



1
00:00:07,610 --> 00:00:04,700
oh good morning everybody thank you all

2
00:00:09,650 --> 00:00:07,620
for coming my name is Sam shamea 'um the

3
00:00:11,360 --> 00:00:09,660
deputy for International Space Station

4
00:00:12,740 --> 00:00:11,370
here at headquarters and it's my

5
00:00:15,740 --> 00:00:12,750
pleasure this morning to introduce dr.

6
00:00:19,010 --> 00:00:15,750
Jessica von Puttkamer he started his

7
00:00:22,220 --> 00:00:19,020
career at NASA in 1962 at the Marshall

8
00:00:25,790 --> 00:00:22,230
Space Flight Center when dr. Wernher von

9
00:00:28,040 --> 00:00:25,800
Braun brought him over from Germany he

10
00:00:30,290 --> 00:00:28,050
worked on the Apollo program it was

11
00:00:32,630 --> 00:00:30,300
essential in the propulsion area he also

12
00:00:34,790 --> 00:00:32,640
worked Skylab he's also as you can tell

13
00:00:37,760 --> 00:00:34,800

by this presentation today has worked

14

00:00:39,260 --> 00:00:37,770

for many years on missions beyond the

15

00:00:41,690 --> 00:00:39,270

earth and beyond the munis and

16

00:00:43,610 --> 00:00:41,700

especially to Mars he has quite a bit of

17

00:00:46,279 --> 00:00:43,620

experience around the agency including

18

00:00:48,709 --> 00:00:46,289

dealing with with the Russians he's

19

00:00:50,900 --> 00:00:48,719

the author of many books he's consulted

20

00:00:53,420 --> 00:00:50,910

on many movies and series inspect the

21

00:01:00,170 --> 00:00:53,430

first Star Trek series consulted on that

22

00:01:01,689 --> 00:01:00,180

I had to mention that so I think that's

23

00:01:05,210 --> 00:01:01,699

about it he started here at headquarters

24

00:01:08,990 --> 00:01:05,220

1974 and he's worked several positions

25

00:01:10,310 --> 00:01:09,000

including mission planning and as well

26
00:01:15,640 --> 00:01:10,320
as international space station program

27
00:01:25,190 --> 00:01:22,030
hey thank you very much it's a nice

28
00:01:27,320 --> 00:01:25,200
painting there by pet rolling and it's

29
00:01:29,690 --> 00:01:27,330
really a photograph and you'll kind of

30
00:01:31,580 --> 00:01:29,700
see a sweet person said you don't

31
00:01:34,100 --> 00:01:31,590
fortunately see whether they are male or

32
00:01:37,069 --> 00:01:34,110
female there must be at least one female

33
00:01:39,260 --> 00:01:37,079
in there and one of an American in the

34
00:01:41,899 --> 00:01:39,270
middle there is ASA and on the right

35
00:01:47,030 --> 00:01:41,909
side is a Russian and the person who

36
00:01:50,210 --> 00:01:47,040
took that photo is a Chinese anyway I

37
00:01:52,940 --> 00:01:50,220
gave I gave this presentation a few

38
00:01:54,289 --> 00:01:52,950

weeks ago in Huntsville it's the

39

00:01:56,630 --> 00:01:54,299

International Space development

40

00:01:59,300 --> 00:01:56,640

conference there and some people they

41

00:02:03,499 --> 00:01:59,310

don't ask me to do it again here at

42

00:02:07,219 --> 00:02:03,509

headquarters and you will be amazed or

43

00:02:09,740 --> 00:02:07,229

some of you but how much effort has

44

00:02:13,190 --> 00:02:09,750

already gone into piloted Mars mission

45

00:02:16,210 --> 00:02:13,200

studies into the in those 60 years

46

00:02:20,869 --> 00:02:16,220

there have been countless studies both

47

00:02:23,059 --> 00:02:20,879

NASA internal and contracted by NASA

48

00:02:26,839 --> 00:02:23,069

with industry and also by external

49

00:02:30,290 --> 00:02:26,849

groupings I can hint only on a few of

50

00:02:32,960 --> 00:02:30,300

them on the major studies and in kind of

51
00:02:38,780 --> 00:02:32,970
at the end come up with some concluding

52
00:02:42,080 --> 00:02:38,790
remarks a full text of my study is

53
00:02:45,559 --> 00:02:42,090
available and on demand and I can also

54
00:02:48,820 --> 00:02:45,569
provide copies of all the slides and I

55
00:02:55,910 --> 00:02:48,830
understand they are recording my

56
00:02:59,559 --> 00:02:55,920
valuable words right now on video okay

57
00:03:07,100 --> 00:02:59,569
let's get started ways that are here

58
00:03:11,630 --> 00:03:07,110
this year this is what we are talking

59
00:03:13,580 --> 00:03:11,640
about Mars force planet from the Sun

60
00:03:17,390 --> 00:03:13,590
further away from the Sun than the earth

61
00:03:21,520 --> 00:03:17,400
is and a great attractor because it's

62
00:03:25,280 --> 00:03:21,530
been fascinating mankind since the early

63
00:03:28,090 --> 00:03:25,290

you know early antiquity it's caused the

64

00:03:32,830 --> 00:03:28,100

myth and legends and religions and

65

00:03:38,930 --> 00:03:32,840

astrological definitions to come about

66

00:03:44,559 --> 00:03:38,940

it became a person a god-like person god

67

00:03:49,840 --> 00:03:44,569

of war or fire of harvesting of

68

00:03:54,170 --> 00:03:49,850

fertility and of course also of macho

69

00:03:57,620 --> 00:03:54,180

masculinity today we know it's a planet

70

00:04:00,759 --> 00:03:57,630

and its seek really a neighbor to earth

71

00:04:05,870 --> 00:04:00,769

it's a closest planet on which we could

72

00:04:09,409 --> 00:04:05,880

build up and a settlement eventually it

73

00:04:12,589 --> 00:04:09,419

has resources lots of resources we know

74

00:04:16,670 --> 00:04:12,599

now today has water even liquid water it

75

00:04:18,560 --> 00:04:16,680

looks like and it therefore means it

76

00:04:21,190 --> 00:04:18,570

could have a head life or it may

77

00:04:24,440 --> 00:04:21,200

actually have life in a microbial form

78

00:04:26,390 --> 00:04:24,450

so it's been a great attractor for

79

00:04:26,909 --> 00:04:26,400

science and of course for the general

80

00:04:29,230 --> 00:04:26,919

public

81

00:04:32,740 --> 00:04:29,240

countless science-fiction stories have

82

00:04:35,940 --> 00:04:32,750

been written about it it's a focus of

83

00:04:39,700 --> 00:04:35,950

pop culture I just remember Orson Welles

84

00:04:48,010 --> 00:04:39,710

and his mouse panic he caused with his

85

00:04:50,140 --> 00:04:48,020

radio message one day and so no wonder

86

00:04:58,980 --> 00:04:50,150

that people have been asking where can

87

00:05:08,890 --> 00:05:02,379

oops no I want to want to go the other

88

00:05:11,950 --> 00:05:08,900

way okay astronomers with their inferior

89

00:05:13,600 --> 00:05:11,960

telescopes saw these types of pictures

90

00:05:18,360 --> 00:05:13,610

this one comes from Giovanni

91

00:05:21,640 --> 00:05:18,370

Schiaparelli 1877 who thought he saw

92

00:05:25,620 --> 00:05:21,650

straight lines on Mars which he in

93

00:05:29,890 --> 00:05:25,630

Italian called Canali and that was later

94

00:05:33,310 --> 00:05:29,900

mistranslated in it to mean you know

95

00:05:36,850 --> 00:05:33,320

water channels he really meant grooves

96

00:05:40,960 --> 00:05:36,860

and therefore with some other people

97

00:05:44,950 --> 00:05:40,970

seeing the same thing Percival Lowell

98

00:05:46,840 --> 00:05:44,960

for example the legend or the

99

00:05:50,230 --> 00:05:46,850

expectation that they actually may be

100

00:05:53,830 --> 00:05:50,240

life on Mars and lots of water came

101
00:05:58,170 --> 00:05:53,840
about in addition you could see seasonal

102
00:06:01,930 --> 00:05:58,180
changes you saw the darkening areas

103
00:06:05,050 --> 00:06:01,940
lightening up again the poles the polar

104
00:06:06,940 --> 00:06:05,060
caps changed their sizes and so people

105
00:06:10,360 --> 00:06:06,950
thought that the mouse was it quite a

106
00:06:14,860 --> 00:06:10,370
livable planet but what really turned

107
00:06:18,760 --> 00:06:14,870
out in 1965 is what you see in the upper

108
00:06:23,800 --> 00:06:18,770
right corner when maryna for the first

109
00:06:25,450 --> 00:06:23,810
probe from Earth flew by Mars and took

110
00:06:27,340 --> 00:06:25,460
the first picture and one of the first

111
00:06:30,279 --> 00:06:27,350
pictures is up here in the corner it

112
00:06:35,200 --> 00:06:30,289
shows just a cratered surface and no

113
00:06:38,390 --> 00:06:35,210

straight lines no ground cover no client

114

