
00:31:50,149 --> 00:31:48,399
alleviated torque roll of the sideways

827
00:31:52,389 --> 00:31:50,159
direction imparted by the rotation of

828
00:31:54,870 --> 00:31:52,399
one propeller and it maximized the

829
00:31:56,870 --> 00:31:54,880
energy of two propellers

830
00:31:59,590 --> 00:31:56,880
only used on some aircraft langley's

831
00:32:02,789 --> 00:31:59,600
showing this is a new idea that improves

832
00:32:04,710 --> 00:32:02,799
the performance of propellers

833
00:32:07,029 --> 00:32:04,720
during world war ii langley was the

834
00:32:09,110 --> 00:32:07,039
center of the naca study in improving

835
00:32:10,310 --> 00:32:09,120
propellers with high thrust at high

836
00:32:12,230 --> 00:32:10,320
speeds

837
00:32:14,789 --> 00:32:12,240
in addition to the work on cuffs paddle

838
00:32:16,870 --> 00:32:14,799

blades and contra rotating propellers

839
00:32:19,430 --> 00:32:16,880
the naca and its research staff

840
00:32:20,950 --> 00:32:19,440
succeeded in reducing rpm while

841
00:32:23,830 --> 00:32:20,960
increasing horsepower speed and

842
00:32:27,830 --> 00:32:23,840
efficiency overall from 84 percent in

843
00:32:30,310 --> 00:32:27,840
1930 to 90 percent by 1945 and the

844
00:32:33,190 --> 00:32:30,320
majority of this work took place in the

845
00:32:34,950 --> 00:32:33,200
8 and 16 foot high-speed tunnels under

846
00:32:36,470 --> 00:32:34,960
the direction of john stack

847
00:32:38,789 --> 00:32:36,480
melvin gough and conducted a

848
00:32:40,470 --> 00:32:38,799
simultaneous flight research program

849
00:32:41,909 --> 00:32:40,480
and theodore theodorsen and his

850
00:32:43,909 --> 00:32:41,919
colleagues in the physical research

851
00:32:45,830 --> 00:32:43,919
division investigated vibration and

852
00:32:48,630 --> 00:32:45,840
flutter

853
00:32:50,149 --> 00:32:48,640
as the work proceeded at langley

854
00:32:52,230 --> 00:32:50,159
surrounded by representatives of the

855
00:32:54,389 --> 00:32:52,240
both the military and industry the

856
00:32:56,070 --> 00:32:54,399
naca's director of aeronautical research

857
00:32:58,870 --> 00:32:56,080
george lewis broke ground for the

858
00:33:01,509 --> 00:32:58,880
committee's new aircraft engine research

859
00:33:03,750 --> 00:33:01,519
laboratory the aerl at cleveland in

860
00:33:06,310 --> 00:33:03,760
january 1941.

861
00:33:08,149 --> 00:33:06,320
the creation of the aerl reflected the

862
00:33:10,630 --> 00:33:08,159
widely held belief that the united

863
00:33:12,710 --> 00:33:10,640

states needed to retain superiority and

864
00:33:14,549 --> 00:33:12,720
aeronautical technology vis-a-vis europe

865
00:33:16,870 --> 00:33:14,559
in the late 1930s and especially in

866
00:33:19,269 --> 00:33:16,880
propulsion

867
00:33:21,669 --> 00:33:19,279
after american entry into the war they

868
00:33:23,509 --> 00:33:21,679
ate aerl with the use of the new

869
00:33:25,830 --> 00:33:23,519
altitude wind tunnel which was the

870
00:33:27,909 --> 00:33:25,840
centerpiece of this new facility they

871
00:33:29,750 --> 00:33:27,919
worked hand-in-hand with government

872
00:33:31,909 --> 00:33:29,760
industry and military

873
00:33:34,549 --> 00:33:31,919
testing and improving existing

874
00:33:37,990 --> 00:33:34,559
technology as well as new designs

875
00:33:40,310 --> 00:33:38,000
what you see here is the massive

876
00:33:42,710 --> 00:33:40,320
douglas sky pirate propulsion system of

877
00:33:44,710 --> 00:33:42,720
a 28 cylinder radial engine and an eight

878
00:33:45,990 --> 00:33:44,720
blade contra rotating propeller system

879
00:33:49,029 --> 00:33:46,000
being tested

880
00:33:51,430 --> 00:33:49,039
and so what the awt was able to do

881
00:33:53,350 --> 00:33:51,440
was replicate a simulated altitude of

882
00:33:55,110 --> 00:33:53,360
thirty thousand feet at four hundred

883
00:33:56,549 --> 00:33:55,120
ninety miles per hour so you can bring

884
00:33:59,509 --> 00:33:56,559
that testing down to the ground and

885
00:34:01,990 --> 00:33:59,519
really focus on that

886
00:34:03,750 --> 00:34:02,000
as world war two raged on and the naca

887
00:34:05,750 --> 00:34:03,760
worked with industry

888
00:34:08,550 --> 00:34:05,760

the naca was completely unaware of the

889
00:34:10,310 --> 00:34:08,560
impending turbo revolution that emerged

890
00:34:11,829 --> 00:34:10,320
in europe with aircraft like the first

891
00:34:12,629 --> 00:34:11,839
practical jet airplane that measures

892
00:34:14,389 --> 00:34:12,639
schmidt

893
00:34:17,270 --> 00:34:14,399
262.