00:06:41,719 --> 00:06:38,400

lives no animals no signs of Intel

115

00:06:44,659 --> 00:06:41,729

agents having duck water channels and so

116

00:06:47,900 --> 00:06:44,669

on so a mariner 4 to a lot of people was

117

00:06:49,939 --> 00:06:47,910

great disappointment who actually put in

118

00:06:54,080 --> 00:06:49,949

their imagination much more into Mars

119

00:06:58,520 --> 00:06:54,090

and ex vivo Sarah later on Mariner 9

120

00:07:00,740 --> 00:06:58,530

became the first orbiter in 1971 it

121

00:07:05,379 --> 00:07:00,750

still is here mariner 9 is still

122

00:07:08,689 --> 00:07:05,389

orbiting Mars and it brought a survey

123

00:07:10,400 --> 00:07:08,699

whole series of a picture SPECT with

124

00:07:14,379 --> 00:07:10,410

shoulders at mass still was very

125

00:07:17,900 --> 00:07:14,389

interesting that marina for saw only a

126

00:07:21,820 --> 00:07:17,910

small piece of it and that they are many

127

00:07:25,730 --> 00:07:21,830

many interesting things and puzzles and

128

00:07:28,189 --> 00:07:25,740

miracle type things on Mars Mars is so

129

00:07:30,050 --> 00:07:28,199

much smaller than Earth but it's got the

130

00:07:34,100 --> 00:07:30,060

biggest mountain in the whole solar

131

00:07:36,469 --> 00:07:34,110

system and it's got this Valles

132

00:07:38,779 --> 00:07:36,479

Marineris the biggest canyon in the

133

00:07:41,510 --> 00:07:38,789

solar system much larger than anything

134

00:07:44,719 --> 00:07:41,520

we have on earth or anywhere it is so

135

00:07:47,029 --> 00:07:44,729

all of those questions still have not

136

00:07:49,460 --> 00:07:47,039

have not been fully answered by science

137

00:07:53,360 --> 00:07:49,470

and so scientists are very interested in

138

00:07:56,510 --> 00:07:53,370

getting their in situ themselves not

139

00:07:59,450 --> 00:07:56,520

just do a remote reconnaissance which is

140

00:08:05,450 --> 00:07:59,460

pretty good if you want to get a kind of

141

00:08:08,089 --> 00:08:05,460

a localized data but if you want a

142

00:08:09,800 --> 00:08:08,099

global view of the whole planet you

143

00:08:12,740 --> 00:08:09,810

either have to launch very very many

144

00:08:20,810 --> 00:08:12,750

unmanned probes or take a human there

145

00:08:25,580 --> 00:08:20,820

who can then start exploring another

146

00:08:31,350 --> 00:08:29,340

in those 60 years in normal innumerable

147

00:08:37,020 --> 00:08:31,360

studies have done I have only a few of

148

00:08:42,360 --> 00:08:37,030

those typical space ships which were

149

00:08:48,390 --> 00:08:42,370

developed after the feasibility of going

150

00:08:52,350 --> 00:08:48,400

to Mars first was hinted at by Werner

151

00:08:55,800 --> 00:08:52,360

von Braun who had shown with his v2

152

00:08:58,650 --> 00:08:55,810

missile that rocket propulsion can

153

00:09:02,220 --> 00:08:58,660

actually fly outside the atmosphere and

154

00:09:04,560 --> 00:09:02,230

work in in the airless space and so

155

00:09:07,080 --> 00:09:04,570

people started to ask well if that is

156

00:09:11,100 --> 00:09:07,090

possible can we one day go to Mars and

157

00:09:14,640 --> 00:09:11,110

it's set of a whole flood of studies

158

00:09:20,880 --> 00:09:14,650

throughout the decades and just a few of

159

00:09:27,230 --> 00:09:20,890

them are here Verner evolves the first

160

00:09:29,520 --> 00:09:27,240

one who in 1948 did a serious techno

161

00:09:35,250 --> 00:09:29,530

scientifically acceptable study on how

162

00:09:37,920 --> 00:09:35,260

to go to Mars he did he wrote a novel

163

00:09:39,329 --> 00:09:37,930

first a technically tale he called it we

164

00:09:42,420 --> 00:09:39,339

would call it the science fiction novel

165

00:09:44,040 --> 00:09:42,430

but he he didn't want the word fiction

166

00:09:47,430 --> 00:09:44,050

in there so he called it technically

167

00:09:52,560 --> 00:09:47,440

Taylor he wrote that in the late 40s and

168

00:09:56,610 --> 00:09:52,570

as they almost as an appendix of it he

169

00:10:00,540 --> 00:09:56,620

provided the the technical study itself

170

00:10:05,700 --> 00:10:00,550

which is shown here the mass project was

171

00:10:08,880 --> 00:10:05,710

published in 1952 first in German and

172

00:10:12,870 --> 00:10:08,890

then in 1953 in English by the

173

00:10:16,079 --> 00:10:12,880

University of Illinois and they really

174

00:10:20,579 --> 00:10:16,089

republished it later in a paper bag in

175

00:10:24,360 --> 00:10:20,589

the preface in the in the forward from

176
00:10:27,240 --> 00:10:24,370
drown himself wrote the author did the

177
00:10:31,320 --> 00:10:27,250
work in his spare time and his soul

178
00:10:35,370 --> 00:10:31,330
computational tool was a slight old but

179
00:10:37,590 --> 00:10:35,380
he laid out the entire mouth expedition

180
00:10:40,980 --> 00:10:37,600
he came up with the

181
00:10:43,350 --> 00:10:40,990
in four chunks or phases of a Mars

182
00:10:46,340 --> 00:10:43,360
expedition which we still use today

183
00:10:48,930 --> 00:10:46,350
namely launch into Earth's orbit

184
00:10:52,949 --> 00:10:48,940
assembling the mass ship in Earth's

185
00:10:56,370 --> 00:10:52,959
orbit doing the trans mass injection

186
00:10:58,470 --> 00:10:56,380
flying to Mars will be number two going

187
00:11:00,360 --> 00:10:58,480
into Mouse orbit and landing his number

188
00:11:02,340 --> 00:11:00,370

three and then returning from bars

189

00:11:04,920 --> 00:11:02,350

flying back to earth is number four so

190

00:11:07,230 --> 00:11:04,930

you can actually segment Mars expedition

191

00:11:13,530 --> 00:11:07,240

in four parts and he already showed that

192

00:11:15,809 --> 00:11:13,540

but his plan was just gigantic it

193

00:11:18,210 --> 00:11:15,819

devolved anything people had ever seen

194

00:11:21,389 --> 00:11:18,220

before despite the Manhattan Project

195

00:11:26,370 --> 00:11:21,399

which was the nuclear bomb or as a b-52

196

00:11:29,850 --> 00:11:26,380

bomber that mass project was so gigantic

197

00:11:35,720 --> 00:11:29,860

he sent ten ships to Mars or in his

198

00:11:39,329 --> 00:11:35,730

vision each one about which 3720 tons

199

00:11:43,259 --> 00:11:39,339

three Landers of 200 tons each they are

200

00:11:46,410 --> 00:11:43,269

the ones with the wings and 70

201
00:11:49,110 --> 00:11:46,420
crew members on board to launch this

202
00:11:53,610 --> 00:11:49,120
into orbit and assembler in Earth's

203
00:11:57,030 --> 00:11:53,620
orbit he needed 46 reusable heavy lift

204
00:12:00,780 --> 00:11:57,040
launchers each 120 times are usable so

205
00:12:03,780 --> 00:12:00,790
he came to a total assembly flight

206
00:12:07,699 --> 00:12:03,790
number of 950 in order to assemble that

207
00:12:11,460 --> 00:12:07,709
fleet and each of those heavy lifters

208
00:12:15,240 --> 00:12:11,470
had a lift of mayors of 6,400 tons about

209
00:12:19,139 --> 00:12:15,250
three times that of the Saturn five so

210
00:12:22,379 --> 00:12:19,149
it was a gigantic and the mission would

211
00:12:24,660 --> 00:12:22,389
have taken two years in 239 days he

212
00:12:26,939 --> 00:12:24,670
later he did it when he realized that

213
00:12:29,999 --> 00:12:26,949

that may have we may be just too much

214

00:12:33,300 --> 00:12:30,009

for a country a country that just came

215

00:12:36,800 --> 00:12:33,310

out of the Korean War and so he scrapped

216

00:12:42,389 --> 00:12:36,810

it he really pared it down to two

217

00:12:46,889 --> 00:12:42,399

spaceships down there in 1956 which had

218

00:12:49,850 --> 00:12:46,899

a much less Emil in a initial mass in

219

00:12:51,390 --> 00:12:49,860

Earth orbit that's really the key

220

00:12:53,700 --> 00:12:51,400

parameter when you

221

00:12:56,040 --> 00:12:53,710

built a mass expedition how much maze do

222

00:13:00,360 --> 00:12:56,050

you need for the spaceship in Earth

223

00:13:03,470 --> 00:13:00,370

orbit and those were about 1700 tons

224

00:13:08,100 --> 00:13:03,480

about half of what the first ones were

225

00:13:11,520 --> 00:13:08,110

he had only 12 crew members and two

226

00:13:14,100 --> 00:13:11,530

ships for safety and one of them was a

227

00:13:17,340 --> 00:13:14,110

passenger ship without the wings and the

228

00:13:19,320 --> 00:13:17,350

cargo ship had the wings with the land

229

00:13:21,000 --> 00:13:19,330

as it could have landed on mask there

230

00:13:29,480 --> 00:13:21,010

were eight people on the peasants ership

231

00:13:36,840 --> 00:13:34,140

the other person in the that group of

232

00:13:39,240 --> 00:13:36,850

old-timers the form pinner moon divorced

233

00:13:42,390 --> 00:13:39,250

dr. Ann sterling her he is shown on the

234

00:13:45,080 --> 00:13:42,400

list who championed electric propulsion

235

00:13:49,260 --> 00:13:45,090

he came up with a very first mass

236

00:13:53,400 --> 00:13:49,270

project based on electric propulsion an

237

00:14:00,540 --> 00:13:53,410

earlier study is shown on top for 1957

238

00:14:04,260 --> 00:14:00,550

and later 1962 using both of nuclear

239

00:14:07,380 --> 00:14:04,270

power for providing the current for the

240

00:14:10,110 --> 00:14:07,390

electric propulsion units the picture on

241

00:14:15,690 --> 00:14:10,120

the in the right corner source Wernher

242

00:14:21,360 --> 00:14:15,700

von Braun and dr. sterling is filmed by

243

00:14:24,360 --> 00:14:21,370

Walt Disney in in one of the films made

244

00:14:27,960 --> 00:14:24,370

by Walt Disney to support for Browns

245

00:14:30,840 --> 00:14:27,970

ideas and here you see stooling her

246

00:14:36,660 --> 00:14:30,850

explaining the electric electric

247

00:14:45,870 --> 00:14:36,670

spaceship to Verna those years in the

248

00:14:47,910 --> 00:14:45,880

50s featured a lot of outreach to the

249

00:14:49,770 --> 00:14:47,920

public from Rowan knew from the

250

00:14:52,170 --> 00:14:49,780

beginning that in order to get any

251

00:14:54,150 --> 00:14:52,180

support for his plans he needed to talk

252

00:14:57,600 --> 00:14:54,160

to the people and he was a great

253

00:14:59,940 --> 00:14:57,610

salesman and the people like Walt Disney

254

00:15:02,940 --> 00:14:59,950

up in the left corner realized that

255

00:15:03,380 --> 00:15:02,950

immediately and pulled him aboard for a

256

00:15:08,120 --> 00:15:03,390

nom

257

00:15:10,370 --> 00:15:08,130

of movies which the Disney made some of

258

00:15:12,500 --> 00:15:10,380

them or all of them were shown and to

259

00:15:16,700 --> 00:15:12,510

the public millions of people have seen

260

00:15:18,500 --> 00:15:16,710

it and were shaken awake by that all of

261

00:15:20,960 --> 00:15:18,510

a sudden they realized hey we can fly

262

00:15:24,050 --> 00:15:20,970

into space if this guy with a strange

263

00:15:26,150 --> 00:15:24,060

accent says so it must be must be true

264

00:15:30,020 --> 00:15:26,160

you know when you have a German accent

265

00:15:33,190 --> 00:15:30,030

people believe you you know they just

266

00:15:36,860 --> 00:15:33,200

look at it let's look at Henry Kissinger

267

00:15:41,960 --> 00:15:36,870

but anyway collier's magazine came out

268

00:15:45,440 --> 00:15:41,970

with the famous editions in 1953 52 and

269

00:15:48,440 --> 00:15:45,450

1953 we're all of those ideas which we

270

00:15:50,990 --> 00:15:48,450

still used today were introduced like a

271

00:15:53,780 --> 00:15:51,000

space space suits down interval in the

272

00:15:58,280 --> 00:15:53,790

bottom or the space station on the left

273

00:16:01,010 --> 00:15:58,290

side kind of a wheel shaped 75 meters in

274

00:16:06,950 --> 00:16:01,020

diameter and various spaceship

275

00:16:09,110 --> 00:16:06,960

configurations well I couldn't help we

276

00:16:12,230 --> 00:16:09,120

have it now getting into the 1960s the

277

00:16:15,950 --> 00:16:12,240

1950s being over and I couldn't help

278

00:16:18,260 --> 00:16:15,960

sneaking that in that shows the moment

279

00:16:21,970 --> 00:16:18,270

when I just had arrived in Huntsville

280

00:16:26,960 --> 00:16:21,980

and the guy they are on the upper left

281

00:16:29,420 --> 00:16:26,970

is me in August 1962 Huntsville really

282

00:16:33,320 --> 00:16:29,430

was a very very nice place at that time

283

00:16:36,530 --> 00:16:33,330

we could record it hunts patch and all

284

00:16:38,420 --> 00:16:36,540

the the green areas behind my picture

285

00:16:41,030 --> 00:16:38,430

there of Real Steel cotton fields

286

00:16:43,610 --> 00:16:41,040

virtually cotton fields today it's all

287

00:16:45,080 --> 00:16:43,620

built a new nodes or build up and of

288

00:16:47,090 --> 00:16:45,090

course all signs way to come to a

289

00:16:49,610 --> 00:16:47,100

hands-free a rocket city and missile and

290

00:16:52,190 --> 00:16:49,620

space capital aren't there anymore I'm

291

00:16:55,730 --> 00:16:52,200

glad I hit those pictures and that the

292

00:17:01,550 --> 00:16:55,740

car of us really my most favorite kind

293

00:17:05,630 --> 00:17:01,560

my whole life Chevy Chevy Impala eight

294

00:17:08,470 --> 00:17:05,640

cylinder beautiful and I drove it for 43

295

00:17:13,310 --> 00:17:08,480

years just about three or four years ago

296

00:17:15,470 --> 00:17:13,320

some old Cobb a champion tour bus saw it

297

00:17:16,350 --> 00:17:15,480

and bought it from me and they are now

298

00:17:19,079 --> 00:17:16,360

working on Kate

299

00:17:22,289 --> 00:17:19,089

he getting a package into into the

300

00:17:25,140 --> 00:17:22,299

original shape but I drop it 43 years as

301
00:17:29,580 --> 00:17:25,150
she had a female character I called her

302
00:17:35,520 --> 00:17:29,590
Emma and well she always almost always

303
00:17:37,640 --> 00:17:35,530
did what I told her but I there was so

304
00:17:40,590 --> 00:17:37,650
much memory is connected my father was

305
00:17:42,510 --> 00:17:40,600
sitting in there one day run Brown was

306
00:17:44,640 --> 00:17:42,520
sitting here or in there often so I

307
00:17:47,130 --> 00:17:44,650
never put part with it and so out of

308
00:17:49,680 --> 00:17:47,140
nostalgia I kept it all those 40 / 40

309
00:17:51,680 --> 00:17:49,690
years and as I said I just hold it up in

310
00:17:54,180 --> 00:17:51,690
Alexandria three or four years ago

311
00:17:56,549 --> 00:17:54,190
Huntsville was really down there I mean

312
00:17:59,700 --> 00:17:56,559
this is the way it looked and we all

313
00:18:02,970 --> 00:17:59,710

liked it very much and of every time I'm

314

00:18:07,830 --> 00:18:02,980

down there I'm reminded of that the

315

00:18:13,970 --> 00:18:07,840

1960s of course it was a time when the

316

00:18:18,120 --> 00:18:13,980

Cold War exerted itself in space when

317

00:18:26,460 --> 00:18:18,130

the Soviets challenged us with Sputnik

318

00:18:30,659 --> 00:18:26,470

in 1957 in 1957 and so in 1957 and then

319

00:18:35,370 --> 00:18:30,669

yoga garvin in 1961 and it really shook

320

00:18:37,740 --> 00:18:35,380

people to the bone it was a shock he had

321

00:18:40,169 --> 00:18:37,750

started with President Eisenhower

322

00:18:43,520 --> 00:18:40,179

watching the Disney movies in the White

323

00:18:48,560 --> 00:18:43,530

House he actually asked for them and

324

00:18:52,980 --> 00:18:48,570

then came Sputnik 1 in 1957 October and

325

00:18:55,710 --> 00:18:52,990

in 1958 NASA was established as kind of

326

00:18:59,370 --> 00:18:55,720

a reaction and the Disney movies

327

00:19:01,500 --> 00:18:59,380

certainly hit for that but say geek

328

00:19:05,450 --> 00:19:01,510

overly F for marussia with his boot

329

00:19:09,930 --> 00:19:05,460

Knicks actually provided the major

330

00:19:14,640 --> 00:19:09,940

impetus for for the year for NASA to

331

00:19:15,840 --> 00:19:14,650

come about 1958 October and in 1960s a

332

00:19:20,039 --> 00:19:15,850

Marshall Space Flight Center in

333

00:19:22,230 --> 00:19:20,049

Huntsville was established to actually

334

00:19:24,570 --> 00:19:22,240

do something about rocket propulsion and

335

00:19:26,820 --> 00:19:24,580

the only people who were familiar with