894
00:34:19,270 --> 00:34:17,280
the naca and the american aeronautical

895
00:34:21,030 --> 00:34:19,280
community concentrated on present and

896
00:34:23,349 --> 00:34:21,040
immediate needs that reflected the

897
00:34:26,149 --> 00:34:23,359
dominance of the propeller in the piston

898
00:34:28,149 --> 00:34:26,159
engine as the primary propulsion system

899
00:34:30,629 --> 00:34:28,159
when faced with fighting a global aerial

900
00:34:31,829 --> 00:34:30,639
war the american military embraced the

901
00:34:34,310 --> 00:34:31,839
standard

902
00:34:36,629 --> 00:34:34,320
and wedded it to large scale production

903
00:34:38,389 --> 00:34:36,639
programs to avoid the strategic mistake

904
00:34:40,069 --> 00:34:38,399
of putting too much emphasis on new

905
00:34:42,310 --> 00:34:40,079
technologies that would only be

906
00:34:44,710 --> 00:34:42,320
practical in the long term and after

907
00:34:46,069 --> 00:34:44,720
costly research and development

908
00:34:48,710 --> 00:34:46,079
not immediately on the aerial

909
00:34:50,790 --> 00:34:48,720
battlefields around the world

910
00:34:52,550 --> 00:34:50,800
but with the war over

911
00:34:54,230 --> 00:34:52,560
the aeronautical community was at a

912
00:34:55,510 --> 00:34:54,240
crossroads during the early days of the

913
00:34:57,349 --> 00:34:55,520

cold war

914
00:34:59,270 --> 00:34:57,359
would it continue with propeller driven

915
00:35:00,790 --> 00:34:59,280
piston engine aircraft or go with the

916
00:35:02,550 --> 00:35:00,800
new technology

917
00:35:04,870 --> 00:35:02,560
and there were multiple alternatives

918
00:35:06,150 --> 00:35:04,880
including the turbo prop a combination

919
00:35:08,470 --> 00:35:06,160
of a gas turbine engine with the

920
00:35:10,710 --> 00:35:08,480
propeller

921
00:35:13,349 --> 00:35:10,720
nevertheless the apparent primacy of the

922
00:35:16,310 --> 00:35:13,359
turbojet led one popular aviation writer

923
00:35:17,750 --> 00:35:16,320
to ask in early 1948 has the propeller a

924
00:35:20,310 --> 00:35:17,760
future

925
00:35:22,150 --> 00:35:20,320
back to fundamental research the naca

926
00:35:24,230 --> 00:35:22,160
and the propeller community conducted

927
00:35:26,390 --> 00:35:24,240
numerous wind tunnel and flight research

928
00:35:27,670 --> 00:35:26,400
experiments to see if they could provide

929
00:35:29,589 --> 00:35:27,680
the answer

930
00:35:30,630 --> 00:35:29,599
such promising programs appeared to be

931
00:35:32,710 --> 00:35:30,640
futile

932
00:35:35,589 --> 00:35:32,720
in the early days of the jet age at a

933
00:35:37,990 --> 00:35:35,599
1949 naca conference on transonic

934
00:35:39,829 --> 00:35:38,000
aircraft design a hamilton standard

935
00:35:41,270 --> 00:35:39,839
engineer having just reported on the

936
00:35:43,829 --> 00:35:41,280
results of wind tunnel tests on a

937
00:35:46,230 --> 00:35:43,839
supersonic propeller for a u.s air force

938
00:35:48,710 --> 00:35:46,240

contract remarked that compared to a jet

939
00:35:51,510 --> 00:35:48,720
engine even if the propeller is good it

940
00:35:56,710 --> 00:35:54,550
one focus that was pursued was

941
00:35:57,589 --> 00:35:56,720
developing supersonic propellers capable

942
00:36:00,069 --> 00:35:57,599
of

943
00:36:02,630 --> 00:36:00,079
taking long-range transport aircraft

944
00:36:05,030 --> 00:36:02,640
into the transonic regime from mach 0.8

945
00:36:06,670 --> 00:36:05,040
to mach 1.2

946
00:36:09,349 --> 00:36:06,680
during the second aeronautical

947
00:36:11,349 --> 00:36:09,359
revolution that's happening now

948
00:36:14,550 --> 00:36:11,359
in europe and north america

949
00:36:17,349 --> 00:36:14,560
at the langley laboratory naca engineers

950
00:36:19,030 --> 00:36:17,359
created a propeller research airplane by

951
00:36:21,030 --> 00:36:19,040
installing an aero products propeller

952
00:36:24,150 --> 00:36:21,040
and a turboprop engine in the nodes of

953
00:36:27,030 --> 00:36:24,160
the mcdonnell xf-88b testbed

954
00:36:30,390 --> 00:36:27,040
the flight program ran from 1953 through

955
00:36:32,870 --> 00:36:30,400
1956 and revealed a propeller design

956
00:36:36,550 --> 00:36:32,880
that was 79 percent efficient at a speed

957
00:36:40,069 --> 00:36:38,630
the aranachal community though faced

958
00:36:42,710 --> 00:36:40,079
many development problems with

959
00:36:44,390 --> 00:36:42,720
supersonic propellers in the 1950s

960
00:36:46,710 --> 00:36:44,400
which seemed

961
00:36:48,550 --> 00:36:46,720
unnecessary if jet technology provided

962
00:36:50,230 --> 00:36:48,560
equal or better performance

963
00:36:52,950 --> 00:36:50,240

a major challenge

964
00:36:55,750 --> 00:36:52,960
was reducing the noise of

965
00:36:57,829 --> 00:36:55,760
the shock waves at the blade tips

966
00:36:59,670 --> 00:36:57,839
the four blade supersonic air products

967
00:37:02,950 --> 00:36:59,680
propeller on the air force's

968
00:37:05,670 --> 00:37:02,960
experimental or xf-84h

969
00:37:07,510 --> 00:37:05,680
generated such mediocre performance and

970
00:37:09,589 --> 00:37:07,520
high-intensity noise and resonant

971
00:37:10,550 --> 00:37:09,599
effects that are rendered by standard

972
00:37:12,870 --> 00:37:10,560
sick

973
00:37:15,670 --> 00:37:12,880
but the naca testing that propeller in

974
00:37:18,150 --> 00:37:15,680
the 16-foot tunnel

975
00:37:20,710 --> 00:37:18,160
was trying to work towards improving it

976
00:37:23,270 --> 00:37:20,720
but by 1957

977
00:37:25,750 --> 00:37:23,280
seeing that there are more avenues of

978
00:37:27,910 --> 00:37:25,760
pushing higher faster and farther with

979
00:37:29,910 --> 00:37:27,920
the turbojet and the new aircraft of the

980
00:37:32,390 --> 00:37:29,920
second design revolution

981
00:37:34,550 --> 00:37:32,400
the naca

982
00:37:37,589 --> 00:37:34,560
disbanded the long-standing subcommittee

983
00:37:39,670 --> 00:37:37,599
on propellers for aircraft in 1957 and

984
00:37:45,270 --> 00:37:39,680
propellers as a major research area

985
00:37:49,430 --> 00:37:46,870
now the modern airplane and its

986
00:37:52,630 --> 00:37:49,440
propeller reached its apex

987
00:37:54,150 --> 00:37:52,640
as the jet age ushered in a new age for

988
00:37:56,069 --> 00:37:54,160

aviation

989
00:37:58,390 --> 00:37:56,079
commercial and military operators

990
00:38:00,310 --> 00:37:58,400
replaced the propeller and piston engine

991
00:38:01,750 --> 00:38:00,320
with the turbojet engine as the main

992
00:38:03,270 --> 00:38:01,760
form of high performance and

993
00:38:04,710 --> 00:38:03,280
long-distance aircraft propulsion in the

994
00:38:06,550 --> 00:38:04,720
1950s

995
00:38:09,030 --> 00:38:06,560
in an ironic twist of history they

996
00:38:10,870 --> 00:38:09,040
reshaped the cultural perception of the

997
00:38:13,190 --> 00:38:10,880
airplane propeller to be a crude relic

998
00:38:15,510 --> 00:38:13,200
of a past age of aviation that was

999
00:38:17,430 --> 00:38:15,520
neither exceptional nor novel and

1000
00:38:19,349 --> 00:38:17,440
perhaps above all else

1001
00:38:21,990 --> 00:38:19,359
justifiably forgotten in the progress

1002
00:38:24,069 --> 00:38:22,000
driven history and memory of flight

1003
00:38:26,069 --> 00:38:24,079
nevertheless the specialists and

1004
00:38:28,310 --> 00:38:26,079
propeller-driven aircraft including a

1005
00:38:31,109 --> 00:38:28,320
new generation of turboprops

1006
00:38:33,190 --> 00:38:31,119
remained an integral part in an of

1007
00:38:36,069 --> 00:38:33,200
aviation in an interconnected world of

1008
00:38:37,910 --> 00:38:36,079
technology where old airplanes flying

1009
00:38:40,310 --> 00:38:37,920
under 500 miles per hour and new

1010
00:38:43,190 --> 00:38:40,320
airplanes that can fly faster than 500

1011
00:38:45,190 --> 00:38:43,200
miles per hour continue to coexist

1012
00:38:47,270 --> 00:38:45,200
so the propellers found on lockheed's

1013
00:38:48,150 --> 00:38:47,280

ill-fated lockheed electra that you see

1014
00:38:50,230 --> 00:38:48,160
here

1015
00:38:53,030 --> 00:38:50,240
as well as the much more successful p3

1016
00:38:55,829 --> 00:38:53,040
orion variant and the hercules transport

1017
00:38:59,109 --> 00:38:55,839
benefited from naca air foils and blade

1018
00:39:01,829 --> 00:38:59,119
designs so 16 series blade profiles and

1019
00:39:03,990 --> 00:39:01,839
square tip blades those are a part of

1020
00:39:06,950 --> 00:39:04,000
what the naca contributed to these new

1021
00:39:08,470 --> 00:39:06,960
aircraft that are now ex coexisting and

1022
00:39:10,950 --> 00:39:08,480
i purposely

1023
00:39:15,270 --> 00:39:10,960
juxtaposed the electra with a 707

1024
00:39:18,230 --> 00:39:15,280
airliner 1966 to show that story

1025
00:39:19,910 --> 00:39:18,240
and it's not until the 1970s and 80s

1026
00:39:21,430 --> 00:39:19,920
that

1027
00:39:23,109 --> 00:39:21,440
nasa

1028
00:39:24,630 --> 00:39:23,119
resurrects propeller research in the

1029
00:39:26,470 --> 00:39:24,640
name of the fuel crisis which was

1030
00:39:29,589 --> 00:39:26,480
another story through the advanced turbo

1031
00:39:31,349 --> 00:39:29,599
pop program so in conclusion

1032
00:39:33,349 --> 00:39:31,359
world war ii proved to be a pivotal

1033
00:39:35,030 --> 00:39:33,359
moment for the naca in regard to

1034
00:39:37,270 --> 00:39:35,040
propellers

1035
00:39:39,349 --> 00:39:37,280
evaluating existing propulsion systems

1036
00:39:41,589 --> 00:39:39,359
and investigations into refinements like

1037
00:39:44,069 --> 00:39:41,599
blade cuffs and paddle blades served the

1038
00:39:45,829 --> 00:39:44,079

war effort well but they were concurrent

1039
00:39:47,430 --> 00:39:45,839
with new avenues such as high-speed

1040
00:39:49,670 --> 00:39:47,440
airfoils

1041
00:39:52,150 --> 00:39:49,680
and dual rotation propellers

1042
00:39:54,630 --> 00:39:52,160
both the fundamental and applied thrusts

1043
00:39:57,109 --> 00:39:54,640
of the naca helped advance the state of

1044
00:39:58,870 --> 00:39:57,119
the art for american combat aircraft and

1045
00:40:00,150 --> 00:39:58,880
the military and commercial aircraft

1046
00:40:00,950 --> 00:40:00,160
that followed

1047
00:40:03,589 --> 00:40:00,960
so

1048
00:40:04,870 --> 00:40:03,599
the naca's researchers took a reinvented

1049
00:40:06,790 --> 00:40:04,880
technology

1050
00:40:09,270 --> 00:40:06,800
already capable of making the airplane a

1051
00:40:12,230 --> 00:40:09,280
global weapon and a vehicle for

1052
00:40:20,390 --> 00:40:12,240
transport and made it even better

1053
00:40:24,150 --> 00:40:22,150
now we go to a veteran well known to us

1054
00:40:26,710 --> 00:40:24,160
all he's already been mentioned many

1055
00:40:27,750 --> 00:40:26,720
times at this symposium and justly so

1056
00:40:29,510 --> 00:40:27,760
and that's

1057
00:40:31,430 --> 00:40:29,520
jim hansen it's a great very great

1058
00:40:33,109 --> 00:40:31,440
pleasure to welcome him to the podium

1059
00:40:34,790 --> 00:40:33,119
he's a professor of history at auburn

1060
00:40:37,030 --> 00:40:34,800
university he's been associated with the

1061
00:40:39,190 --> 00:40:37,040
nasa history program for the past 34

1062
00:40:40,870 --> 00:40:39,200
years beginning with his first book

1063
00:40:43,190 --> 00:40:40,880

engineer in charge a history of the

1064
00:40:45,430 --> 00:40:43,200
langley aeronautical laboratory i think

1065
00:40:47,750 --> 00:40:45,440
probably the finest center history the

1066
00:40:49,910 --> 00:40:47,760
nasa program ever produced here's the

1067
00:40:52,790 --> 00:40:49,920
author of 11 books including first man

1068
00:40:54,390 --> 00:40:52,800
the life of neil armstrong a 2005 new

1069
00:40:57,270 --> 00:40:54,400
york times bestseller he's been

1070
00:40:59,190 --> 00:40:57,280
co-author of three naca nasa

1071
00:41:00,390 --> 00:40:59,200
autobiographies from the ground up with

1072
00:41:02,790 --> 00:41:00,400
fred wike

1073
00:41:04,870 --> 00:41:02,800
truth lives and rings with alan mcdonald

1074
00:41:07,109 --> 00:41:04,880
and forever young with astronaut john

1075
00:41:09,750 --> 00:41:07,119
young he will speak to us fittingly on

1076
00:41:11,829 --> 00:41:09,760
that last topic the real right stuff a

1077
00:41:14,630 --> 00:41:11,839
historical examination of the culture

1078
00:41:18,390 --> 00:41:14,640
and accomplishments of the naca research

1079
00:41:18,400 --> 00:41:25,990
thank you

1080
00:41:31,030 --> 00:41:27,430
okay

1081
00:41:35,190 --> 00:41:32,710
in the public eye

1082
00:41:37,589 --> 00:41:35,200
test pilots have usually been perceived

1083
00:41:40,230 --> 00:41:37,599
as dashing glamorous and utterly

1084
00:41:42,630 --> 00:41:40,240
fearless young knights of the air

1085
00:41:44,710 --> 00:41:42,640
test pilots put new and untried aircraft

1086
00:41:46,390 --> 00:41:44,720
into screaming power dives followed by

1087
00:41:48,150 --> 00:41:46,400
high g pullouts

1088
00:41:49,349 --> 00:41:48,160

finding whether the wings will remain in

1089
00:41:52,230 --> 00:41:49,359
one piece

1090
00:41:54,950 --> 00:41:52,240
or the entire machine disintegrate

1091
00:41:56,069 --> 00:41:54,960
much of this slurred imagery was pure

1092
00:41:58,150 --> 00:41:56,079
myth

1093
00:42:01,030 --> 00:41:58,160
developing at least in part from the

1094
00:42:04,309 --> 00:42:01,040
action-packed motion pictures of the

1095
00:42:11,589 --> 00:42:04,319
thirties and nineteen forties

1096
00:42:15,990 --> 00:42:13,670
look like a major glitz here we go

1097
00:42:18,710 --> 00:42:16,000
um

1098
00:42:21,030 --> 00:42:18,720
films such as the 1938 academy award

1099
00:42:23,670 --> 00:42:21,040
nominee test pilot starring two of

1100
00:42:25,750 --> 00:42:23,680
hollywood's most manly stars clark gable

1101
00:42:29,030 --> 00:42:25,760
and spencer tracy

1102
00:42:31,670 --> 00:42:29,040
action as a pair of reckless sky devils

1103
00:42:33,589 --> 00:42:31,680
carve a glorious destiny out of white

1104
00:42:35,990 --> 00:42:33,599
clouds and blue skies

1105
00:42:38,309 --> 00:42:36,000
the valiant drama of men who don't live

1106
00:42:40,550 --> 00:42:38,319
long and the women they love

1107
00:42:41,990 --> 00:42:40,560
in a mighty conflict with the fury of

1108
00:42:45,190 --> 00:42:42,000
the skies

1109
00:42:49,190 --> 00:42:45,200
mgm proudly presents the powerful drama

1110
00:42:51,670 --> 00:42:49,200
of the captains courageous of the air

1111
00:42:53,990 --> 00:42:51,680
scenes of gable flying sensationally

1112
00:42:56,309 --> 00:42:54,000
through thunderstorms lightning ice high

1113
00:42:58,950 --> 00:42:56,319

winds and everything else hollywood can

1114
00:43:01,349 --> 00:42:58,960
throw at a pilot came to a climax at the

1115
00:43:04,309 --> 00:43:01,359
national air races where ninety thousand

1116
00:43:07,430 --> 00:43:04,319
thrilled spec spectators watched gable's

1117
00:43:10,390 --> 00:43:07,440
racer catch fire as he cut tied around a

1118
00:43:13,589 --> 00:43:10,400
pylon his newly wed wife

1119
00:43:16,069 --> 00:43:13,599
played by myrna loy

1120
00:43:17,990 --> 00:43:16,079
cries out to tracy

1121
00:43:20,870 --> 00:43:18,000
he's on fire

1122
00:43:23,030 --> 00:43:20,880
oh that's nothing replies tracy it's

1123
00:43:25,349 --> 00:43:23,040
nice to have a little fire you don't

1124
00:43:28,710 --> 00:43:25,359
know how cold it gets up there

1125
00:43:30,470 --> 00:43:28,720
besides the guy is made of asbestos

1126
00:43:33,510 --> 00:43:30,480
how can you talk like that the wife

1127
00:43:35,430 --> 00:43:33,520
challenges how dare you tracy shouts

1128
00:43:37,670 --> 00:43:35,440
back why you little fool who are you

1129
00:43:40,790 --> 00:43:37,680
talking to what do you think this game

1130
00:43:43,030 --> 00:43:40,800
is anyway it's death every time you move

1131
00:43:44,790 --> 00:43:43,040
it ain't safe to even sit in one of them

1132
00:43:46,069 --> 00:43:44,800
it ain't safe even to look at one of

1133
00:43:49,589 --> 00:43:46,079
them

1134
00:43:51,910 --> 00:43:49,599
well the hero survives

1135
00:43:54,550 --> 00:43:51,920
even wins the race

1136
00:43:56,390 --> 00:43:54,560
and later after a few drinks opens up

1137
00:43:57,750 --> 00:43:56,400
about the dangers of tests flying to

1138
00:43:59,829 --> 00:43:57,760

friends

1139
00:44:01,990 --> 00:43:59,839
the sky looks sweet and wears a pretty

1140
00:44:04,470 --> 00:44:02,000
blue dress doesn't she

1141
00:44:06,630 --> 00:44:04,480
yeah but don't kid yourself she lives up

1142
00:44:08,870 --> 00:44:06,640
there she invites you up there and when

1143
00:44:11,430 --> 00:44:08,880
she gets you up there she knocks you

1144
00:44:14,870 --> 00:44:11,440
down flat on your ass

1145
00:44:16,550 --> 00:44:14,880
how realistic was this popular image of

1146
00:44:18,069 --> 00:44:16,560
the test pilot

1147
00:44:19,670 --> 00:44:18,079
not very

1148
00:44:22,309 --> 00:44:19,680
granted during the golden age of

1149
00:44:24,309 --> 00:44:22,319
aviation a certain breed of test pilot

1150
00:44:26,950 --> 00:44:24,319
fitting a less spectacular version of

1151
00:44:29,109 --> 00:44:26,960
the popular image did exist

1152
00:44:31,589 --> 00:44:29,119
indeed the test pilot that gable

1153