336

00:19:30,090 --> 00:19:26,830

rocket propulsion was von Braun and his

337

00:19:33,110 --> 00:19:30,100

team so I being a student

338

00:19:36,870 --> 00:19:33,120

back then for me it was no natural to

339

00:19:38,610 --> 00:19:36,880

try to join that group and as you've

340

00:19:42,600 --> 00:19:38,620

seen at the picture before in August

341

00:19:46,350 --> 00:19:42,610

1962 from Braun had brought me over and

342

00:19:49,020 --> 00:19:46,360

I started work there never regretted it

343

00:19:53,700 --> 00:19:49,030

we built the Sedins up in the left

344

00:19:56,760 --> 00:19:53,710

corner and the Russians built the n one

345

00:20:00,150 --> 00:19:56,770

on the right upper corner about the same

346

00:20:02,730 --> 00:20:00,160

size of the Sedin but they were not very

347

00:20:05,130 --> 00:20:02,740

fortunate it flew four times and

348

00:20:08,070 --> 00:20:05,140

exploded for time so that was the end of

349

00:20:12,600 --> 00:20:08,080

the moon race as high as the Russians

350

00:20:15,810 --> 00:20:12,610

were concerned they went on and built

351

00:20:19,909 --> 00:20:15,820

the energy are up in the lower right

352

00:20:22,950 --> 00:20:19,919

corner a huge power pack of a rocket

353

00:20:25,020 --> 00:20:22,960

which also launched the Soviet shuttle

354

00:20:28,770 --> 00:20:25,030

called boo on there in the lower left

355

00:20:30,510 --> 00:20:28,780

corner in the lower lift picture and we

356

00:20:32,520 --> 00:20:30,520

had our own shadow there on the left and

357

00:20:35,130 --> 00:20:32,530

then there was a space station Mir in

358

00:20:40,049 --> 00:20:35,140

our own first space station Skylab so

359

00:20:42,299 --> 00:20:40,059

that was essentially what we started

360

00:20:49,430 --> 00:20:42,309

building in the 60s and it went on into

361

00:20:53,520 --> 00:20:49,440

70s as high as mass is concerned the 60s

362

00:20:56,370 --> 00:20:53,530

meant for us at Huntsville said on five

363

00:20:58,860 --> 00:20:56,380

and so all the mouse studies we did at

364

00:21:03,390 --> 00:20:58,870

that time were based on the 75 with its

365

00:21:09,169 --> 00:21:03,400

10-meter diameter and after the Apollo

366

00:21:12,270 --> 00:21:09,179

lunar landing in July 1969 this was the

367

00:21:14,430 --> 00:21:12,280

pay rate in Huntsville it with von Braun

368

00:21:18,330 --> 00:21:14,440

being carried around and those were the

369

00:21:20,880 --> 00:21:18,340

typical signs being held up they knew

370

00:21:22,890 --> 00:21:20,890

that he was a champion of mass and so

371

00:21:26,010 --> 00:21:22,900

there were people in the crowd sucked it

372

00:21:28,980 --> 00:21:26,020

to mass von Braun so that was a clear

373

00:21:33,090 --> 00:21:28,990

message from the man on the street so to

374

00:21:34,950 --> 00:21:33,100

speak and we heated it I think not a

375

00:21:37,020 --> 00:21:34,960

thought yeah that's the next step then

376

00:21:38,820 --> 00:21:37,030

we thought that the Apollo program would

377

00:21:41,430 --> 00:21:38,830

go on that we would establish some kind

378

00:21:43,389 --> 00:21:41,440

of a presence on the moon we hate the

379

00:21:45,249 --> 00:21:43,399

apollo extension systems after

380

00:21:49,919 --> 00:21:45,259

polo we had the Apollo application

381

00:21:54,310 --> 00:21:49,929

program and landed there are six times

382

00:21:56,579 --> 00:21:54,320

up till the early 1970s so we felt

383

00:22:00,159 --> 00:21:56,589

pretty sure that we would go on to mouth

384

00:22:03,419 --> 00:22:00,169

and so we looked at the Sedin and came

385

00:22:06,989 --> 00:22:03,429

up with all kinds of follow-on

386

00:22:10,269 --> 00:22:06,999

configurations on the very left is the

387

00:22:14,979 --> 00:22:10,279

basic Saturn and then by adding all

388

00:22:19,119 --> 00:22:14,989

kinds of extensions elongations of the

389

00:22:22,359 --> 00:22:19,129

status or striping on boosters we got

390

00:22:25,060 --> 00:22:22,369

higher payloads there were all kinds of

391

00:22:28,539 --> 00:22:25,070

you know just like our heavy lift people

392

00:22:31,149 --> 00:22:28,549

have been looking at in the last few

393

00:22:34,389 --> 00:22:31,159

years we did that all right in the 60s

394

00:22:36,339 --> 00:22:34,399

and not enough we set on fives we always

395

00:22:39,070 --> 00:22:36,349

we always thought that there must be a

396

00:22:42,009 --> 00:22:39,080

follow-on called a posted on so we head

397

00:22:46,269 --> 00:22:42,019

up in the right corner rockets which

398

00:22:48,999 --> 00:22:46,279

went beyond 7-5 7-5 again they're being

399

00:22:51,849 --> 00:22:49,009

on the in the left on the left side and

400

00:22:54,239 --> 00:22:51,859

from there you could kind of put

401
00:22:58,869 --> 00:22:54,249
together all kinds of configurations and

402
00:23:03,389 --> 00:22:58,879
then the famous Nova Rockets on the

403
00:23:06,399 --> 00:23:03,399
bottom all of those were were designed

404
00:23:10,450 --> 00:23:06,409
conceptualized at least with mouse in

405
00:23:13,690 --> 00:23:10,460
mind in pie industry studies on the on

406
00:23:16,959 --> 00:23:13,700
the far left is the basic seven and next

407
00:23:20,339 --> 00:23:16,969
to it the original nova which had

408
00:23:23,859 --> 00:23:20,349
preceded the set and five in our studies

409
00:23:26,859 --> 00:23:23,869
originally we wanted to fly to the moon

410
00:23:29,320 --> 00:23:26,869
directly not like a polo but launch on

411
00:23:31,959 --> 00:23:29,330
earth and land on the moon without any

412
00:23:34,719 --> 00:23:31,969
big maneuvers in between that would have

413
00:23:38,799 --> 00:23:34,729

taken the Nova with eight f-1 engines

414

00:23:41,469 --> 00:23:38,809

and then NASA went through a trail of

415

00:23:43,329 --> 00:23:41,479

studies and came up with Earth's orbit

416

00:23:46,899 --> 00:23:43,339

rendezvous and with lunar orbit

417

00:23:51,310 --> 00:23:46,909

rendezvous modes and rejected the direct

418

00:23:53,919 --> 00:23:51,320

Lite mode for cost reasons and also the

419

00:23:56,410 --> 00:23:53,929

size of the vehicle so finally the

420

00:24:03,710 --> 00:23:56,420

outcome was lunar orbit rendezvous

421

00:24:06,440 --> 00:24:03,720

and that then kind of finalized the

422

00:24:11,710 --> 00:24:06,450

design of the set and five with five f-1

423

00:24:15,020 --> 00:24:11,720

engines but those monsters were you know

424

00:24:17,870 --> 00:24:15,030

spawned by mental engineering a

425

00:24:20,380 --> 00:24:17,880

tremendous creativity we got out of out

426
00:24:23,090 --> 00:24:20,390
of our teams out of industry at the time

427
00:24:25,130 --> 00:24:23,100
I always liked this one that's the

428
00:24:28,400 --> 00:24:25,140
biggest awesome order it's a single

429
00:24:31,370 --> 00:24:28,410
stage to orbit called Nexus proposed by

430
00:24:33,980 --> 00:24:31,380
craft Erica who was at general dynamics

431
00:24:37,340 --> 00:24:33,990
at that time and he was a man behind the

432
00:24:42,160 --> 00:24:37,350
center stage which is still flying so

433
00:24:45,890 --> 00:24:42,170
this came from in 1964 and it would have

434
00:24:47,870 --> 00:24:45,900
launched 1,000 tons into orbit so you

435
00:24:51,680 --> 00:24:47,880
would need only this one for to fly to

436
00:24:54,440 --> 00:24:51,690
Mars from orbit the e me or the initial

437
00:24:58,520 --> 00:24:54,450
Mason Earth orbit for mass wants to be

438
00:25:00,910 --> 00:24:58,530

not less than 700 tons depending on

439

00:25:03,320 --> 00:25:00,920

propulsion like chemical or nuclear

440

00:25:07,220 --> 00:25:03,330

electric propulsion and also on the time

441

00:25:10,040 --> 00:25:07,230

of you know the years when you fly but

442

00:25:12,590 --> 00:25:10,050

basically what we need is like 700 tons

443

00:25:14,450 --> 00:25:12,600

in orbit and that decides what kind of

444

00:25:17,630 --> 00:25:14,460

heavy lift do we need to we have to

445

00:25:20,000 --> 00:25:17,640

build today so that one could launch a

446

00:25:21,860 --> 00:25:20,010

thousand tones and it weighed twenty

447

00:25:27,380 --> 00:25:21,870

four thousand tons at liftoff which is

448

00:25:32,360 --> 00:25:27,390

about the mass of a ocean freighter now

449

00:25:36,860 --> 00:25:32,370

it never was built of course as high as

450

00:25:40,910 --> 00:25:36,870

Mouse is concerned the studies were

451
00:25:43,960 --> 00:25:40,920
bundled in a package called Empire early

452
00:25:48,710 --> 00:25:43,970
manned planetary in the planetary

453
00:25:51,410 --> 00:25:48,720
round-trip expedition and was passed out

454
00:25:53,450 --> 00:25:51,420
to a bunch of industries large

455
00:25:56,990 --> 00:25:53,460
industries like Ford's and a dynamics

456
00:26:00,350 --> 00:25:57,000
Lockheed trw Boeing and they all came in

457
00:26:03,410 --> 00:26:00,360
with various proposals how to go to Mars

458
00:26:07,280 --> 00:26:03,420
the Empire studies were tremendously

459
00:26:09,800 --> 00:26:07,290
creative they developed aid a treasure

460
00:26:14,690 --> 00:26:09,810
trove of knowledge

461
00:26:18,050 --> 00:26:14,700
of engineering inside of rationalities

462
00:26:21,470 --> 00:26:18,060
which still is valid today if people

463
00:26:23,690 --> 00:26:21,480

would just go to the library's or

464

00:26:25,970 --> 00:26:23,700

looking into archives they would find a

465

00:26:28,100 --> 00:26:25,980

lot of answers there without having to

466

00:26:30,350 --> 00:26:28,110

reinvent the wheels because we really

467

00:26:34,490 --> 00:26:30,360

try to cover the waterfront with those

468

00:26:38,480 --> 00:26:34,500

Empire studies in the 60s we looked at

469

00:26:41,920 --> 00:26:38,490

mass flybys maint flybys and when I same

470

00:26:45,380 --> 00:26:41,930

and I certainly don't mean it in a in a

471

00:26:47,900 --> 00:26:45,390

political incorrect way but that's the

472

00:26:49,580 --> 00:26:47,910

way it was called in fact the question

473

00:26:51,410 --> 00:26:49,590

whether there should men or women on

474

00:26:55,040 --> 00:26:51,420

board never came up in date in those

475

00:26:58,100 --> 00:26:55,050

years when von Braun talked about 70

476
00:27:00,200 --> 00:26:58,110
people to Mars or 60 people to Mars he

477
00:27:03,560 --> 00:27:00,210
didn't specify you know that these are

478
00:27:06,130 --> 00:27:03,570
just males it was that the subject was

479
00:27:13,190 --> 00:27:06,140
not discussed it was just you know

480
00:27:19,310 --> 00:27:13,200
totally beyond engineering levels anyway

481
00:27:22,400 --> 00:27:19,320
so am and flybys meant stop overs and

482
00:27:26,690 --> 00:27:22,410
meant landings and not just a mouse but

483
00:27:29,360 --> 00:27:26,700
Venus and you could actually have double

484
00:27:32,450 --> 00:27:29,370
flybys fly by Venus and then also fly by

485
00:27:38,510 --> 00:27:32,460
mouse at the same time get two bucks you

486
00:27:41,720 --> 00:27:38,520
know for one shot and use windows as a

487
00:27:44,030 --> 00:27:41,730
propulsive assistant is that will

488
00:27:46,130 --> 00:27:44,040

accelerate you as in a flyby or

489

00:27:53,030 --> 00:27:46,140

decelerating on the way coming back to

490

00:27:56,480 --> 00:27:53,040

earth back in the Soviet Union people

491

00:28:01,810 --> 00:27:56,490

didn't sleep either this guy's a geek of

492

00:28:05,150 --> 00:28:01,820

early f the the fun Brown of Russia

493

00:28:07,640 --> 00:28:05,160

taught in the late 50s already in the

494

00:28:10,730 --> 00:28:07,650

early 60s the same things the same

495

00:28:13,840 --> 00:28:10,740

thoughts he later of course was a guy

496

00:28:17,810 --> 00:28:13,850

behind Sputnik behind cacao bean and

497

00:28:19,940 --> 00:28:17,820

behind Soyuz and it's still flying today

498

00:28:22,040 --> 00:28:19,950

I mean he was a real genius a

499

00:28:24,510 --> 00:28:22,050

hard-headed

500

00:28:26,700 --> 00:28:24,520

stubborn like that he had always to

501
00:28:30,570 --> 00:28:26,710
fight against the politicians in Moscow

502
00:28:32,750 --> 00:28:30,580
yeah but he got his way and he also had

503
00:28:35,549 --> 00:28:32,760
competitors all kinds of little

504
00:28:37,500 --> 00:28:35,559
princedoms where other designers had

505
00:28:40,710 --> 00:28:37,510
certain schools their own developments

506
00:28:43,200 --> 00:28:40,720
their own sponsors in Moscow so it was

507
00:28:45,810 --> 00:28:43,210
not just like a unified NASA there it

508
00:28:47,280 --> 00:28:45,820
was five or six different groups

509
00:28:50,340 --> 00:28:47,290
fighting against each other for the

510
00:28:54,900 --> 00:28:50,350
dollar of other ubers and so he had a

511
00:28:57,870 --> 00:28:54,910
real complicated life he died early

512
00:29:02,280 --> 00:28:57,880
trafone Brown in the late in the late

513
00:29:04,530 --> 00:29:02,290

60s years we know of course his daughter

514

00:29:10,070 --> 00:29:04,540

Natalia she's been to NASA we have

515

00:29:15,270 --> 00:29:10,080

invited to several times and she is now

516

00:29:17,669 --> 00:29:15,280

number one as far as prominence in space

517

00:29:21,080 --> 00:29:17,679

in Moscow because she's his daughter and

518

00:29:24,870 --> 00:29:21,090

so every time they are sorting out

519

00:29:28,470 --> 00:29:24,880

celebrities she's in front of it Natalya

520

00:29:31,940 --> 00:29:28,480

she's about 74 now and a physician a

521

00:29:36,270 --> 00:29:31,950

doctor of surgery a very very nice lady

522

00:29:39,390 --> 00:29:36,280

who's been fighting for years to find

523

00:29:41,370 --> 00:29:39,400

out who her daddy really was and what

524

00:29:43,370 --> 00:29:41,380

people are thinking about it when we

525

00:29:45,480 --> 00:29:43,380

celebrate at the Explorer one

526
00:29:48,060 --> 00:29:45,490
anniversary enhance reader a few years

527
00:29:51,720 --> 00:29:48,070
ago we invited Natalia because without

528
00:29:53,310 --> 00:29:51,730
her daddy our explorer never would have

529
00:29:56,160 --> 00:29:53,320
flown there wouldn't have been a Sputnik

530
00:29:57,900 --> 00:29:56,170
and we wouldn't have felt challenged so

531
00:30:00,060 --> 00:29:57,910
he invited her and she really liked that

532
00:30:02,669 --> 00:30:00,070
and she came back and said now I know

533
00:30:05,820 --> 00:30:02,679
you know what you people think about my

534
00:30:09,450 --> 00:30:05,830
father and it makes me happy so that was

535
00:30:14,100 --> 00:30:09,460
khalaf and he thought about Mars I have

536
00:30:16,650 --> 00:30:14,110
this book here maslansky project by

537
00:30:19,500 --> 00:30:16,660
Coley if the mass project by Kovalev

538
00:30:27,270 --> 00:30:19,510

which describes in detail what they

539

00:30:32,100 --> 00:30:27,280

wanted to do in in 1964 he came up with

540

00:30:34,690 --> 00:30:32,110

the first ideas of the n1 rocket here is

541

00:30:38,290 --> 00:30:34,700

a 1 which they used to

542

00:30:41,890 --> 00:30:38,300

try to beat us to the moon with their

543

00:30:45,730 --> 00:30:41,900

version of the 75 but the plans for the

544

00:30:48,730 --> 00:30:45,740

n1 are much older than the space race he

545

00:30:52,720 --> 00:30:48,740

originally sketched the n1 in support

546

00:30:55,930 --> 00:30:52,730

for Mars he gave it a payload an orbital

547

00:30:58,810 --> 00:30:55,940

payload of 75 to 85 tons which would

548

00:31:00,310 --> 00:30:58,820

have fit into their mass scenario he

549

00:31:03,400 --> 00:31:00,320

didn't want to have a landing there he

550

00:31:06,760 --> 00:31:03,410

wanted to have a flyby first and so

551
00:31:10,120 --> 00:31:06,770
later on that backfired because when the

552
00:31:13,900 --> 00:31:10,130
n1 then was built it had only 75 or 85

553
00:31:17,020 --> 00:31:13,910
tons orbital payload compared 220 tons

554
00:31:19,330 --> 00:31:17,030
by the 75 and so that may have

555
00:31:23,950 --> 00:31:19,340
contributed to them losing the space

556
00:31:26,500 --> 00:31:23,960
race to the moon but basically the

557
00:31:30,580 --> 00:31:26,510
design of the n1 goes back to those

558