00:44:33,670 --> 00:44:31,599
portrayed in the movie was based on the

1154
00:44:36,309 --> 00:44:33,680
life of jimmy collins

1155
00:44:38,230 --> 00:44:36,319
who fit the image relatively well

1156
00:44:40,950 --> 00:44:38,240
especially as collins with the help of

1157
00:44:44,069 --> 00:44:40,960
his editor at doubleday floydly recalled

1158
00:44:47,750 --> 00:44:44,079
the adventures of his flying in the 1935

1159
00:44:49,829 --> 00:44:47,760
autobiography entitled also test pilot

1160
00:44:52,150 --> 00:44:49,839
but in truth there were not many test

1161
00:44:54,870 --> 00:44:52,160
pilots like collins

1162
00:44:57,430 --> 00:44:54,880
not who fit the image of the

1163
00:44:59,430 --> 00:44:57,440

swashbuckling aviator

1164
00:45:01,670 --> 00:44:59,440
unfortunately the fact that collins was

1165
00:45:04,230 --> 00:45:01,680
killed in march 1935

1166
00:45:06,470 --> 00:45:04,240
while dive testing the new grumman f3f

1167
00:45:09,109 --> 00:45:06,480
navy fighter did nothing but feed the

1168
00:45:11,270 --> 00:45:09,119
fire of the sensationalized image and

1169
00:45:14,309 --> 00:45:11,280
led to an even more excited view of the

1170
00:45:17,430 --> 00:45:14,319
test pilot with the 1938 debut of the

1171
00:45:22,150 --> 00:45:19,910
the daredevil test pilot survived world

1172
00:45:24,309 --> 00:45:22,160
war ii and then some

1173
00:45:26,710 --> 00:45:24,319
despite the aeronautical community's

1174
00:45:29,270 --> 00:45:26,720
steadily growing appreciation of true

1175
00:45:31,589 --> 00:45:29,280
engineering test flying the spec the

1176
00:45:33,670 --> 00:45:31,599
spectacular and still highly dangerous

1177
00:45:35,829 --> 00:45:33,680
aspects of test flying

1178
00:45:37,910 --> 00:45:35,839
were disproportionately emphasized in

1179
00:45:40,069 --> 00:45:37,920
books and films

1180
00:45:43,589 --> 00:45:40,079
all the way to tom wolf's

1181
00:45:46,950 --> 00:45:43,599
classic of 1979 on the ineffable right

1182
00:45:49,190 --> 00:45:46,960
stuff and the 1984 movie based on it

1183
00:45:52,470 --> 00:45:49,200
glorifying air force test pilot chuck

1184
00:45:55,349 --> 00:45:52,480
yeager as the top of the flyers pyramid

1185
00:45:57,670 --> 00:45:55,359
the one with the purest ability quote to

1186
00:45:59,510 --> 00:45:57,680
go up in a hurdling piece of machinery

1187
00:46:01,990 --> 00:45:59,520
and put his height on the line and then

1188
00:46:04,630 --> 00:46:02,000

have the moxie the reflexes the

1189
00:46:07,270 --> 00:46:04,640
experience the coolness to pull it back

1190
00:46:09,349 --> 00:46:07,280
in the last yawning moment

1191
00:46:11,430 --> 00:46:09,359
the year following the adaptation

1192
00:46:13,270 --> 00:46:11,440
general yeager rode the wave of popular

1193
00:46:14,630 --> 00:46:13,280
enthusiasm into his best-selling

1194
00:46:16,710 --> 00:46:14,640
autobiography

1195
00:46:19,430 --> 00:46:16,720
which in terms of romanticizing what a

1196
00:46:21,670 --> 00:46:19,440
test pilot did and how he did it matched

1197
00:46:25,829 --> 00:46:21,680
if not surpassed jimmy collins's

1198
00:46:28,710 --> 00:46:25,839
autobiography of 50 years earlier

1199
00:46:31,430 --> 00:46:28,720
in stark contrast to this popular image

1200
00:46:34,069 --> 00:46:31,440
there were test pilots in major respects

1201
00:46:35,589 --> 00:46:34,079
inherently different from chuck yeager

1202
00:46:38,150 --> 00:46:35,599
who possessed what i call in my

1203
00:46:39,670 --> 00:46:38,160
biography of neil armstrong the real

1204
00:46:43,109 --> 00:46:39,680
right stuff

1205
00:46:44,710 --> 00:46:43,119
these flyers were true research pilots

1206
00:46:46,390 --> 00:46:44,720
for sure that is what the national

1207
00:46:47,510 --> 00:46:46,400
advisory committee for aeronautics

1208
00:46:50,230 --> 00:46:47,520
called them

1209
00:46:52,950 --> 00:46:50,240
and as the naca research pilot culture

1210
00:46:55,589 --> 00:46:52,960
developed from the time of the naca's

1211
00:46:58,309 --> 00:46:55,599
earliest flight research programs

1212
00:47:00,950 --> 00:46:58,319
through the 30s and 40s to the very end

1213
00:47:04,069 --> 00:47:00,960

of the naca when it transitioned and

1214
00:47:07,349 --> 00:47:04,079
principally helped make nasa into what

1215
00:47:09,990 --> 00:47:07,359
it became a research pilot did not

1216
00:47:11,990 --> 00:47:10,000
strive to break records but rather to

1217
00:47:14,550 --> 00:47:12,000
advance the science and technology of

1218
00:47:17,750 --> 00:47:14,560
flight across a broad front

1219
00:47:19,510 --> 00:47:17,760
the mo of a research pilot was not to go

1220
00:47:21,910 --> 00:47:19,520
up in a hurling piece of machinery and

1221
00:47:23,750 --> 00:47:21,920
put his hide on the line but rather

1222
00:47:26,710 --> 00:47:23,760
approach the progress of flight as a man

1223
00:47:29,670 --> 00:47:26,720
of science trained to serve accurately

1224
00:47:31,990 --> 00:47:29,680
criticize fairly think logically and be

1225
00:47:34,630 --> 00:47:32,000
prepared by his advanced education and

1226
00:47:37,190 --> 00:47:34,640
training to exercise a care and a

1227
00:47:38,950 --> 00:47:37,200
patient in his flying thereby achieving

1228
00:47:41,829 --> 00:47:38,960
the most significant experimental

1229
00:47:43,270 --> 00:47:41,839
results possible from every second of

1230
00:47:45,990 --> 00:47:43,280
every flight

1231
00:47:47,990 --> 00:47:46,000
that's how the real right stuff worked

1232
00:47:50,829 --> 00:47:48,000
that's how neil armstrong who flew

1233
00:47:53,030 --> 00:47:50,839
projects for the naca from march

1234
00:47:54,790 --> 00:47:53,040
1955 fresh out of the school of

1235
00:47:56,470 --> 00:47:54,800
engineering at purdue

1236
00:47:58,150 --> 00:47:56,480
right up to the time he reported to

1237
00:47:59,430 --> 00:47:58,160
houston as part of the second group of

1238
00:48:01,910 --> 00:47:59,440

astronauts

1239
00:48:04,790 --> 00:48:01,920
in september 1962.

1240
00:48:08,030 --> 00:48:04,800
in those six years armstrong flew 50

1241
00:48:12,950 --> 00:48:08,040
different types of aircraft a total of 2

1242
00:48:14,470 --> 00:48:12,960
450 research flying hours 900 than 900

1243
00:48:16,470 --> 00:48:14,480
of them in jets

1244
00:48:19,030 --> 00:48:16,480
while at the nasa center that now bears

1245
00:48:21,109 --> 00:48:19,040
his name neil actively engaged in both

1246
00:48:24,630 --> 00:48:21,119
piloting and engineering aspects of the

1247
00:48:26,549 --> 00:48:24,640
x-15 program almost from its inception

1248
00:48:29,190 --> 00:48:26,559
he worked closely with designers and

1249
00:48:31,670 --> 00:48:29,200
engineers in the development of the x-15

1250
00:48:32,870 --> 00:48:31,680
adaptive self-adaptive control system

1251
00:48:35,670 --> 00:48:32,880
for flights at the edge of the

1252
00:48:37,670 --> 00:48:35,680
atmosphere and he made seven flights in

1253
00:48:39,430 --> 00:48:37,680
the rocket plane reaching a peak

1254
00:48:41,750 --> 00:48:39,440
altitude of over two hundred and seven

1255
00:48:44,069 --> 00:48:41,760
thousand feet and a top speed of nearly

1256
00:48:46,230 --> 00:48:44,079
four thousand miles per hour

1257
00:48:48,230 --> 00:48:46,240
but my purpose today is not to again

1258
00:48:51,109 --> 00:48:48,240
feature neil armstrong as the research

1259
00:48:53,030 --> 00:48:51,119
pilot who had the real right stuff

1260
00:48:55,190 --> 00:48:53,040
no question but that armstrong will

1261
00:48:57,030 --> 00:48:55,200
always stand as the most famous and one

1262
00:48:59,430 --> 00:48:57,040
of the greatest of all of the naca

1263
00:49:01,430 --> 00:48:59,440

pilots

1264
00:49:03,510 --> 00:49:01,440
which by my rough count

1265
00:49:06,069 --> 00:49:03,520
involved something over a hundred pilots

1266
00:49:09,030 --> 00:49:06,079
from neal's time at the end of the naca

1267
00:49:10,390 --> 00:49:09,040
back to 1919 when most of the test

1268
00:49:12,309 --> 00:49:10,400
flying

1269
00:49:15,030 --> 00:49:12,319
for the committee was being done by

1270
00:49:17,589 --> 00:49:15,040
lieutenant eddie allen lieutenant h m

1271
00:49:19,190 --> 00:49:17,599
cronk or one of seven other pilots on

1272
00:49:21,589 --> 00:49:19,200
loan from the army

1273
00:49:24,870 --> 00:49:21,599
this was prior to the committee in early

1274
00:49:27,430 --> 00:49:24,880
1920 hiring the first pilot pilot of his

1275
00:49:29,670 --> 00:49:27,440
own thomas carroll who during the great

1276
00:49:31,349 --> 00:49:29,680
war had served in france teaching air

1277
00:49:33,270 --> 00:49:31,359
tactics

1278
00:49:36,549 --> 00:49:33,280
there is another pilot who exemplified

1279
00:49:39,270 --> 00:49:36,559
the naca research culture as well if not

1280
00:49:42,549 --> 00:49:39,280
better than neil armstrong and armstrong

1281
00:49:45,349 --> 00:49:42,559
felt exactly that way about it himself

1282
00:49:47,349 --> 00:49:45,359
when i first met neil back in 2001 and

1283
00:49:49,589 --> 00:49:47,359
sat down with him at his home to talk

1284
00:49:51,910 --> 00:49:49,599
about my writing his life story

1285
00:49:54,390 --> 00:49:51,920
at some point in that conversation i

1286
00:49:56,870 --> 00:49:54,400
asked him if he had ever had anything to

1287
00:49:57,750 --> 00:49:56,880
do with veteran langley test pilot jack

1288
00:49:59,589 --> 00:49:57,760

reader

1289
00:50:02,150 --> 00:49:59,599
someone who had gotten to know well

1290
00:50:03,430 --> 00:50:02,160
while writing engineer in charge

1291
00:50:05,270 --> 00:50:03,440
instantly

1292
00:50:08,390 --> 00:50:05,280
neil perked up

1293
00:50:11,030 --> 00:50:08,400
and turned to his wife and said carol

1294
00:50:12,390 --> 00:50:11,040
jack reader was the best test pilot i

1295
00:50:14,549 --> 00:50:12,400
ever knew

1296
00:50:18,069 --> 00:50:14,559
and it's interesting that bill berry

1297
00:50:21,349 --> 00:50:18,079
chose this picture for the cover of the

1298
00:50:22,870 --> 00:50:21,359
nasa history of naca bibliography

1299
00:50:24,950 --> 00:50:22,880
because that's jack reader right in the

1300
00:50:27,349 --> 00:50:24,960
middle of that scene

1301
00:50:29,589 --> 00:50:27,359
but neil said to his wife jack reader

1302
00:50:32,069 --> 00:50:29,599
was the best test pilot i ever knew then

1303
00:50:35,670 --> 00:50:32,079
turning back to mean neil added

1304
00:50:40,950 --> 00:50:38,790
absolutely true story

1305
00:50:43,190 --> 00:50:40,960
so let me take the rest of my grief time

1306
00:50:44,790 --> 00:50:43,200
up here to tell you about jack reader

1307
00:50:48,309 --> 00:50:44,800
truly one of the most outstanding

1308
00:50:49,910 --> 00:50:48,319
research pilots in naca and nasa history

1309
00:50:51,109 --> 00:50:49,920
i think it's what neil would want me to

1310
00:50:53,750 --> 00:50:51,119
do

1311
00:50:55,349 --> 00:50:53,760
in the spring of 1938 at the very time

1312
00:50:59,270 --> 00:50:55,359
the clark gable film was filling up

1313
00:51:01,510 --> 00:50:59,280

movie houses 22 year old john p reader

1314
00:51:03,270 --> 00:51:01,520
came to work at naca langley right out

1315
00:51:05,349 --> 00:51:03,280
of an aeronautical engineering program

1316
00:51:08,069 --> 00:51:05,359
at the university of michigan one of

1317
00:51:09,750 --> 00:51:08,079
eight institutions whose aero program

1318
00:51:11,430 --> 00:51:09,760
operated with the advantage of an

1319
00:51:14,309 --> 00:51:11,440
endowment from the guggenheim fund for

1320
00:51:16,790 --> 00:51:14,319
the promotion of aeronautics

1321
00:51:19,109 --> 00:51:16,800
at his initial interview after arriving

1322
00:51:20,950 --> 00:51:19,119
at langley reader requested

1323
00:51:24,150 --> 00:51:20,960
assignment to the flight research

1324
00:51:26,790 --> 00:51:24,160
division he had learned to fly gliders

1325
00:51:29,270 --> 00:51:26,800
while a student in ann arbor he began

1326
00:51:31,990 --> 00:51:29,280
taking private flying lessons in a piper

1327
00:51:34,309 --> 00:51:32,000
cub immediately upon arrival in hampton

1328
00:51:36,950 --> 00:51:34,319
and in taking the naca post he had

1329
00:51:39,030 --> 00:51:36,960
turned down navy flight training

1330
00:51:41,829 --> 00:51:39,040
the full-scale tunnel section however

1331
00:51:44,549 --> 00:51:41,839
was in more urgent need of personnel and

1332
00:51:46,710 --> 00:51:44,559
reader was assigned there working with a

1333
00:51:50,069 --> 00:51:46,720
unique facility that became operational

1334
00:51:52,230 --> 00:51:50,079
in 1931 for tests of full-scale aircraft

1335
00:51:54,309 --> 00:51:52,240
or very large models

1336
00:51:56,069 --> 00:51:54,319
jack would spend four years four and a

1337
00:51:58,790 --> 00:51:56,079
half years in the full-scale tunnel

1338
00:52:01,109 --> 00:51:58,800

section during which time he engaged in

1339
00:52:03,589 --> 00:52:01,119
studies of stability and control

1340
00:52:05,510 --> 00:52:03,599
engine cooling and drag reduction

1341
00:52:08,470 --> 00:52:05,520
some of this work was of a generally

1342
00:52:09,990 --> 00:52:08,480
applicable fundamental nature much of it

1343
00:52:11,829 --> 00:52:10,000
however was directed toward the

1344
00:52:13,030 --> 00:52:11,839
improvement of specific military

1345
00:52:17,670 --> 00:52:13,040
aircraft

1346
00:52:18,549 --> 00:52:17,680
investigate in the full-scale tunnel

1347
00:52:20,549 --> 00:52:18,559
were

1348
00:52:24,069 --> 00:52:20,559
bell and curtis fighters navy

1349
00:52:25,510 --> 00:52:24,079
observation and torpedo planes and army

1350
00:52:28,510 --> 00:52:25,520
attack bombers

1351
00:52:31,750 --> 00:52:28,520
jack also ran tests on the voxikarsky

1352
00:52:33,990 --> 00:52:31,760
v-173 the so-called flying pancake a

1353
00:52:36,549 --> 00:52:34,000
highly unusual flying mock-up of an

1354
00:52:39,430 --> 00:52:36,559
earlier powered lift short takeoff and

1355
00:52:40,710 --> 00:52:39,440
landing stole fighter aircraft conceived

1356
00:52:43,109 --> 00:52:40,720
and developed

1357
00:52:44,950 --> 00:52:43,119
by charles zimmerman a university of

1358
00:52:47,030 --> 00:52:44,960
kansas engineer who came to work at

1359
00:52:49,589 --> 00:52:47,040
langley in 1929

1360
00:52:51,829 --> 00:52:49,599
stayed until 1927 and then returned to

1361
00:52:53,589 --> 00:52:51,839
langley in 46. he would be part of

1362
00:52:56,150 --> 00:52:53,599
gilbert's space task group

1363
00:52:57,910 --> 00:52:56,160

and go on to nasa and a lot of pictures

1364
00:53:01,589 --> 00:52:57,920
showing test setups in the full-scale

1365
00:53:05,030 --> 00:53:01,599
tunnel from 1939 into 1942 you can see

1366
00:53:07,829 --> 00:53:05,040
jack readers standing below the aircraft

1367
00:53:10,309 --> 00:53:07,839
while part of the fst staff reader was

1368
00:53:13,270 --> 00:53:10,319
the author or co-author of nine

1369
00:53:16,549 --> 00:53:13,280
technical reports the trs being the

1370
00:53:18,950 --> 00:53:16,559
highest echelon of naca of the nac

1371
00:53:20,790 --> 00:53:18,960
publication program this was a highly

1372
00:53:22,870 --> 00:53:20,800
respectable output for the four and a

1373
00:53:25,270 --> 00:53:22,880
half years that jack spent as a member

1374
00:53:27,190 --> 00:53:25,280
of that staff his research papers

1375
00:53:28,790 --> 00:53:27,200
contributed important insights into the

1376
00:53:31,910 --> 00:53:28,800
relationships between aircraft

1377
00:53:34,470 --> 00:53:31,920
performance stability and control and

1378
00:53:35,829 --> 00:53:34,480
aerodynamic design of great importance

1379
00:53:38,790 --> 00:53:35,839
to jack's growing technical

1380
00:53:40,150 --> 00:53:38,800
sophistications where his daily contacts

1381
00:53:42,470 --> 00:53:40,160
contacts with

1382
00:53:44,950 --> 00:53:42,480
excellent research engineers from other

1383
00:53:47,510 --> 00:53:44,960
langley divisions for example one of his

1384
00:53:50,470 --> 00:53:47,520
daily contacts was abe silverstein who

1385
00:53:52,710 --> 00:53:50,480
later became the director of nasa lewis

1386
00:53:55,349 --> 00:53:52,720
another was harry get who became a

1387
00:53:56,870 --> 00:53:55,359
senior division chief at naca ames and

1388
00:53:58,790 --> 00:53:56,880

then later appointed as the first

1389
00:54:00,150 --> 00:53:58,800
director of nasa goddard

1390
00:54:02,069 --> 00:54:00,160
in addition to

1391
00:54:03,910 --> 00:54:02,079
demonstrating outstanding technical

1392
00:54:06,390 --> 00:54:03,920
aptitude in his years at the full-scale

1393
00:54:08,710 --> 00:54:06,400
tunnel reader gained valuable insights

1394
00:54:10,710 --> 00:54:08,720
into aircraft aerodynamics and design

1395
00:54:13,109 --> 00:54:10,720
which were to serve him extremely well

1396
00:54:14,870 --> 00:54:13,119
as a as a test pilot

1397
00:54:17,430 --> 00:54:14,880
world war ii brought a tremendous

1398
00:54:19,270 --> 00:54:17,440
expansion of nac facilities including

1399
00:54:21,990 --> 00:54:19,280
the building of entire new laboratories

1400
00:54:25,190 --> 00:54:22,000
in ohio and california at langley the

1401
00:54:27,630 --> 00:54:25,200
size of the staff rose from 524

1402
00:54:30,390 --> 00:54:27,640
in 1939 to

1403
00:54:32,230 --> 00:54:30,400
3220 in 1945.

1404
00:54:36,230 --> 00:54:32,240
within that the professional staff

1405
00:54:38,390 --> 00:54:36,240
quadrupled from 204 to 832

1406
00:54:41,829 --> 00:54:38,400
the volume and range of work expected of

1407
00:54:43,829 --> 00:54:41,839
the naca required those buildups much of

1408
00:54:46,390 --> 00:54:43,839
it involved wind tunnel testing but the

1409
00:54:49,910 --> 00:54:46,400
demands to flight test military aircraft

1410
00:54:51,910 --> 00:54:49,920
were urgent with 119 different aircraft

1411
00:54:55,589 --> 00:54:51,920
coming to langley for flight and gut

1412
00:54:58,549 --> 00:54:55,599
investigation between 1939 and 1945

1413
00:54:59,430 --> 00:54:58,559

spending the equivalent of over 1100

1414
00:55:02,069 --> 00:54:59,440
months

1415
00:55:03,430 --> 00:55:02,079
cumulatively as part of the lab's test

1416
00:55:05,349 --> 00:55:03,440
resume

1417
00:55:08,230 --> 00:55:05,359
langley needed pilots

1418
00:55:11,030 --> 00:55:08,240
up until 1939 two pilots had been able

1419
00:55:14,069 --> 00:55:11,040
to do all of the research flying

1420
00:55:15,829 --> 00:55:14,079
one was william mcavoy a 45 year old

1421
00:55:17,670 --> 00:55:15,839
pilot who had learned to fly in the army

1422
00:55:19,750 --> 00:55:17,680
late in world war one

1423
00:55:22,549 --> 00:55:19,760
finding no place in army aviation

1424
00:55:26,710 --> 00:55:22,559
following armistice mcavoy a trained

1425
00:55:29,430 --> 00:55:26,720
draftsman got hired by the naca in 1921.

1426
00:55:31,589 --> 00:55:29,440
by 1923 young bill worked his way into

1427
00:55:33,430 --> 00:55:31,599
the position of assistant chief test

1428
00:55:35,430 --> 00:55:33,440
pilot to tom carroll

1429
00:55:37,030 --> 00:55:35,440
following carol's departure from langley

1430
00:55:39,030 --> 00:55:37,040
in 1929

1431
00:55:40,870 --> 00:55:39,040
mcavoy became chief test pilot and

1432
00:55:43,910 --> 00:55:40,880
remained in the leadership position

1433
00:55:45,589 --> 00:55:43,920
until his transfer in 1940 to ames where

1434
00:55:48,390 --> 00:55:45,599
he filled the same position until his

1435
00:55:50,309 --> 00:55:48,400
retirement in 1957.

1436
00:55:53,430 --> 00:55:50,319
the second man doing most of the

1437
00:55:56,470 --> 00:55:53,440
research flying up to 1939 was melvin

1438
00:55:58,710 --> 00:55:56,480

goff a 1926 graduate in mechanical

1439
00:56:00,630 --> 00:55:58,720
engineering from johns hopkins

1440
00:56:02,630 --> 00:56:00,640
goff's original assignment was to the

1441
00:56:05,190 --> 00:56:02,640
propeller research tunnel that jeremy

1442
00:56:07,910 --> 00:56:05,200
just told us about his evolution into a

1443
00:56:10,309 --> 00:56:07,920
langley research pilot set a critically

1444
00:56:13,349 --> 00:56:10,319
important precedent in the emergence of

1445
00:56:16,309 --> 00:56:13,359
the real right stuff within the naca in

1446
00:56:18,150 --> 00:56:16,319
1928 the naca sent golf for flight

1447
00:56:19,750 --> 00:56:18,160
training to pensacola

1448
00:56:21,829 --> 00:56:19,760
returning to langley as a fully

1449
00:56:24,950 --> 00:56:21,839
qualified naval aviator in the spring of

1450
00:56:26,710 --> 00:56:24,960
1929 goff became the first member of the

1451
00:56:29,349 --> 00:56:26,720
flight group to be trained both as an

1452
00:56:31,510 --> 00:56:29,359
engineer and a pilot setting a precedent

1453
00:56:33,990 --> 00:56:31,520
that has existed to this day

1454
00:56:35,349 --> 00:56:34,000
since this time all nac and nasa pilots

1455
00:56:37,670 --> 00:56:35,359
have been required to have engineering

1456
00:56:38,789 --> 00:56:37,680
or scientific degrees as well as pilot

1457
00:56:40,630 --> 00:56:38,799
skills

1458
00:56:43,430 --> 00:56:40,640
goth remained in the flangly flight

1459
00:56:45,670 --> 00:56:43,440
group until 1958 becoming chief pilot

1460
00:56:47,910 --> 00:56:45,680
when mcavoy left for ames

1461
00:56:49,990 --> 00:56:47,920
up to the time of pearl harbor the nac

1462
00:56:53,270 --> 00:56:50,000
had been able to add three or four new

1463
00:56:56,309 --> 00:56:53,280

pilots including an engineering graduate

1464
00:56:59,510 --> 00:56:56,319
from the university of tennessee herbert

1465
00:57:01,510 --> 00:56:59,520
hoover not that one herb hoover reported

1466
00:57:04,630 --> 00:57:01,520
for duty in 1940 and became head of

1467
00:57:06,630 --> 00:57:04,640
flight operations at langley in 1943

1468
00:57:08,950 --> 00:57:06,640
after making many contributions to

1469
00:57:11,990 --> 00:57:08,960
flight research including thunderstorm

1470
00:57:14,870 --> 00:57:12,000
research and being the first civilian

1471
00:57:17,349 --> 00:57:14,880
pilot of the x1

1472
00:57:19,109 --> 00:57:17,359
hoover was killed in the crash of a b-45

1473
00:57:20,710 --> 00:57:19,119
in 1952

1474
00:57:23,109 --> 00:57:20,720
but the addition of hoover and a couple

1475
00:57:24,950 --> 00:57:23,119
others in 1940 was not enough

1476
00:57:27,109 --> 00:57:24,960
in need of additional pilots at a time

1477
00:57:29,589 --> 00:57:27,119
when the traditional sources for new

1478
00:57:32,470 --> 00:57:29,599
naca pilots the army and navy were

1479
00:57:36,309 --> 00:57:32,480
releasing none for civilian use langley

1480
00:57:39,670 --> 00:57:36,319
turned to the goth model to supply more

1481
00:57:41,270 --> 00:57:39,680
pilots in the late summer of 1942 goth

1482
00:57:43,829 --> 00:57:41,280
along with future langley center

1483
00:57:46,069 --> 00:57:43,839
director floyd thompson put forward a

1484
00:57:47,750 --> 00:57:46,079
call for a group of young engineers

1485
00:57:49,670 --> 00:57:47,760
preferably with some

1486
00:57:52,470 --> 00:57:49,680
some flying experience from the langley

1487
00:57:53,910 --> 00:57:52,480
staff to be selected for training

1488
00:57:55,030 --> 00:57:53,920

as pilots in the flight research

1489
00:57:56,710 --> 00:57:55,040
division

1490
00:57:59,270 --> 00:57:56,720
some of the established test pilots

1491
00:58:01,510 --> 00:57:59,280
viewed the proposal with skepticism

1492
00:58:04,150 --> 00:58:01,520
herb hoover especially had grave

1493
00:58:06,230 --> 00:58:04,160
reservations about the plan but goff

1494
00:58:08,150 --> 00:58:06,240
knew better from personal experience

1495
00:58:09,829 --> 00:58:08,160
convinced his superiors and by the fall

1496
00:58:12,549 --> 00:58:09,839
of 1942

1497
00:58:14,549 --> 00:58:12,559
35 eager applicants had been interviewed

1498
00:58:17,270 --> 00:58:14,559
for the pilot training program

1499
00:58:19,109 --> 00:58:17,280
altogether five engineer pilots as they

1500
00:58:20,630 --> 00:58:19,119
called them were trained in the program

1501
00:58:23,589 --> 00:58:20,640
and each went on to make major

1502
00:58:25,349 --> 00:58:23,599
contributions to naca flight research

1503
00:58:28,230 --> 00:58:25,359
three of the pilots including jack

1504
00:58:30,950 --> 00:58:28,240
reeder were retained at langley

1505
00:58:33,670 --> 00:58:30,960
and two went to the other naca

1506
00:58:36,069 --> 00:58:33,680
installations the choice of reader was

1507
00:58:37,990 --> 00:58:36,079
likely the easiest one jack had more

1508
00:58:39,030 --> 00:58:38,000
than proved his metal in the full-scale

1509
00:58:40,870 --> 00:58:39,040
tunnel

1510
00:58:43,750 --> 00:58:40,880
and he had 10 years of personal

1511
00:58:46,870 --> 00:58:43,760
experience piloting a 90 horsepower

1512
00:58:48,870 --> 00:58:46,880
monocoque which he had purchased in 1930

1513
00:58:51,430 --> 00:58:48,880

which was an airplane with reputation

1514
00:58:53,030 --> 00:58:51,440
for being tricky to fly

1515
00:58:54,470 --> 00:58:53,040
here in this slide if you can take a

1516
00:58:57,030 --> 00:58:54,480
close look at it is a list of the

1517
00:58:58,950 --> 00:58:57,040
aircraft employed in the langley pilot

1518
00:58:59,990 --> 00:58:58,960
training program in the order of their

1519
00:59:02,069 --> 00:59:00,000
use

1520
00:59:04,710 --> 00:59:02,079
note that as the student progressed he

1521
00:59:07,670 --> 00:59:04,720
flew aircraft of increasing weight power

1522
00:59:09,190 --> 00:59:07,680
wing loading and reduced power loading

1523
00:59:11,670 --> 00:59:09,200
note also the progression in

1524
00:59:13,349 --> 00:59:11,680
configuration types first there was a

1525
00:59:15,990 --> 00:59:13,359
group of increasingly sophisticated

1526
00:59:18,630 --> 00:59:16,000
general aviation types after which came

1527
00:59:20,870 --> 00:59:18,640
in an advanced navy trainer followed by

1528
00:59:23,510 --> 00:59:20,880
a succession of single-engine fighters

1529
00:59:26,309 --> 00:59:23,520
dive bombers a torpedo bomber and one

1530
00:59:28,309 --> 00:59:26,319
twin-engine aircraft the lockheed 12.