00:31:35,640 --> 00:31:30,590
years the first mass project in Russia

559
00:31:42,250 --> 00:31:35,650
was called aletta after a famous

560
00:31:45,040 --> 00:31:42,260
socialist film from 1924 where I Lita is

561
00:31:48,720 --> 00:31:45,050
a queen of mouse you know something like

562
00:31:54,520 --> 00:31:48,730
edgar rice burroughs did for us here so

563
00:31:57,510 --> 00:31:54,530

that was the 60s now we are coming 20

564

00:32:02,080 --> 00:31:57,520

yard this is a picture of Korra Leafs

565

00:32:05,620 --> 00:32:02,090

mouth ship the assembly on the far left

566

00:32:09,400 --> 00:32:05,630

required assembly shank the spherical

567

00:32:12,910 --> 00:32:09,410

ones the ball like housing there in the

568

00:32:17,320 --> 00:32:12,920

middle this is where the the assembly

569

00:32:20,230 --> 00:32:17,330

people the cosmonauts state there is a

570

00:32:22,960 --> 00:32:20,240

Soyuz space ship actually docked to it

571

00:32:27,940 --> 00:32:22,970

and then it had six to eight docking

572

00:32:30,640 --> 00:32:27,950

ports where these stages could dock and

573

00:32:33,520 --> 00:32:30,650

then be linked together to assemble the

574

00:32:35,020 --> 00:32:33,530

mashup there was a pretty smart idea who

575

00:32:38,170 --> 00:32:35,030

knows you know maybe something like that

576
00:32:40,960 --> 00:32:38,180
is what we want to do one day on the one

577
00:32:43,900 --> 00:32:40,970
side away from us is the extra mile ship

578
00:32:45,400 --> 00:32:43,910
and on the near side here is where the

579
00:32:48,280 --> 00:32:45,410
propulsion modules

580
00:32:51,730 --> 00:32:48,290
striped together which he needed and

581
00:32:57,190 --> 00:32:51,740
then the ship itself is shown here in a

582
00:33:03,370 --> 00:32:57,200
in a section with those of floor plans

583
00:33:08,740 --> 00:33:03,380
and so on with a energy solar energy

584
00:33:13,990 --> 00:33:08,750
collecting scholarships shield and then

585
00:33:18,280 --> 00:33:14,000
the propulsion unit at the bottom this

586
00:33:20,170 --> 00:33:18,290
is their plan at that time in 64 it

587
00:33:22,120 --> 00:33:20,180
would have up in the left corner it

588
00:33:25,510 --> 00:33:22,130

would have required a whole number of n1

589

00:33:26,740 --> 00:33:25,520

rockets to launch the components into

590

00:33:30,130 --> 00:33:26,750

Earth orbit where there would be

591

00:33:32,670 --> 00:33:30,140

assembled as I just showed then the

592

00:33:35,890 --> 00:33:32,680

departure to Mars would take place

593

00:33:38,200 --> 00:33:35,900

propulsion modules being dropped as they

594

00:33:42,310 --> 00:33:38,210

emptied so you don't want to carry debt

595

00:33:44,950 --> 00:33:42,320

mess along and then finally turning

596

00:33:48,520 --> 00:33:44,960

around and separating the landing module

597

00:33:52,270 --> 00:33:48,530

in red landing on Mars then the ascent

598

00:33:56,890 --> 00:33:52,280

stage going up again rendezvousing with

599

00:33:59,920 --> 00:33:56,900

the orbiting mother ship in orbit and

600

00:34:04,690 --> 00:33:59,930

then returning back to earth that is

601
00:34:07,830 --> 00:34:04,700
taken from a cove earlier spoke they

602
00:34:11,440 --> 00:34:07,840
figured out all kinds of requirements

603
00:34:14,980 --> 00:34:11,450
here is a table where he looked at

604
00:34:19,150 --> 00:34:14,990
various flight modes to Mars orbiters

605
00:34:22,600 --> 00:34:19,160
and Landers and return flights and came

606
00:34:26,560 --> 00:34:22,610
up in the middle with the tonnage email

607
00:34:30,190 --> 00:34:26,570
required in Earth orbit to carry 20 tons

608
00:34:32,770 --> 00:34:30,200
to deliver 20 22 miles 20 tons is quite

609
00:34:35,890 --> 00:34:32,780
a lot if you talk about habitat and

610
00:34:38,980 --> 00:34:35,900
provisions and so on so it would take at

611
00:34:42,250 --> 00:34:38,990
the lower the lower two examples they

612
00:34:46,210 --> 00:34:42,260
are like between 600 700 tons in Earth's

613
00:34:48,790 --> 00:34:46,220

orbit minimum to do that and that number

614

00:34:52,960 --> 00:34:48,800

hasn't changed for the last 60 years so

615

00:34:55,900 --> 00:34:52,970

it is a kind of a best or the minimum

616

00:34:58,150 --> 00:34:55,910

meo you need if you want to have a mouse

617

00:35:01,299 --> 00:34:58,160

slide if you go up to a thousand

618

00:35:03,010 --> 00:35:01,309

so much the better the the more mess you

619

00:35:05,260 --> 00:35:03,020

have for the initial medicine Earth

620

00:35:08,170 --> 00:35:05,270

orbit the morgue you can take along and

621

00:35:10,569 --> 00:35:08,180

the longer you can stay on Mars he would

622

00:35:13,660 --> 00:35:10,579

have just stayed very shortly and come

623

00:35:18,640 --> 00:35:13,670

back at least to do something for the

624

00:35:24,760 --> 00:35:18,650

first time well now we are coming to the

625

00:35:26,650 --> 00:35:24,770

third decade the 70s remember we had the

626

00:35:30,130 --> 00:35:26,660

60s with those tremendous Apollo

627

00:35:35,799 --> 00:35:30,140

successors Apollo 8 Apollo 10 Apollo 11

628

00:35:39,370 --> 00:35:35,809

Apollo 12 in 69 now we have in 1970 and

629

00:35:43,089 --> 00:35:39,380

in the politicians in Washington started

630

00:35:45,549 --> 00:35:43,099

asking what's next buddy but the

631

00:35:47,980 --> 00:35:45,559

administration had changed it wasn't

632

00:35:51,130 --> 00:35:47,990

president johnson lyndon johnson anymore

633

00:35:54,160 --> 00:35:51,140

it was President Nixon and the

634

00:35:58,539 --> 00:35:54,170

Republicans and so they asked well what

635

00:36:00,490 --> 00:35:58,549

should we do now we cannot just take in

636

00:36:06,400 --> 00:36:00,500

order to continue the way they wanted

637

00:36:10,299 --> 00:36:06,410

the the JFK lunar program and Nixon had

638

00:36:12,250 --> 00:36:10,309

a Advisory Committee PSAC called a

639

00:36:15,069 --> 00:36:12,260

president science advisory committee

640

00:36:18,370 --> 00:36:15,079

with the chair a chairman being lead to

641

00:36:22,029 --> 00:36:18,380

bridge that they had already in 67

642

00:36:24,720 --> 00:36:22,039

prepared a recommendation that the

643

00:36:27,099 --> 00:36:24,730

United States should develop a reusable

644

00:36:29,289 --> 00:36:27,109

shuttle of usable space ships they

645

00:36:32,470 --> 00:36:29,299

called it either fully or partially the

646

00:36:37,960 --> 00:36:32,480

usable in order to reduce costs that was

647

00:36:42,880 --> 00:36:37,970

recommendation in 67 and the White House

648

00:36:46,420 --> 00:36:42,890

also had a space task OOP STG space task

649

00:36:49,930 --> 00:36:46,430

group headed by vice president Agnew

650

00:36:52,900 --> 00:36:49,940

Spiro Agnew with Lee do bridge of the

651
00:36:55,180 --> 00:36:52,910
PSAC and robert siemens Secretary of the

652
00:36:59,460 --> 00:36:55,190
Air Force and Thomas Paine NASA

653
00:37:03,339 --> 00:36:59,470
Administrator as members so all of those

654
00:37:05,680 --> 00:37:03,349
came to us and said what next you have

655
00:37:07,630 --> 00:37:05,690
now landed on the moon and we said yeah

656
00:37:10,269 --> 00:37:07,640
be one over on the moon and said no Nick

657
00:37:11,140 --> 00:37:10,279
start we need something something back

658
00:37:14,450 --> 00:37:11,150
here on earth

659
00:37:20,660 --> 00:37:14,460
the things have changed Vietnam and so

660
00:37:25,160 --> 00:37:20,670
on so it was fiscal 69 going into a

661
00:37:28,880 --> 00:37:25,170
physical 70 and we were hoping for a new

662
00:37:31,910 --> 00:37:28,890
start mouse but there were no new starts

663
00:37:34,670 --> 00:37:31,920

the only thing we got in those early

664

00:37:37,190 --> 00:37:34,680

years was in 1972 President Nixon

665

00:37:40,130 --> 00:37:37,200

approving the shattered in in its

666

00:37:43,099 --> 00:37:40,140

minimum form we had done a lot of

667

00:37:45,410 --> 00:37:43,109

shuttle studies before fully reusable in

668

00:37:47,839 --> 00:37:45,420

all kinds of variations and had to

669