1531
00:59:31,109 --> 00:59:28,319
the first fighter that jack reader flew

1532
00:59:34,069 --> 00:59:31,119
is the curtis xp-42 a derivative of the

1533
00:59:37,030 --> 00:59:34,079
p-36 air core service fighter

1534
00:59:38,789 --> 00:59:37,040
well the mel golf model worked

1535
00:59:40,630 --> 00:59:38,799
it did more than that it produced

1536
00:59:42,390 --> 00:59:40,640
someone who neil armstrong some years

1537
00:59:44,230 --> 00:59:42,400
later 60 years later called the best

1538
00:59:45,910 --> 00:59:44,240

test pilot he ever knew

1539
00:59:49,349 --> 00:59:45,920
in his first full year as a research

1540
00:59:52,230 --> 00:59:49,359
pilot reader flew tests flew 19 aircraft

1541
00:59:53,990 --> 00:59:52,240
nine of which were fighters in 1951 he

1542
00:59:56,150 --> 00:59:54,000
became head of flight operations and

1543
00:59:58,549 --> 00:59:56,160
chief test pilot when he retired from

1544
01:00:02,870 --> 00:59:58,559
nasa in the late 1970s he had captained

1545
01:00:04,870 --> 01:00:02,880
more than 235 airplanes 61 helicopters

1546
01:00:07,670 --> 01:00:04,880
and eight vertical takeoff and landing

1547
01:00:10,150 --> 01:00:07,680
aircraft reader was actually nasa's

1548
01:00:11,829 --> 01:00:10,160
first helicopter pilot test pilot and

1549
01:00:14,069 --> 01:00:11,839
was internationally known for his

1550
01:00:16,470 --> 01:00:14,079
pioneering work in helicopter and vetol

1551
01:00:18,150 --> 01:00:16,480
aerodynamics and handling he was also a

1552
01:00:20,309 --> 01:00:18,160
leading member of the team that drafted

1553
01:00:22,470 --> 01:00:20,319
the original military specifications for

1554
01:00:24,309 --> 01:00:22,480
the flying qualities of helicopters and

1555
01:00:26,710 --> 01:00:24,319
he was a founding member of the twirly

1556
01:00:29,510 --> 01:00:26,720
birds in his obituary following his

1557
01:00:31,430 --> 01:00:29,520
death from alzheimer's in 1999 one of

1558
01:00:33,910 --> 01:00:31,440
the research pilots who had trained and

1559
01:00:36,549 --> 01:00:33,920
worked under jack lee person is quoted

1560
01:00:38,309 --> 01:00:36,559
as saying jack was my hero he was in my

1561
01:00:41,030 --> 01:00:38,319
estimation the finest engineering test

1562
01:00:43,030 --> 01:00:41,040
pilot in the world he demanded a lot

1563
01:00:45,349 --> 01:00:43,040

from himself and he demanded a lot from

1564
01:00:47,270 --> 01:00:45,359
his pilots he was the kind of guy who

1565
01:00:48,870 --> 01:00:47,280
was always sampling the airplane always

1566
01:00:51,109 --> 01:00:48,880
looking for little things that maybe he

1567
01:00:53,829 --> 01:00:51,119
hadn't noticed for noticed before he

1568
01:00:55,910 --> 01:00:53,839
just had an innate feel for airplanes

1569
01:00:57,270 --> 01:00:55,920
he could fly them all and he was honest

1570
01:00:59,109 --> 01:00:57,280
to a fault

1571
01:01:00,870 --> 01:00:59,119
which brings me back to chuck yeager and

1572
01:01:03,349 --> 01:01:00,880
the popular notion of the hot shot

1573
01:01:05,270 --> 01:01:03,359
daredevil death defying test pilot

1574
01:01:07,270 --> 01:01:05,280
without question jaeger's view of flying

1575
01:01:09,270 --> 01:01:07,280
was very different from that of the naca

1576
01:01:10,710 --> 01:01:09,280
research pilot and there was no love

1577
01:01:12,870 --> 01:01:10,720
lost between them

1578
01:01:15,430 --> 01:01:12,880
according to jaeger the nac wasn't

1579
01:01:17,109 --> 01:01:15,440
thrilled as a quote wasn't thrilled with

1580
01:01:20,069 --> 01:01:17,119
the army's selection of him as a test

1581
01:01:21,430 --> 01:01:20,079
pilot quote the naca team thought i was

1582
01:01:23,190 --> 01:01:21,440
a wild man

1583
01:01:25,589 --> 01:01:23,200
one of the stories the nanny sea old

1584
01:01:27,349 --> 01:01:25,599
timers used to tell me about yeager

1585
01:01:29,270 --> 01:01:27,359
concerns why the army air force has

1586
01:01:31,430 --> 01:01:29,280
selected him to fly the x1 for the

1587
01:01:33,270 --> 01:01:31,440
assault on the sonde barrier it was not

1588
01:01:34,789 --> 01:01:33,280

because jaeger was the most qualified to

1589
01:01:37,270 --> 01:01:34,799
meet the unknown dangers of the first

1590
01:01:39,109 --> 01:01:37,280
supersonic flight they told me it was

1591
01:01:41,190 --> 01:01:39,119
because air force leadership considered

1592
01:01:42,470 --> 01:01:41,200
him the most expendable of all of its

1593
01:01:44,309 --> 01:01:42,480
test pilots

1594
01:01:46,390 --> 01:01:44,319
jaeger who remembers being treated with

1595
01:01:49,510 --> 01:01:46,400
this sort of condescension called the

1596
01:01:51,589 --> 01:01:49,520
naca pilots the most arrogant bunch at

1597
01:01:53,750 --> 01:01:51,599
edwards quote there was nothing

1598
01:01:56,069 --> 01:01:53,760
worthwhile that a military pilot could

1599
01:01:59,349 --> 01:01:56,079
tell them i rated them about as high as

1600
01:02:01,910 --> 01:01:59,359
my shoelaces i lived balls out flew the

1601
01:02:03,990 --> 01:02:01,920
same way i had my own standards and as

1602
01:02:05,670 --> 01:02:04,000
far as i was concerned there was no room

1603
01:02:07,910 --> 01:02:05,680
at edwards for test pilots who couldn't

1604
01:02:09,750 --> 01:02:07,920
measure up to the machines they flew

1605
01:02:11,349 --> 01:02:09,760
i was harsh in my judgments because a

1606
01:02:13,910 --> 01:02:11,359
pilot either knew what he was doing or

1607
01:02:16,069 --> 01:02:13,920
he didn't the naca pilots were probably

1608
01:02:18,870 --> 01:02:16,079
good engineers who could fly precisely

1609
01:02:21,190 --> 01:02:18,880
but they were sorry fighter pilots

1610
01:02:23,029 --> 01:02:21,200
well of course naca pilots were not

1611
01:02:25,349 --> 01:02:23,039
supposed to be fighter pilots they were

1612
01:02:26,950 --> 01:02:25,359
supposed to be research pilots

1613
01:02:29,190 --> 01:02:26,960

neil armstrong was a pretty good

1614
01:02:31,670 --> 01:02:29,200
engineer jaeger conceded in his

1615
01:02:33,990 --> 01:02:31,680
autobiography but he wasn't too good an

1616
01:02:35,910 --> 01:02:34,000
airplane driver

1617
01:02:37,270 --> 01:02:35,920
in my interviews with armstrong neil

1618
01:02:38,870 --> 01:02:37,280
responded

1619
01:02:40,710 --> 01:02:38,880
this way

1620
01:02:42,470 --> 01:02:40,720
jaeger had limited understanding of

1621
01:02:43,990 --> 01:02:42,480
aeronautical engineering he really i

1622
01:02:46,069 --> 01:02:44,000
don't think understood quite what we

1623
01:02:48,150 --> 01:02:46,079
were trying to learn he was very good at

1624
01:02:49,670 --> 01:02:48,160
flying aircraft and doing aerobatics and

1625
01:02:51,990 --> 01:02:49,680
loved getting into mock combat

1626
01:02:53,670 --> 01:02:52,000
situations one-on-one but he seemed to

1627
01:02:55,430 --> 01:02:53,680
have less interest in precision and

1628
01:02:57,589 --> 01:02:55,440
getting information and drawing

1629
01:02:59,829 --> 01:02:57,599
conclusions from that he seemed to be

1630
01:03:01,670 --> 01:02:59,839
impatient not so much bored but

1631
01:03:05,670 --> 01:03:01,680
impatient with the planning and

1632
01:03:11,910 --> 01:03:09,510
the planning and techniques of the naca

1633
01:03:13,910 --> 01:03:11,920
perhaps the right stuff as tom wolf

1634
01:03:15,910 --> 01:03:13,920
perceived it really did exist

1635
01:03:17,670 --> 01:03:15,920
and chuck yeager had the most manly dose

1636
01:03:19,589 --> 01:03:17,680
of it perhaps

1637
01:03:21,510 --> 01:03:19,599
but surely as historians we must

1638
01:03:23,990 --> 01:03:21,520

conclude that it was engineer pilots

1639
01:03:26,069 --> 01:03:24,000
like jack reeder and neil armstrong who

1640
01:03:28,069 --> 01:03:26,079
possessed the real right stuff

1641
01:03:30,109 --> 01:03:28,079
it was in fact the culture of the real

1642
01:03:33,430 --> 01:03:30,119
right stuff as articulated and

1643
01:03:35,829 --> 01:03:33,440
institutionalized by the naca involving

1644
01:03:37,510 --> 01:03:35,839
test pilots engaged in less spectacular

1645
01:03:40,150 --> 01:03:37,520
but more quantitative types of

1646
01:03:41,829 --> 01:03:40,160
experimental flying and precise

1647
01:03:44,150 --> 01:03:41,839
experimental flying with highly

1648
01:03:46,150 --> 01:03:44,160
instrumented aircraft that provided the

1649
01:03:48,789 --> 01:03:46,160
essential productive link between the

1650
01:03:51,029 --> 01:03:48,799
world of the cockpit and the theoretical

1651
01:04:00,150 --> 01:03:51,039
design and engineering aspects of the

1652
01:04:03,190 --> 01:04:01,829
thanks very much for that jim and i

1653
01:04:04,870 --> 01:04:03,200
think we'll have probably some very

1654
01:04:06,789 --> 01:04:04,880
interesting questions in the q a

1655
01:04:08,470 --> 01:04:06,799
following up on that

1656
01:04:10,710 --> 01:04:08,480
we have now

1657
01:04:11,670 --> 01:04:10,720
for our final presentation in this

1658
01:04:13,670 --> 01:04:11,680
session

1659
01:04:15,829 --> 01:04:13,680
we have another very gifted young

1660
01:04:18,309 --> 01:04:15,839
scholar dr matthew hirsch a lecturer in

1661
01:04:19,829 --> 01:04:18,319
bioengineering and science technology

1662
01:04:22,309 --> 01:04:19,839
and society at the university of

1663
01:04:24,069 --> 01:04:22,319

pennsylvania

1664
01:04:25,670 --> 01:04:24,079
he uh where he teaches the history of

1665
01:04:26,390 --> 01:04:25,680
aerospace technologies and engineering

1666
01:04:28,069 --> 01:04:26,400
ethics

1667
01:04:29,750 --> 01:04:28,079
he's a former fellow right here at the

1668
01:04:32,309 --> 01:04:29,760
national aerospace museum and at the

1669
01:04:34,069 --> 01:04:32,319
huntington usc institute on california

1670
01:04:36,150 --> 01:04:34,079
in the west and is the author of

1671
01:04:38,630 --> 01:04:36,160
inventing the american astronaut he'll

1672
01:04:40,950 --> 01:04:38,640
take this discussion to the next level

1673
01:04:43,990 --> 01:04:40,960
treating flight tests to moonshot the

1674
01:04:59,029 --> 01:04:44,000
naca the astronauts and the culture of

1675
01:05:01,829 --> 01:05:00,230
thank you

1676
01:05:04,069 --> 01:05:01,839
today we've heard a great deal about the

1677
01:05:06,390 --> 01:05:04,079
contributions of the national advisory

1678
01:05:08,549 --> 01:05:06,400
committee for aeronautics to aviation

1679
01:05:10,870 --> 01:05:08,559
i'd like to continue that story by

1680
01:05:12,150 --> 01:05:10,880
examining the influence of the naca on

1681
01:05:14,150 --> 01:05:12,160
space flight

1682
01:05:15,510 --> 01:05:14,160
in fact my talk may be the only one you

1683
01:05:17,750 --> 01:05:15,520
will hear at this symposium that

1684
01:05:20,390 --> 01:05:17,760
concerns a time period during which the

1685
01:05:22,309 --> 01:05:20,400
naca did not actually exist

1686
01:05:25,750 --> 01:05:22,319
though not an independent organization

1687
01:05:27,270 --> 01:05:25,760
after 1958 the naca through its

1688
01:05:29,349 --> 01:05:27,280

personnel did make valuable

1689
01:05:31,349 --> 01:05:29,359
contributions to space flight research

1690
01:05:33,109 --> 01:05:31,359
that paid dividends long after the

1691
01:05:35,190 --> 01:05:33,119
organization that had employed them had

1692
01:05:38,230 --> 01:05:35,200
evolved into the national aeronautics

1693
01:05:40,870 --> 01:05:38,240
and space administration

1694
01:05:42,630 --> 01:05:40,880