00:37:50,630 --> 00:37:47,849

reduce it and cut it back with every

670

00:37:53,509 --> 00:37:50,640

iteration every time the Bureau of the

671

00:37:55,130 --> 00:37:53,519

budget said no that's too much or some

672

00:37:58,579 --> 00:37:55,140

other people told us it's too much we

673

00:38:01,759 --> 00:37:58,589

went back you know and and interest you

674

00:38:04,210 --> 00:38:01,769

know like like soldiers cut it even back

675

00:38:07,339 --> 00:38:04,220

down until we got the current shuddered

676

00:38:10,640 --> 00:38:07,349

at least something under there wouldn't

677

00:38:17,660 --> 00:38:10,650

have been anything else these people

678

00:38:20,479 --> 00:38:17,670

here the space task group were given our

679

00:38:26,829 --> 00:38:20,489

view of America's next decades in space

680

00:38:30,319 --> 00:38:26,839

it is a NASA's plan prepared mostly by

681

00:38:32,420 --> 00:38:30,329

George Mueller who was ahead of the

682

00:38:35,359 --> 00:38:32,430

manned spaceflight office here it

683

00:38:37,880 --> 00:38:35,369

headquarters and by burner from brown at

684

00:38:40,489 --> 00:38:37,890

Marshall and Robert giggles at the

685

00:38:42,859 --> 00:38:40,499

Houston manned spacecraft Center and

686

00:38:45,489 --> 00:38:42,869

then of course Johnson Space Center they

687

00:38:53,029 --> 00:38:45,499

came up with what's called the

688

00:38:56,870 --> 00:38:53,039

integrated program plan IPP that was a

689

00:38:59,450 --> 00:38:56,880

no 1969 which was presented in

690

00:39:02,390 --> 00:38:59,460

Washington and you can see it's got

691

00:39:04,549 --> 00:39:02,400

everything in the kitchen sink it's got

692

00:39:09,529 --> 00:39:04,559

transportation their third row from the

693

00:39:13,579 --> 00:39:09,539

top with a shuttle in there no it's a

694

00:39:16,910 --> 00:39:13,589

bottom the shutter landers nuclear talk

695

00:39:19,660 --> 00:39:16,920

or nuclear stage and Mars Lander there

696

00:39:24,039 --> 00:39:19,670

and then

697

00:39:27,849 --> 00:39:24,049

the other things on top space station on

698

00:39:30,069 --> 00:39:27,859

top and space space and so on and in an

699

00:39:33,280 --> 00:39:30,079

evolutionary sense the integrated

700

00:39:36,160 --> 00:39:33,290

program plan was kind of parallel

701
00:39:40,000 --> 00:39:36,170
developments developing things at the

702
00:39:42,160 --> 00:39:40,010
same time so to make much major use out

703
00:39:44,740 --> 00:39:42,170
of commonality so you didn't have to use

704
00:39:46,750 --> 00:39:44,750
or reinvent a lunar station when you

705
00:39:49,930 --> 00:39:46,760
could use a space station module for it

706
00:39:51,819 --> 00:39:49,940
and you didn't have to redesign a mouse

707
00:39:55,089 --> 00:39:51,829
mission module if you could use a space

708
00:39:57,940 --> 00:39:55,099
station module instead for it so there

709
00:39:59,620 --> 00:39:57,950
there was some sense to this because we

710
00:40:02,079 --> 00:39:59,630
fed it we could reduce costs by

711
00:40:05,140 --> 00:40:02,089
commonality which required parallel

712
00:40:08,170 --> 00:40:05,150
developments but the overall cost still

713
00:40:10,329 --> 00:40:08,180

it was of course tremendous and we

714

00:40:15,930 --> 00:40:10,339

didn't put any years on top that came

715

00:40:21,309 --> 00:40:15,940

only a little later on August for a 1969

716

00:40:24,180 --> 00:40:21,319

which it always was a very important

717

00:40:27,910 --> 00:40:24,190

date for us Wernher von Braun presented

718

00:40:36,579 --> 00:40:27,920

the man mouse mission portion of it to

719

00:40:40,030 --> 00:40:36,589

the space task group wanna go big that

720

00:40:44,440 --> 00:40:40,040

was a study done at Marshall with Boeing

721

00:40:46,420 --> 00:40:44,450

the Boeing as a contractor which was for

722

00:40:48,849 --> 00:40:46,430

in my up in our opinion at that time

723

00:40:52,180 --> 00:40:48,859

very reasonable it was based on the 75

724

00:40:55,750 --> 00:40:52,190

we didn't know yet that the 75 was you

725

00:40:58,539 --> 00:40:55,760

know going to be dropped it had nuclear

726

00:41:03,579 --> 00:40:58,549

propulsion there the norva engine which

727

00:41:07,690 --> 00:41:03,589

had accumulated quite a amazing number

728

00:41:11,319 --> 00:41:07,700

of successful starts and about 4,000 or

729

00:41:14,890 --> 00:41:11,329

even more seconds of firing time with a

730

00:41:19,720 --> 00:41:14,900

departure of 1981 and return 1986 for

731

00:41:23,069 --> 00:41:19,730

the math slide the cost in \$69 would

732

00:41:26,609 --> 00:41:23,079

have been four billion dollars in 1971

733

00:41:30,250 --> 00:41:26,619

increased to seven to eight billion by

734

00:41:32,800 --> 00:41:30,260

1975 and returning down to six billion

735

00:41:37,060 --> 00:41:32,810

in 1976

736

00:41:39,940 --> 00:41:37,070

and we we did it in four plants at the

737

00:41:45,100 --> 00:41:39,950

original from brown plane from 81 launch

738

00:41:47,020 --> 00:41:45,110

was called plan a and it kind of thought

739

00:41:50,320 --> 00:41:47,030

we thought that this could be an Apollo

740

00:41:53,680 --> 00:41:50,330

like decision you like like JFK made the

741

00:41:56,560 --> 00:41:53,690

decision in May 1961 go to the moon

742

00:41:58,870 --> 00:41:56,570

that's some president now would have to

743

00:42:01,180 --> 00:41:58,880

make a decision like that now go to Mars

744

00:42:03,670 --> 00:42:01,190

and that would have been plan a but we

745

00:42:05,520 --> 00:42:03,680

came up with plan be also at the same

746

00:42:08,650 --> 00:42:05,530

time in that booklet I just thought

747

00:42:11,140 --> 00:42:08,660

where the mass light everything else was

748

00:42:13,690 --> 00:42:11,150

kept in there that was George Miller he

749

00:42:16,420 --> 00:42:13,700

said no plan B Plan C will not be

750

00:42:18,730 --> 00:42:16,430

different it'll just move into time a

751
00:42:21,760 --> 00:42:18,740
little bit further that was his way of

752
00:42:24,370 --> 00:42:21,770
trying to save Mars and so plain be

753
00:42:26,650 --> 00:42:24,380
moved the mouse expedition to nineteen

754
00:42:29,470 --> 00:42:26,660
eighty sweet when I did until nineteen

755
00:42:31,390 --> 00:42:29,480
eighty six and play and see mouths

756
00:42:35,350 --> 00:42:31,400
nineteen eighty six to nineteen eighty

757
00:42:39,210 --> 00:42:35,360
nine so all four plants all three planes

758
00:42:42,850 --> 00:42:39,220
in that booklet were integrated and

759
00:42:46,630 --> 00:42:42,860
included mouth but it did not meet with

760
00:42:51,160 --> 00:42:46,640
great support and so NASA went back and

761
00:42:54,150 --> 00:42:51,170
added plan D which which meant no mouse

762
00:43:10,589 --> 00:42:54,160
at all but station and shouted together

763
00:43:17,260 --> 00:43:13,690

that's another picture of the mouth ship

764

00:43:19,480 --> 00:43:17,270

out of out of Marshall at that time 69

765

00:43:22,809 --> 00:43:19,490

we've seen over engine and the

766

00:43:24,339 --> 00:43:22,819

propulsion modules or they tank the tank

767

00:43:27,970 --> 00:43:24,349

modules which are topped when they're

768

00:43:32,049 --> 00:43:27,980

empty and the front portion of the mouth

769

00:43:34,630 --> 00:43:32,059

ships two of them two ships in 69 a kind

770

00:43:40,269 --> 00:43:34,640

of hema headed because the of the

771

00:43:43,240 --> 00:43:40,279

diameter of the mouse entry capsule we

772

00:43:48,299 --> 00:43:43,250

didn't know yet what the atmosphere on

773

00:43:51,609 --> 00:43:48,309

Mars was like so we were kind of

774

00:43:55,890 --> 00:43:51,619

uncertain there what kind of mouth

775

00:43:58,779 --> 00:43:55,900

cylinder shape we need it was the

776

00:44:01,059 --> 00:43:58,789

forward portion of both airless it was a

777

00:44:03,599 --> 00:44:01,069

vacuum you had to could enter it through

778

00:44:07,870 --> 00:44:03,609

an airlock so we didn't have to

779

00:44:09,430 --> 00:44:07,880

pressurize the entire head head section

780