as many of you know naca engineers and

1695
01:05:44,470 --> 01:05:42,640
managers formed the leading edge of

1696
01:05:47,349 --> 01:05:44,480
nasa's human space flight program of the

1697
01:05:50,309 --> 01:05:47,359
1960s and beyond it was not clear in

1698
01:05:52,309 --> 01:05:50,319
1958 who would steward america's first

1699
01:05:55,109 --> 01:05:52,319
human space flight program but an

1700
01:05:57,349 --> 01:05:55,119
impassioned appeal by naca director hugh

1701
01:06:00,309 --> 01:05:57,359
dryden to presidential science advisor

1702
01:06:02,309 --> 01:06:00,319
james killian in 1958 made it clear to

1703
01:06:04,549 --> 01:06:02,319
the eisenhower administration that the

1704
01:06:06,309 --> 01:06:04,559
naca was the natural home for human

1705
01:06:08,069 --> 01:06:06,319
space flight research given the

1706
01:06:09,990 --> 01:06:08,079
organization's experience with

1707
01:06:13,029 --> 01:06:10,000
experimental flight research and its

1708
01:06:15,349 --> 01:06:13,039
diverse pool of talent from engineers to

1709
01:06:17,910 --> 01:06:15,359
pilots

1710
01:06:21,190 --> 01:06:17,920
when the naca was absorbed into nasa in

1711
01:06:23,430 --> 01:06:21,200
1958 the research cultures of naca field

1712
01:06:26,630 --> 01:06:23,440
centers were absorbed into it along with

1713
01:06:28,230 --> 01:06:26,640

naca's engineers and scientists indeed

1714
01:06:30,549 --> 01:06:28,240
one can draw a direct line from the

1715
01:06:32,630 --> 01:06:30,559
advanced aeronautical work of the naca

1716
01:06:34,390 --> 01:06:32,640
to nasa's human spaceflight program

1717
01:06:36,470 --> 01:06:34,400
which challenged the same scientists and

1718
01:06:39,029 --> 01:06:36,480
engineers who explored aviation to

1719
01:06:41,910 --> 01:06:39,039
tackle new challenges in space

1720
01:06:44,470 --> 01:06:41,920
the names of some of these individuals

1721
01:06:46,390 --> 01:06:44,480
max feiger caldwell johnson can be found

1722
01:06:48,549 --> 01:06:46,400
on the patents for the space vehicles

1723
01:06:50,630 --> 01:06:48,559
they would eventually invent

1724
01:06:52,630 --> 01:06:50,640
spacecraft designers at a time when

1725
01:06:54,710 --> 01:06:52,640
spacecraft designer was not yet a

1726
01:06:56,390 --> 01:06:54,720
recognized profession they applied

1727
01:06:58,309 --> 01:06:56,400
decades of knowledge working for

1728
01:07:00,630 --> 01:06:58,319
america's first civilian aeronautical

1729
01:07:02,789 --> 01:07:00,640
laboratory the naca facility at langley

1730
01:07:05,029 --> 01:07:02,799
field to make the united states a space

1731
01:07:06,309 --> 01:07:05,039
faring nation

1732
01:07:08,789 --> 01:07:06,319
science

1733
01:07:11,670 --> 01:07:08,799
not stunts or a slavish devotion to the

1734
01:07:14,069 --> 01:07:11,680
past was the hallmark of their work

1735
01:07:15,990 --> 01:07:14,079
joining the naca as a research scientist

1736
01:07:18,630 --> 01:07:16,000
after his naval service during world war

1737
01:07:20,710 --> 01:07:18,640
ii max fager led the design work in

1738
01:07:22,470 --> 01:07:20,720

langley's pilotless aircraft research

1739
01:07:24,710 --> 01:07:22,480
division before committing an active

1740
01:07:26,470 --> 01:07:24,720
aeronautical blasphemy rejecting a

1741
01:07:28,789 --> 01:07:26,480
winged vehicle as america's first

1742
01:07:31,349 --> 01:07:28,799
spaceship in favor of a rocket boosted

1743
01:07:33,190 --> 01:07:31,359
blunt body capsule suggested by naca

1744
01:07:35,510 --> 01:07:33,200
engineer harvey allen

1745
01:07:37,510 --> 01:07:35,520
collaborative disruptive science became

1746
01:07:39,829 --> 01:07:37,520
the hallmark of work at langley and

1747
01:07:42,789 --> 01:07:39,839
other naca facilities

1748
01:07:45,270 --> 01:07:42,799
while nasa beginning in 1958 would

1749
01:07:47,589 --> 01:07:45,280
continue to and to expand the work done

1750
01:07:49,510 --> 01:07:47,599
at langley the essential architecture of

1751
01:07:52,390 --> 01:07:49,520
america's first human space flight

1752
01:07:54,470 --> 01:07:52,400
program project mercury was the creation

1753
01:07:56,870 --> 01:07:54,480
of the naca

1754
01:08:00,470 --> 01:07:56,880
this inventive culture extended from the

1755
01:08:03,589 --> 01:08:00,480
naa's ncaa naca scientists and engineers

1756
01:08:06,549 --> 01:08:03,599
to its research pilots

1757
01:08:09,829 --> 01:08:06,559
the period i want to examine today 1959

1758
01:08:11,750 --> 01:08:09,839
through 1969 was one steeped in the naca

1759
01:08:13,670 --> 01:08:11,760
flying culture that professor hansen has

1760
01:08:15,430 --> 01:08:13,680
already introduced for us

1761
01:08:17,590 --> 01:08:15,440
in a space race that seemed to be

1762
01:08:18,709 --> 01:08:17,600
slipping further out of america's grasp

1763
01:08:20,550 --> 01:08:18,719

every day

1764
01:08:22,390 --> 01:08:20,560
test pilot astronauts soon came to

1765
01:08:24,870 --> 01:08:22,400
represent the public face of american

1766
01:08:27,269 --> 01:08:24,880
space exploration and serve as a

1767
01:08:28,950 --> 01:08:27,279
reminder to an anxious public that what

1768
01:08:30,630 --> 01:08:28,960
was at stake was something more than

1769
01:08:33,110 --> 01:08:30,640
impressive machines

1770
01:08:35,990 --> 01:08:33,120
exploring space might seem glorious and

1771
01:08:38,149 --> 01:08:36,000
dangerous but if pursued soundly by men

1772
01:08:41,269 --> 01:08:38,159
who carried the naca's values with them

1773
01:08:47,349 --> 01:08:41,279
into the cosmos it could bring a new era

1774
01:08:47,359 --> 01:08:50,070
the

1775
01:08:55,510 --> 01:08:52,709
naca's connections to nasa's astronaut

1776
01:08:57,349 --> 01:08:55,520
corps are deep but not obvious of the

1777
01:08:59,829 --> 01:08:57,359
first two selection groups of american

1778
01:09:01,749 --> 01:08:59,839
astronauts only one neil armstrong had

1779
01:09:03,669 --> 01:09:01,759
flown for the naca

1780
01:09:05,189 --> 01:09:03,679
naca pilots though had always been

1781
01:09:07,189 --> 01:09:05,199
considered among the most likely

1782
01:09:10,149 --> 01:09:07,199
candidates for america's first human

1783
01:09:11,829 --> 01:09:10,159
space flight program in 1958 the united

1784
01:09:14,149 --> 01:09:11,839
states air force made an informal

1785
01:09:16,950 --> 01:09:14,159
preliminary selection of potential crew

1786
01:09:19,030 --> 01:09:16,960
members for its man in space soonest

1787
01:09:21,110 --> 01:09:19,040
project which would attempt to orbit a

1788
01:09:22,789 --> 01:09:21,120

piloted capsule launched atop a

1789
01:09:25,269 --> 01:09:22,799
ballistic missile

1790
01:09:28,309 --> 01:09:25,279
this list comprised nine respected u.s

1791
01:09:29,829 --> 01:09:28,319
air force and naca test pilots including

1792
01:09:32,470 --> 01:09:29,839
armstrong

1793
01:09:34,390 --> 01:09:32,480
when nasa absorbed the naca and assumed

1794
01:09:37,669 --> 01:09:34,400
control of manned space flight in august

1795
01:09:40,470 --> 01:09:37,679
1958 the air force canceled the miss

1796
01:09:42,709 --> 01:09:40,480
project but naca personnel remained

1797
01:09:45,590 --> 01:09:42,719
influential in the selection of nasa's

1798
01:09:47,910 --> 01:09:45,600
early astronauts

1799
01:09:50,229 --> 01:09:47,920
the individuals ultimately responsible

1800
01:09:53,349 --> 01:09:50,239
for selecting america's first astronauts

1801
01:09:55,750 --> 01:09:53,359
themselves former naca managers insisted

1802
01:09:57,750 --> 01:09:55,760
that first and foremost all of the men

1803
01:09:59,990 --> 01:09:57,760
chosen as astronauts would be test

1804
01:10:03,350 --> 01:10:00,000
pilots in government service

1805
01:10:06,070 --> 01:10:03,360
in november 1958 nasa's new space task

1806
01:10:08,229 --> 01:10:06,080
group a fledgling fledgling human space

1807
01:10:10,630 --> 01:10:08,239
flight initiative based in a nondescript

1808
01:10:12,550 --> 01:10:10,640
office building near and near the old

1809
01:10:14,709 --> 01:10:12,560
naca langley field research center in

1810
01:10:16,790 --> 01:10:14,719
virginia requested permission from the

1811
01:10:19,350 --> 01:10:16,800
civil service commission to hire 40

1812
01:10:22,229 --> 01:10:19,360
scientific specialists with demonstrated

1813
01:10:24,550 --> 01:10:22,239

experience in quote hazardous rigorous

1814
01:10:25,830 --> 01:10:24,560
and stressful experience including test

1815
01:10:27,510 --> 01:10:25,840
piloting

1816
01:10:30,470 --> 01:10:27,520
following publication in the federal

1817
01:10:32,470 --> 01:10:30,480
register on december 9th 1958 though

1818
01:10:34,870 --> 01:10:32,480
nasa pulled the announcement as space

1819
01:10:37,350 --> 01:10:34,880
task group members like former naca and

1820
01:10:38,950 --> 01:10:37,360
engineer manager robert gilruth began

1821
01:10:41,430 --> 01:10:38,960
leaning toward a force comprised

1822
01:10:43,350 --> 01:10:41,440
entirely of government test pilots whom

1823
01:10:45,750 --> 01:10:43,360
nasa could recruit and select outside of

1824
01:10:47,669 --> 01:10:45,760
normal civil service procedures

1825
01:10:50,709 --> 01:10:47,679
in addition to active duty military

1826
01:10:53,510 --> 01:10:50,719
aviators gilruth and former naca

1827
01:10:55,430 --> 01:10:53,520
colleague george lowe solicited naca

1828
01:10:57,910 --> 01:10:55,440
test pilots at various nasa field

1829
01:10:59,830 --> 01:10:57,920
centers these were the only civilians

1830
01:11:01,350 --> 01:10:59,840
nasa considered for what would become

1831
01:11:03,830 --> 01:11:01,360
project mercury

1832
01:11:06,390 --> 01:11:03,840
ultimately none joined nasa's effort but

1833
01:11:08,310 --> 01:11:06,400
mostly because they were in many cases

1834
01:11:10,870 --> 01:11:08,320
already committed to high-speed

1835
01:11:13,110 --> 01:11:10,880
high-altitude research projects in order

1836
01:11:15,350 --> 01:11:13,120
to attract these pilots nasa would need

1837
01:11:17,990 --> 01:11:15,360
to demonstrate the same professionalism

1838
01:11:19,350 --> 01:11:18,000

with project mercury as the naca had

1839
01:11:21,430 --> 01:11:19,360
always demonstrated with its

1840
01:11:24,149 --> 01:11:21,440
experimental programs

1841
01:11:26,709 --> 01:11:24,159
even without the direct participation of

1842
01:11:29,350 --> 01:11:26,719
naca pilots as flight crews though

1843
01:11:32,310 --> 01:11:29,360
enough naca personnel participated in

1844
01:11:34,390 --> 01:11:32,320
and supervised nasa operations to ensure

1845
01:11:38,950 --> 01:11:34,400
cultural continuity between project

1846
01:11:41,510 --> 01:11:38,960
mercury and earlier flight test efforts

1847
01:11:43,830 --> 01:11:41,520
for nasa's early astronauts robert

1848
01:11:47,350 --> 01:11:43,840
gilruth a minnesota born aeronautical

1849
01:11:49,110 --> 01:11:47,360
engineer who had joined the naca in 1937

1850
01:11:51,189 --> 01:11:49,120
became the most important face of nasa

1851
01:11:53,430 --> 01:11:51,199
management and the individual with the

1852
01:11:54,870 --> 01:11:53,440
most direct control over the astronauts

1853
01:11:57,110 --> 01:11:54,880
working lives

1854
01:11:59,990 --> 01:11:57,120
after world war ii gilruth had risen

1855
01:12:01,510 --> 01:12:00,000
rapidly in the naca's ranks becoming

1856
01:12:03,669 --> 01:12:01,520
becoming one of its highest paid

1857
01:12:06,790 --> 01:12:03,679
managers by 1948.

1858
01:12:08,950 --> 01:12:06,800
shortly after nasa's formation in 1958

1859
01:12:11,110 --> 01:12:08,960
administrator t keith glennon had

1860
01:12:12,390 --> 01:12:11,120
assigned gilruth to chair the space task

1861
01:12:14,070 --> 01:12:12,400
group

1862
01:12:16,229 --> 01:12:14,080
if german immigrate rocket designer

1863
01:12:18,070 --> 01:12:16,239

verner von braun epitomized america's

1864
01:12:20,709 --> 01:12:18,080
rocket-making leadership before and

1865
01:12:22,390 --> 01:12:20,719
after nasa's formation gilruth with a

1866
01:12:24,149 --> 01:12:22,400
much lower public profile

1867
01:12:26,790 --> 01:12:24,159
and three dozen engineers under his

1868
01:12:27,990 --> 01:12:26,800
direction spoke for its test pilots and

1869
01:12:29,830 --> 01:12:28,000
managed the problems of human

1870
01:12:31,750 --> 01:12:29,840
spaceflight including the creation of

1871
01:12:35,030 --> 01:12:31,760
spacecraft and the recruitment of the

1872
01:12:39,990 --> 01:12:37,110
though often drawn to the allure and

1873
01:12:42,070 --> 01:12:40,000
danger of flying test pilots as we've

1874
01:12:44,550 --> 01:12:42,080
all learned were and are far more

1875
01:12:46,390 --> 01:12:44,560
studious and responsible than they seem

1876
01:12:48,870 --> 01:12:46,400
the early test parts test pilots were

1877
01:12:51,030 --> 01:12:48,880
able ambitious and aggressive men but

1878
01:12:53,189 --> 01:12:51,040
they were neither heroic inventors nor

1879
01:12:55,669 --> 01:12:53,199
captains of industry rather they were

1880
01:12:57,910 --> 01:12:55,679
elite technologists who despite certain

1881
01:12:59,750 --> 01:12:57,920
unique personality traits and uncommon

1882
01:13:01,669 --> 01:12:59,760
abilities had succeeded in large

1883
01:13:03,430 --> 01:13:01,679
organizations known for their often

1884
01:13:05,510 --> 01:13:03,440
limited autonomy and highly

1885
01:13:06,790 --> 01:13:05,520
circumscribed standards of conduct and

1886
01:13:09,590 --> 01:13:06,800
performance

1887
01:13:11,990 --> 01:13:09,600
flight testing as we learned emphasized

1888
01:13:15,110 --> 01:13:12,000

not radical handling and death defying

1889
01:13:16,709 --> 01:13:15,120
stunts but a slow incremental process

1890
01:13:18,950 --> 01:13:16,719
through which the characteristics of new

1891
01:13:20,870 --> 01:13:18,960
aircraft are evaluated in a series of

1892
01:13:23,350 --> 01:13:20,880
choreographed maneuvers

1893
01:13:25,030 --> 01:13:23,360
followed as former test pilot and nasa

1894
01:13:26,709 --> 01:13:25,040
astronaut and

1895
01:13:28,229 --> 01:13:26,719
national air and space museum director

1896
01:13:31,350 --> 01:13:28,239
michael collins later recounted by

1897
01:13:33,830 --> 01:13:31,360
laborious data analysis to outsiders the

1898
01:13:36,709 --> 01:13:33,840
test pilots seemed to be foolhardy men

1899
01:13:38,630 --> 01:13:36,719
who lived life on the edge to the pilots

1900
01:13:39,750 --> 01:13:38,640
their work was as dull as it was

1901
01:13:41,750 --> 01:13:39,760
dangerous

1902
01:13:43,590 --> 01:13:41,760
requiring a more diverse set of skills

1903
01:13:47,990 --> 01:13:43,600
than those that had equipped previous

1904
01:13:50,630 --> 01:13:48,000
generations of aces and barnstormers

1905
01:13:53,910 --> 01:13:50,640
though later critics likened america's

1906
01:13:55,910 --> 01:13:53,920
first astronauts to lab rats nasa sought

1907
01:13:58,310 --> 01:13:55,920
promising career aviators with

1908
01:14:01,510 --> 01:13:58,320
substantial time in the cockpit not the

1909
01:14:04,310 --> 01:14:01,520
nation's youngest or most docile pilots

1910
01:14:05,990 --> 01:14:04,320
as one examiner later noted astronauts

1911
01:14:08,310 --> 01:14:06,000
would be responsible for more than

1912
01:14:11,270 --> 01:14:08,320
merely providing biomedical data

1913
01:14:13,669 --> 01:14:11,280

operating experiments or even flying

1914
01:14:15,590 --> 01:14:13,679
nasa hoped its astronaut pilots would

1915
01:14:17,750 --> 01:14:15,600
demonstrate evidence

1916
01:14:20,070 --> 01:14:17,760
evidence of sufficient drive and

1917
01:14:22,229 --> 01:14:20,080
creativity to ensure positive

1918
01:14:23,270 --> 01:14:22,239
contributions to the development of the

1919
01:14:25,669 --> 01:14:23,280
vehicle

1920
01:14:27,990 --> 01:14:25,679
and therefore nasa sought out promising

1921
01:14:29,910 --> 01:14:28,000
well-qualified fliers with substantial

1922
01:14:32,149 --> 01:14:29,920
engineering training

1923
01:14:34,149 --> 01:14:32,159
adopting the model of naca research

1924
01:14:36,709 --> 01:14:34,159
pilots the astronauts took this

1925
01:14:38,709 --> 01:14:36,719
responsibility seriously determined to

1926
01:14:40,950 --> 01:14:38,719
not only contribute to the space program

1927
01:14:42,709 --> 01:14:40,960
but to impress the larger test pilot

1928
01:14:44,470 --> 01:14:42,719
community with their efforts

1929
01:14:47,270 --> 01:14:44,480
they were not alone

1930
01:14:49,189 --> 01:14:47,280
with the support of the former naca's

1931
01:14:51,030 --> 01:14:49,199
gill ruth and fager the astronauts

1932
01:14:54,870 --> 01:14:51,040
insinuated themselves into vehicle

1933
01:14:59,669 --> 01:14:57,030
as nasa's project mercury astronauts

1934
01:15:03,110 --> 01:14:59,679
deke slayton wally sherrah and alan

1935
01:15:05,189 --> 01:15:03,120
shepard explained to journalists in 1959

1936
01:15:07,189 --> 01:15:05,199
they and their fellow test pilots had

1937
01:15:08,470 --> 01:15:07,199
not been hired by nasa to sign

1938
01:15:10,709 --> 01:15:08,480

autographs

1939
01:15:12,149 --> 01:15:10,719
pose for photographs or even fly

1940
01:15:14,070 --> 01:15:12,159
aircraft

1941
01:15:15,910 --> 01:15:14,080
rather continuing a tradition of

1942
01:15:19,110 --> 01:15:15,920
experimental flight pioneered by the

1943
01:15:21,990 --> 01:15:19,120
naca the new aerospace agency had hired

1944
01:15:24,470 --> 01:15:22,000
professional empiricists to design and

1945
01:15:26,149 --> 01:15:24,480
conduct audacious flight experiments

1946
01:15:30,870 --> 01:15:26,159
experiments that would push the limits

1947
01:15:32,630 --> 01:15:30,880
of speed altitude and human ability

1948
01:15:34,470 --> 01:15:32,640
in the astronauts firsthand account of

1949
01:15:36,470 --> 01:15:34,480
their work we7

1950
01:15:38,310 --> 01:15:36,480
deke slayton recounted how the men upon

1951
01:15:40,149 --> 01:15:38,320
their arrival in nasa had divided

1952
01:15:42,470 --> 01:15:40,159
various engineering aspects of project

1953
01:15:45,030 --> 01:15:42,480
mercury among them scott carpenter to

1954
01:15:47,669 --> 01:15:45,040
navigation gordon cooper to the redstone

1955
01:15:49,590 --> 01:15:47,679
john glenn to cockpit design gus grissom

1956
01:15:51,270 --> 01:15:49,600
to flight controls wally sharata

1957
01:15:53,669 --> 01:15:51,280
spacesuit development alan shepard to

1958
01:15:54,870 --> 01:15:53,679
recovery systems slayton to the atlas

1959
01:15:56,790 --> 01:15:54,880
launch vehicle

1960
01:15:59,430 --> 01:15:56,800
astronauts took these took to these

1961
01:16:01,270 --> 01:15:59,440
assignments with alacrity and enthusiasm

1962
01:16:02,709 --> 01:16:01,280
exploiting their notoriety to push

1963
01:16:04,630 --> 01:16:02,719

design changes

1964
01:16:06,149 --> 01:16:04,640
grissom in particular was so obsessed

1965
01:16:08,070 --> 01:16:06,159
with the design of the capsules

1966
01:16:09,990 --> 01:16:08,080
autopilots leighton recalled that one

1967
01:16:11,750 --> 01:16:10,000
nasa manager eventually exclaimed that

1968
01:16:13,350 --> 01:16:11,760
if the device did not work it would be

1969
01:16:15,430 --> 01:16:13,360
grissom's fault

1970
01:16:17,510 --> 01:16:15,440
robert gilruth encouraged the astronauts

1971
01:16:19,830 --> 01:16:17,520
to push for a redesign of equipment they

1972
01:16:22,470 --> 01:16:19,840
felt unsuitable and later recalled the

1973
01:16:24,310 --> 01:16:22,480
men as doing excellent work quote people

1974
01:16:26,229 --> 01:16:24,320
used to tell me that i had no control

1975
01:16:28,470 --> 01:16:26,239
over the astronauts gilruth later

1976
01:16:29,750 --> 01:16:28,480
remarked i tell you those boys were

1977
01:16:31,830 --> 01:16:29,760
wonderful

1978
01:16:33,990 --> 01:16:31,840
as the ones ultimately responsible for

1979
01:16:35,990 --> 01:16:34,000
flying the vehicles the astronauts

1980
01:16:38,790 --> 01:16:36,000
argued that they possessed the best idea

1981
01:16:39,830 --> 01:16:38,800
of what would and would not work in

1982
01:16:41,590 --> 01:16:39,840
space

1983
01:16:44,070 --> 01:16:41,600
and they enjoyed the support from

1984
01:16:46,310 --> 01:16:44,080
gilrouth which made the astronauts vital

1985
01:16:48,630 --> 01:16:46,320
arbiters in the design process

1986
01:16:51,030 --> 01:16:48,640
we decided that since we were the test

1987
01:16:52,870 --> 01:16:51,040
pilots who would be flying the thing

1988
01:16:55,669 --> 01:16:52,880

we had the right to stir things up a bit

1989
01:16:59,030 --> 01:16:55,679
slayton recalled that is what they had

1990
01:17:02,470 --> 01:17:00,950
interactions between astronauts and

1991
01:17:04,709 --> 01:17:02,480
ground engineers

1992
01:17:05,830 --> 01:17:04,719
were occasionally chilly but always

1993
01:17:07,750 --> 01:17:05,840
productive

1994
01:17:09,669 --> 01:17:07,760
quote we had a fair amount of prestige

1995
01:17:11,590 --> 01:17:09,679
around the country noted wali shara at

1996
01:17:13,430 --> 01:17:11,600
the time and though we did not always

1997
01:17:15,590 --> 01:17:13,440
succeed in getting what we wanted we

1998
01:17:16,390 --> 01:17:15,600
sometimes ganged up all seven of us

1999
01:17:18,310 --> 01:17:16,400
together

2000
01:17:20,070 --> 01:17:18,320
the extra weight helped us to win at

2001
01:17:22,149 --> 01:17:20,080
least a compromise

2002
01:17:24,870 --> 01:17:22,159
astronauts valued robust design

2003
01:17:27,189 --> 01:17:24,880
redundancy and flexible operation

2004
01:17:28,870 --> 01:17:27,199
engineers favored precision systems

2005
01:17:30,390 --> 01:17:28,880
making efficient use of volume and

2006
01:17:32,470 --> 01:17:30,400
weight limitations

2007
01:17:34,550 --> 01:17:32,480
often the proposed design changes like

2008
01:17:36,390 --> 01:17:34,560
the addition of a window to the mercury

2009
01:17:38,149 --> 01:17:36,400
spacecraft were remedied with actually

2010
01:17:40,390 --> 01:17:38,159
very little debate

2011
01:17:42,229 --> 01:17:40,400
to some nasa engineers the astronauts

2012
01:17:44,070 --> 01:17:42,239
insistence on redesigning capsule

2013
01:17:46,070 --> 01:17:44,080

hardware to suit their tastes may have

2014
01:17:47,830 --> 01:17:46,080
been infuriating but the astronauts

2015
01:17:50,310 --> 01:17:47,840
participation in mercury engineering

2016
01:17:52,310 --> 01:17:50,320
work never rose to the level of mutiny

2017
01:17:54,950 --> 01:17:52,320
indeed the astronauts independence was a

2018
01:17:57,350 --> 01:17:54,960
professional mindset borrowed from naca

2019
01:17:59,030 --> 01:17:57,360
flight test programs and encouraged by

2020
01:18:01,350 --> 01:17:59,040
space task group managers who were

2021
01:18:04,790 --> 01:18:01,360
disposed to trust test pilots and wanted

2022
01:18:07,030 --> 01:18:04,800
to exploit their skills and expertise

2023
01:18:09,110 --> 01:18:07,040
nor did their attention to detail unduly

2024
01:18:11,270 --> 01:18:09,120
delay the space program

2025
01:18:12,870 --> 01:18:11,280
as air force and nasa managers debated

2026
01:18:15,030 --> 01:18:12,880
selection criteria for astronaut

2027
01:18:17,110 --> 01:18:15,040
candidates in the late 1950s in the

2028
01:18:18,630 --> 01:18:17,120
soviet union a similar controversy had

2029
01:18:21,030 --> 01:18:18,640
raged between two conceptions of the

2030
01:18:22,950 --> 01:18:21,040
space traveler with advocates of a less

2031
01:18:24,790 --> 01:18:22,960
independent pilot role eventually

2032
01:18:26,950 --> 01:18:24,800
prevailing

2033
01:18:28,390 --> 01:18:26,960
naca engineers had always been more

2034
01:18:30,149 --> 01:18:28,400
concerned with promulgating good

2035
01:18:32,950 --> 01:18:30,159
engineering practice than establishing

2036
01:18:34,790 --> 01:18:32,960
high profile records and laborious

2037
01:18:37,270 --> 01:18:34,800
occasionally time-consuming testing of

2038
01:18:39,590 --> 01:18:37,280

boosters and subsystems was fundamental

2039
01:18:41,990 --> 01:18:39,600
to the american design process

2040
01:18:44,070 --> 01:18:42,000
nasa as astronaut john glenn asserted

2041
01:18:47,669 --> 01:18:44,080
wish to be quote right

2042
01:18:51,990 --> 01:18:49,510
in a space race characterized by

2043
01:18:54,229 --> 01:18:52,000
occasional stunts nasa's methodical

2044
01:18:56,550 --> 01:18:54,239
testing of launch and space vehicles

2045
01:18:58,709 --> 01:18:56,560
placed a premium on safety and regarded

2046
01:19:00,229 --> 01:18:58,719
astronauts as key members of a flight

2047
01:19:03,350 --> 01:19:00,239
test program

2048
01:19:05,030 --> 01:19:03,360
writing in 1966 kenneth keniston seized

2049
01:19:07,270 --> 01:19:05,040
upon the technical expertise of

2050
01:19:09,669 --> 01:19:07,280
astronauts and not their flying skills

2051
01:19:10,870 --> 01:19:09,679
or supposed heroism as their defining

2052
01:19:14,149 --> 01:19:10,880
trait

2053
01:19:16,709 --> 01:19:14,159
shira for example spoke of the hotshot

2054
01:19:18,470 --> 01:19:16,719
pilot as not just a scarf and goggles

2055
01:19:20,470 --> 01:19:18,480
type but one who could use his

2056
01:19:24,070 --> 01:19:20,480
engineering confidence to work on

2057
01:19:26,550 --> 01:19:24,080
systems and make the best airplane ever

2058
01:19:27,750 --> 01:19:26,560
even more request respected by nasa than

2059
01:19:29,990 --> 01:19:27,760
machine like

2060
01:19:32,390 --> 01:19:30,000
reliability was the pilot astronaut's

2061
01:19:33,990 --> 01:19:32,400
imper imperturb ability in the face of

2062
01:19:36,149 --> 01:19:34,000
mechanical failure

2063
01:19:37,990 --> 01:19:36,159

such resourcefulness validated human

2064
01:19:39,910 --> 01:19:38,000
piloting and advertised the unique

2065
01:19:41,510 --> 01:19:39,920
skills present within the burgeoning

2066
01:19:44,709 --> 01:19:41,520
astronaut corps

2067
01:19:46,470 --> 01:19:44,719
indeed writing in 1964 on the results of

2068
01:19:48,229 --> 01:19:46,480
the mercury flights air force

2069
01:19:49,990 --> 01:19:48,239
psychiatrists noted that for one

2070
01:19:51,590 --> 01:19:50,000
astronaut they interviewed the quote

2071
01:19:53,189 --> 01:19:51,600
failure of automatic instruments

2072
01:19:55,910 --> 01:19:53,199
intensified the feelings of personal

2073
01:19:58,070 --> 01:19:55,920
contribution and success to the mission

2074
01:20:00,950 --> 01:19:58,080
time and again astronauts demonstrated

2075
01:20:02,630 --> 01:20:00,960
these talents in 1966 armstrong

2076
01:20:05,110 --> 01:20:02,640
recovered from a potentially lethal

2077
01:20:06,470 --> 01:20:05,120
in-flight mishap on the gemini 8 flight

2078
01:20:08,390 --> 01:20:06,480
summoning up enough strength and

2079
01:20:10,870 --> 01:20:08,400
coordination to end an uncontrollable

2080
01:20:12,550 --> 01:20:10,880
spin that threatened to live leave him

2081
01:20:15,830 --> 01:20:12,560
and pilot dave scott

2082
01:20:19,350 --> 01:20:18,390
like the naca test pilots who preceded

2083
01:20:21,510 --> 01:20:19,360
them

2084
01:20:23,430 --> 01:20:21,520
the test pilots who became america's

2085
01:20:25,189 --> 01:20:23,440
first astronauts combine traditional

2086
01:20:27,270 --> 01:20:25,199
piloting skills with the kind of

2087
01:20:29,669 --> 01:20:27,280
technical and managerial expertise

2088
01:20:32,229 --> 01:20:29,679

increasingly necessary in test flying

2089
01:20:35,350 --> 01:20:32,239
and indeed in all of modern society

2090
01:20:37,669 --> 01:20:35,360
quote in earlier flight one 1959 air

2091
01:20:40,709 --> 01:20:37,679
force publication concluded flying

2092
01:20:43,270 --> 01:20:40,719
entailed a high level of psychomotor

2093
01:20:46,149 --> 01:20:43,280
ability for example in the coordinated

2094
01:20:47,669 --> 01:20:46,159
manipulation of stick rudder bar and

2095
01:20:50,070 --> 01:20:47,679
throttle

2096
01:20:52,070 --> 01:20:50,080
at present advances in mechanical

2097
01:20:53,910 --> 01:20:52,080
systems have review have reduced these

2098
01:20:55,990 --> 01:20:53,920
functions essentially to those of

2099
01:20:57,030 --> 01:20:56,000
information processing and decision

2100
01:20:59,510 --> 01:20:57,040
making

2101
01:21:01,750 --> 01:20:59,520
this change though required more from

2102
01:21:04,790 --> 01:21:01,760
aviators not less

2103
01:21:06,550 --> 01:21:04,800
and nasa's astronauts easily met this

2104
01:21:08,790 --> 01:21:06,560
challenge

2105
01:21:11,750 --> 01:21:08,800
ten years after the air force wrote of

2106
01:21:14,070 --> 01:21:11,760
the changing skill set of pilots former

2107
01:21:16,070 --> 01:21:14,080
naca test pilot neil armstrong would

2108
01:21:18,709 --> 01:21:16,080
demonstrate a mastery of these diverse

2109
01:21:21,189 --> 01:21:18,719
skills when he with lunar module pilot

2110
01:21:23,910 --> 01:21:21,199
edwin buzz aldrin landed eagle on the

2111
01:21:31,430 --> 01:21:23,920
lunar surface

2112
01:21:34,470 --> 01:21:32,790
we've had i think an extraordinary

2113
01:21:36,229 --> 01:21:34,480

session i'd like you to join me in

2114
01:21:41,350 --> 01:21:36,239
giving another round of applause for all

2115
01:21:44,870 --> 01:21:43,189
we now have the same protocol that we've

2116
01:21:47,830 --> 01:21:44,880
followed for the rest of the day if you

2117
01:21:49,750 --> 01:21:47,840
wish to offer a question come forth sign

2118
01:21:52,070 --> 01:21:49,760
a release form and then

2119
01:22:01,510 --> 01:21:52,080
state your identity before posing your

2120
01:22:12,709 --> 01:22:02,870
it's the end of the day but it's not

2121
01:22:12,719 --> 01:22:16,709
come on down

2122
01:22:19,669 --> 01:22:17,990
hi sean

2123
01:22:21,590 --> 01:22:19,679
um i had a question for

2124
01:22:23,270 --> 01:22:21,600
mainly for jeremy but also for everyone

2125
01:22:26,390 --> 01:22:23,280
else on the panel um looking at

2126
01:22:28,709 --> 01:22:26,400
propellers in the 50s because i remember

2127
01:22:31,270 --> 01:22:28,719
look during iraq two

2128
01:22:32,950 --> 01:22:31,280
reading stories about how these jets

2129
01:22:34,709 --> 01:22:32,960
were just they were going so fast they

2130
01:22:35,669 --> 01:22:34,719
couldn't do any sort of surveillance on

2131
01:22:38,229 --> 01:22:35,679
the ground

2132
01:22:40,149 --> 01:22:38,239
turning back to these propeller aircraft

2133
01:22:42,229 --> 01:22:40,159
is there anything along those lines that

2134
01:22:44,229 --> 01:22:42,239
you've picked up where individuals are

2135
01:22:46,390 --> 01:22:44,239
saying these propeller aircraft have a

2136
01:22:48,390 --> 01:22:46,400
real purpose we need to continue to

2137
01:22:49,990 --> 01:22:48,400
research them especially um

2138
01:22:52,870 --> 01:22:50,000

pre-satellite where they're not able to

2139
01:22:54,790 --> 01:22:52,880
come in and and do uh observations that

2140
01:22:59,430 --> 01:22:54,800
way

2141
01:23:01,910 --> 01:22:59,440
driven airplane becomes in the 50s 60s

2142
01:23:03,430 --> 01:23:01,920
and 70s is a reflection of that

2143
01:23:06,470 --> 01:23:03,440
technology

2144
01:23:07,430 --> 01:23:06,480
advancement in the 30s and 40s

2145
01:23:09,110 --> 01:23:07,440
and

2146
01:23:10,950 --> 01:23:09,120
so the idea is that that's carrying over

2147
01:23:12,709 --> 01:23:10,960
the technology but when the fuel crisis

2148
01:23:14,390 --> 01:23:12,719
comes and that's when another potential

2149
01:23:15,990 --> 01:23:14,400
reinvention of the propeller comes into

2150
01:23:18,149 --> 01:23:16,000
being

2151
01:23:20,390 --> 01:23:18,159
and overall the industry sees that well

2152
01:23:21,910 --> 01:23:20,400
we can take that technology off the

2153
01:23:23,590 --> 01:23:21,920
shelf

2154
01:23:25,669 --> 01:23:23,600
for combat aircraft especially in the

2155
01:23:27,750 --> 01:23:25,679
50s and 60s and we can use that so

2156
01:23:30,070 --> 01:23:27,760
there's no more work to be done so they

2157
01:23:31,830 --> 01:23:30,080
emphasize other things so industry is

2158
01:23:33,270 --> 01:23:31,840
actually quite anti-propeller in the

2159
01:23:35,590 --> 01:23:33,280
propeller

2160
01:23:37,990 --> 01:23:35,600
manufacturers have to diversify

2161
01:23:39,830 --> 01:23:38,000
as a result of that so there's this gap

2162
01:23:42,550 --> 01:23:39,840
in the 50s and 60s but by the time the

2163
01:23:43,750 --> 01:23:42,560

fuel crisis with the advanced turboprop

2164
01:23:45,590 --> 01:23:43,760
program

2165
01:23:47,030 --> 01:23:45,600
uh that the there's this potential

2166
01:23:49,430 --> 01:23:47,040
reinvention that takes place that's

2167
01:23:50,550 --> 01:23:49,440
still kind of hanging fire as we speak

2168
01:23:52,709 --> 01:23:50,560
speak as

2169
01:23:55,270 --> 01:23:52,719
uh fuel prices go up and down mostly

2170
01:23:57,510 --> 01:23:55,280
down now so so it's still there but it's

2171
01:23:59,990 --> 01:23:57,520
sort of a you know the idea though for

2172
01:24:05,910 --> 01:24:00,000
high performance aircraft is that the

2173
01:24:10,070 --> 01:24:07,990
larry burke i have another question for

2174
01:24:11,590 --> 01:24:10,080
jeremy it's a bit of an oddball question

2175
01:24:13,910 --> 01:24:11,600
maybe

2176
01:24:16,310 --> 01:24:13,920
did any of the propeller research find

2177
01:24:17,750 --> 01:24:16,320
its way back into improvements in the

2178
01:24:20,310 --> 01:24:17,760
wind tunnels

2179
01:24:22,070 --> 01:24:20,320
or are the two

2180
01:24:23,910 --> 01:24:22,080
too dissimilar

2181
01:24:25,030 --> 01:24:23,920
to take lessons from one and apply them

2182
01:24:27,030 --> 01:24:25,040
to the other

2183
01:24:28,390 --> 01:24:27,040
well i'll defer to an expert on wind

2184
01:24:30,550 --> 01:24:28,400
tunnel design

2185
01:24:32,550 --> 01:24:30,560
but you're in a wind tunnel it's a fan

2186
01:24:35,270 --> 01:24:32,560
and it's supposed to move air

2187
01:24:37,030 --> 01:24:35,280
uh consistently in a uniform manner but

2188
01:24:39,350 --> 01:24:37,040

it's not necessarily the same type of

2189
01:24:41,830 --> 01:24:39,360
technology would need for high thrust

2190
01:24:43,510 --> 01:24:41,840
and high performance uh so the designs

2191
01:24:45,910 --> 01:24:43,520
are a little bit different our you know

2192
01:24:47,430 --> 01:24:45,920
our artifact of the day the full-scale

2193
01:24:49,350 --> 01:24:47,440
tunnel fan that we have out in the

2194
01:24:52,229 --> 01:24:49,360
milestones of flight gallery that was

2195
01:24:54,550 --> 01:24:52,239
just installed uh it's a fixed pitch

2196
01:24:56,790 --> 01:24:54,560
propeller made out of wood and so that's

2197
01:24:58,629 --> 01:24:56,800
not necessarily an advanced technology

2198
01:25:00,070 --> 01:24:58,639
the original fan assembly in the

2199
01:25:02,629 --> 01:25:00,080
full-scale tunnel was made out of

2200
01:25:04,629 --> 01:25:02,639
aluminum alloy advanced technology but

2201
01:25:06,950 --> 01:25:04,639
actually vibrated and flexed too much so

2202
01:25:11,669 --> 01:25:06,960
they went back to what's considered old

2203
01:25:11,679 --> 01:25:16,310
other questions

2204
01:25:20,709 --> 01:25:18,709
i was struck by jeremy's last comment

2205
01:25:22,470 --> 01:25:20,719
it's fine to have a

2206
01:25:23,830 --> 01:25:22,480
wooden propeller and a metal hub it

2207
01:25:25,830 --> 01:25:23,840
doesn't work so well the other way

2208
01:25:28,629 --> 01:25:25,840
around there was a university that shall

2209
01:25:31,350 --> 01:25:28,639
remain nameless that had b-29 blades in

2210
01:25:33,110 --> 01:25:31,360
a wooden hub in their how in their

2211
01:25:35,830 --> 01:25:33,120
university wind tunnel and came rather

2212
01:25:37,910 --> 01:25:35,840
badly adrift one night

2213
01:25:40,070 --> 01:25:37,920

other questions

2214
01:25:41,350 --> 01:25:40,080
jim dick if we don't have questions from

2215
01:25:43,350 --> 01:25:41,360
the audience i have a question i'd like

2216
01:25:45,030 --> 01:25:43,360
to address to you and that is fine one

2217
01:25:47,590 --> 01:25:45,040
thing i didn't want to do in my talk

2218
01:25:49,590 --> 01:25:47,600
that i maybe should make explicit is is

2219
01:25:51,590 --> 01:25:49,600
do some kind of a tar brush on military

2220
01:25:53,669 --> 01:25:51,600
test pilots you know but the specific

2221
01:25:56,070 --> 01:25:53,679
remarks aren't that i quoted and those

2222
01:25:57,830 --> 01:25:56,080
are verbatim are armstrong's comments

2223
01:25:59,990 --> 01:25:57,840
about yeager yeah

2224
01:26:02,310 --> 01:26:00,000
i would guess i have never studied in

2225
01:26:03,350 --> 01:26:02,320
any detail the military test pilot

2226
01:26:04,950 --> 01:26:03,360
culture

2227
01:26:07,669 --> 01:26:04,960
i would think that it's very close to

2228
01:26:09,669 --> 01:26:07,679
the naca research culture so

2229
01:26:11,430 --> 01:26:09,679
in what way similar in what ways if any

2230
01:26:12,870 --> 01:26:11,440
different funny you should say because i

2231
01:26:15,270 --> 01:26:12,880
was about to make a little comment on

2232
01:26:17,990 --> 01:26:15,280
that um i had a i had a very good

2233
01:26:21,430 --> 01:26:18,000
fortune i did my i did a senior thesis

2234
01:26:24,550 --> 01:26:21,440
on flight testing in 1969 and 1970 and

2235
01:26:27,270 --> 01:26:24,560
in 1970 i had the chance to

2236
01:26:30,470 --> 01:26:27,280
have scott crossfield review it he was

2237
01:26:31,669 --> 01:26:30,480
very much a classic military pilot navy

2238
01:26:32,550 --> 01:26:31,679

background

2239
01:26:33,830 --> 01:26:32,560
went

2240
01:26:35,110 --> 01:26:33,840
through the university of washington

2241
01:26:37,350 --> 01:26:35,120
masters degree in aeronautical

2242
01:26:39,189 --> 01:26:37,360
engineering came down was hired by walt

2243
01:26:41,189 --> 01:26:39,199
williams flew then

2244
01:26:43,030 --> 01:26:41,199
at edwards for a number of years

2245
01:26:44,550 --> 01:26:43,040
then transitioned to

2246
01:26:47,110 --> 01:26:44,560
north american because he was so

2247
01:26:49,750 --> 01:26:47,120
involved in trying to get the x-15 going

2248
01:26:51,990 --> 01:26:49,760
in 1971

2249
01:26:54,070 --> 01:26:52,000
i made the acquaintance of chuck yeager

2250
01:26:55,510 --> 01:26:54,080
and coincidentally neil armstrong in

2251
01:26:57,110 --> 01:26:55,520
that same year

2252
01:26:58,229 --> 01:26:57,120
and both of them all three of these

2253
01:26:59,110 --> 01:26:58,239
individuals

2254
01:27:21,110 --> 01:26:59,120
i

2255
01:27:22,790 --> 01:27:21,120
all day

2256
01:27:25,510 --> 01:27:22,800
with a newly admitted graduate student

2257
01:27:27,510 --> 01:27:25,520
and gave me a one-on-one tutorial on

2258
01:27:29,430 --> 01:27:27,520
flight dynamics and high altitude flight

2259
01:27:31,030 --> 01:27:29,440
and regions of low dynamic pressure i

2260
01:27:32,629 --> 01:27:31,040
thought that was extraordinary i saw the

2261
01:27:34,790 --> 01:27:32,639
guy hung the moon

2262
01:27:36,790 --> 01:27:34,800
chuck yeager was defense had ashay in

2263
01:27:38,870 --> 01:27:36,800

pakistan at the time that i contacted

2264
01:27:41,830 --> 01:27:38,880
him he was in the midst of a very nasty

2265
01:27:44,229 --> 01:27:41,840
war between india and pakistan and yet

2266
01:27:46,470 --> 01:27:44,239
he took the time to extract material

2267
01:27:48,550 --> 01:27:46,480
from his log books and patiently answer

2268
01:27:50,149 --> 01:27:48,560
a questionnaire that i sent i thought

2269
01:27:52,229 --> 01:27:50,159
that was that was kind of impressive

2270
01:27:55,270 --> 01:27:52,239
itself later on then i i worked pretty

2271
01:27:58,550 --> 01:27:55,280
closely uh with jaeger at 80 at edwards

2272
01:28:00,310 --> 01:27:58,560
in the uh 1980s and i had gotten to work

2273
01:28:01,910 --> 01:28:00,320
out of dryden as part of my dryden

2274
01:28:04,470 --> 01:28:01,920
contract when i was here at smithsonian

2275
01:28:06,229 --> 01:28:04,480
from the 1970s onwards there are

2276
01:28:08,310 --> 01:28:06,239
differences in the culture

2277
01:28:10,310 --> 01:28:08,320
but i would say this

2278
01:28:12,390 --> 01:28:10,320
we have to remember

2279
01:28:16,310 --> 01:28:12,400
a critical difference

2280
01:28:19,270 --> 01:28:16,320
there are pilots who fly fighters

2281
01:28:21,750 --> 01:28:19,280
and there are fighter pilots

2282
01:28:25,590 --> 01:28:21,760
the two are not the same

2283
01:28:30,229 --> 01:28:25,600
i have flown in fighters with both

2284
01:28:34,390 --> 01:28:30,239
f-104 f-105 f4 f15

2285
01:28:36,629 --> 01:28:34,400
f16 f15e that's my backseat experience

2286
01:28:38,310 --> 01:28:36,639
with these guys and i will tell you your

2287
01:28:39,910 --> 01:28:38,320
research pilots are excellent but your

2288
01:28:43,350 --> 01:28:39,920

fighter pilots are in a very different

2289
01:28:45,350 --> 01:28:43,360
world what jaeger considered himself he

2290
01:28:46,470 --> 01:28:45,360
always considered himself a fighter

2291
01:28:52,550 --> 01:28:46,480
pilot

2292
01:28:57,270 --> 01:28:54,390
you have to recognize there's two kinds

2293
01:28:58,629 --> 01:28:57,280
of right stuff there's a combat right

2294
01:29:00,709 --> 01:28:58,639
stuff

2295
01:29:02,550 --> 01:29:00,719
where the stakes of your life

2296
01:29:05,030 --> 01:29:02,560
and then there's a flight test right

2297
01:29:08,229 --> 01:29:05,040
stuff where the stakes are getting the

2298
01:29:09,990 --> 01:29:08,239
right information what i think

2299
01:29:13,270 --> 01:29:10,000
tom wolf mist

2300
01:29:15,590 --> 01:29:13,280
was confusing the sense of recklessness

2301
01:29:17,590 --> 01:29:15,600
with the sense of adventure in both you

2302
01:29:19,030 --> 01:29:17,600
have to have the sense of adventure but

2303
01:29:20,790 --> 01:29:19,040
not the sense of recklessness i'm

2304
01:29:22,229 --> 01:29:20,800
getting the cut off i'll be happy to

2305
01:29:23,990 --> 01:29:22,239
join you with the bar afterwards so we

2306
01:29:26,229 --> 01:29:24,000
can go in this in detail we've had a