00:44:11,470 --> 00:44:09,440

I still remember when we talked about

781

00:44:15,640 --> 00:44:11,480

that discussed it whether that was safe

782

00:44:20,470 --> 00:44:15,650

to do and those little entry Apollo

783

00:44:23,799 --> 00:44:20,480

shape shapes are scientific probes which

784

00:44:29,650 --> 00:44:23,809

we would have dropped onto Mars from

785

00:44:33,430 --> 00:44:29,660

orbit before actually landing there this

786

00:44:37,960 --> 00:44:33,440

was see the mission itself launched down

787

00:44:41,859 --> 00:44:37,970

there on on mass in 1981 dropping the

788

00:44:44,589 --> 00:44:41,869

first propulsion module halfway out

789

00:44:48,339 --> 00:44:44,599

after after the trans mouse injection

790

00:44:51,099 --> 00:44:48,349

and then going to Mars and going into a

791

00:44:53,349 --> 00:44:51,109

high orbit first whereas a PM to

792

00:44:56,410 --> 00:44:53,359

propulsion module two is jettisoned and

793

00:44:59,200 --> 00:44:56,420

then circular icing and going into a

794

00:45:02,049 --> 00:44:59,210

smaller orbit into a smaller radius

795

00:45:06,900 --> 00:45:02,059

orbit and there from their land on Mars

796

00:45:10,450 --> 00:45:06,910

and then return back and fly back home

797

00:45:13,420 --> 00:45:10,460

we had a capsule designed I think that

798

00:45:16,839 --> 00:45:13,430

was with the help and assistance of JSC

799

00:45:18,700 --> 00:45:16,849

at that time looking like an Apollo

800

00:45:21,090 --> 00:45:18,710

capsule only bigger and it had a

801
00:45:27,350 --> 00:45:21,100
laboratory inside living for us

802
00:45:34,680 --> 00:45:30,660
inserted you see the ascent capsule the

803
00:45:36,150 --> 00:45:34,690
ascent stage so to fly up into orbit you

804
00:45:39,390 --> 00:45:36,160
didn't have to take the whole thing up

805
00:45:44,340 --> 00:45:39,400
you just launched out of that hole with

806
00:45:47,640 --> 00:45:44,350
the people sitting up on top well before

807
00:45:50,790 --> 00:45:47,650
I get to that let's finish this sad

808
00:45:54,150 --> 00:45:50,800
story of the 70s as far as this is

809
00:45:57,900 --> 00:45:54,160
concerned the plan D I mentioned was off

810
00:46:01,170 --> 00:45:57,910
the table Tom Paine who was our NASA

811
00:46:06,740 --> 00:46:01,180
Administrator then went back and asked

812
00:46:09,990 --> 00:46:06,750
for four billion for fiscal fiscal 70

813
00:46:13,080 --> 00:46:10,000

5271 this would have kept the set on

814

00:46:16,740 --> 00:46:13,090

five in production and provided startup

815

00:46:19,830 --> 00:46:16,750

money for shuttle in station this was

816

00:46:22,650 --> 00:46:19,840

cut by the Bureau of the budget to three

817

00:46:24,390 --> 00:46:22,660

point seven three billion and then came

818

00:46:26,880 --> 00:46:24,400

an across-the-board cut for the whole

819

00:46:29,760 --> 00:46:26,890

government of ten percent which left us

820

00:46:32,250 --> 00:46:29,770

with three points we three billion we

821

00:46:35,280 --> 00:46:32,260

had to close the electronic research

822

00:46:37,920 --> 00:46:35,290

center in cambridge was one of the nasa

823

00:46:40,980 --> 00:46:37,930

centers at that time and the nasa

824

00:46:42,930 --> 00:46:40,990

contractor workforce failed from hundred

825

00:46:47,730 --> 00:46:42,940

ninety thousand two hundred forty

826

00:46:49,890 --> 00:46:47,740

thousand in 1971 then congress and it

827

00:46:52,950 --> 00:46:49,900

was just Bureau of the budget up to now

828

00:46:57,180 --> 00:46:52,960

then Congress added its own cuts which

829

00:46:59,310 --> 00:46:57,190

left NASA was 3.27 billion and that was

830

00:47:03,870 --> 00:46:59,320

about one-third of our budget of the

831

00:47:06,510 --> 00:47:03,880

mid-60s in constant year dollars well

832

00:47:10,260 --> 00:47:06,520

about that time they realized something

833

00:47:14,520 --> 00:47:10,270

needs to be done we cannot just fold it

834

00:47:16,170 --> 00:47:14,530

we needed pilot flights because we

835

00:47:19,170 --> 00:47:16,180

wouldn't have had any pilot the flights

836

00:47:22,890 --> 00:47:19,180

afterwards so Nixon approved a reduced

837

00:47:26,610 --> 00:47:22,900

shudder in 1971 which was not fully

838

00:47:31,980 --> 00:47:26,620

reusable it flew from 1980 1 2 next to

839

00:47:36,270 --> 00:47:31,990

lie over 30 years which is quite an

840

00:47:46,030 --> 00:47:42,820

well also in 1970 NASA went back to

841

00:47:50,890 --> 00:47:46,040

studying man Mars using the phone brown

842

00:47:54,700 --> 00:47:50,900

study of 69 reviewing the work and came

843

00:47:57,760 --> 00:47:54,710

up with a new start which that did not

844

00:48:01,690 --> 00:47:57,770

require a certain 575 was not there

845

00:48:04,410 --> 00:48:01,700

anymore so we baselined a shuttle

846

00:48:09,520 --> 00:48:04,420

derived launch vehicle as heavy lifter

847

00:48:12,760 --> 00:48:09,530

it would have just taken six crew

848

00:48:15,910 --> 00:48:12,770

members for the expedition so we again

849

00:48:18,880 --> 00:48:15,920

shrunk it down from 12 to six the space

850

00:48:22,930 --> 00:48:18,890

station was seen as essential for

851

00:48:26,410 --> 00:48:22,940

orbital test and demo flights also there

852

00:48:29,830 --> 00:48:26,420

was a competing proposal by a scientist

853

00:48:35,190 --> 00:48:29,840

Fred singer who came up with a Phobos

854

00:48:38,110 --> 00:48:35,200

Deimos mission 1978 PhD mission called

855

00:48:40,990 --> 00:48:38,120

which used electric propulsion with some

856

00:48:45,400 --> 00:48:41,000

chemical assistance launched from

857

00:48:48,010 --> 00:48:45,410

geosynchronous orbit on low thrust a no

858

00:48:49,960 --> 00:48:48,020

space station envisioned so in order to

859

00:48:52,480 --> 00:48:49,970

get all of those parts up to

860

00:48:54,700 --> 00:48:52,490

geosynchronous orbits you need it I

861

00:48:57,700 --> 00:48:54,710

don't know how many 40 or 50 shuttle

862

00:48:59,680 --> 00:48:57,710

flights and some upper stage some space

863

00:49:01,380 --> 00:48:59,690

talk in order to assemble in

864

00:49:04,360 --> 00:49:01,390

geosynchronous he wanted geosynchronous

865

00:49:06,640 --> 00:49:04,370

because the take of the velocity the

866

00:49:08,650 --> 00:49:06,650

Delta V would have been much less there

867

00:49:12,340 --> 00:49:08,660

and he could a few smaller engines and

868

00:49:16,030 --> 00:49:12,350

electric propulsion and outside in in

869

00:49:18,190 --> 00:49:16,040

those 70s seventies a very kind of a no

870

00:49:20,380 --> 00:49:18,200

action type we had to sit and twiddle

871

00:49:22,840 --> 00:49:20,390

our thumbs because the sutter was being

872

00:49:24,550 --> 00:49:22,850

developed you know behind the scenery

873

00:49:27,360 --> 00:49:24,560

where nobody could see it so the public

874

00:49:31,060 --> 00:49:27,370

lost interest in space more and more

875

00:49:36,690 --> 00:49:31,070

Congress who which reviewed our budget

876

00:49:44,050 --> 00:49:38,680

uninterested there wasn't anything going

877

00:49:45,660 --> 00:49:44,060

on after the Skylab flights in 73 and CA

878

00:49:47,549 --> 00:49:45,670

esti PE the Apollo so

879

00:49:50,280 --> 00:49:47,559

use test project those were not new

880

00:49:54,359 --> 00:49:50,290

starts there were just kind of it's a

881

00:49:57,030 --> 00:49:54,369

tail end of existing programs there was

882

00:50:00,420 --> 00:49:57,040

nothing else we could show so there was

883

00:50:04,230 --> 00:50:00,430

one year when the shuttle program was

884

00:50:06,450 --> 00:50:04,240

saved in Congress by only one voice you

885

00:50:10,069 --> 00:50:06,460

are pretty fortunate our opponents were

886

00:50:13,620 --> 00:50:10,079

pretty strong mostly Democrats there was

887

00:50:16,400 --> 00:50:13,630

Senator Proxmire senator mondale who

888

00:50:19,440 --> 00:50:16,410

later of course became a vice president

889

00:50:23,490 --> 00:50:19,450

so those seventies were tough really

890

00:50:25,980 --> 00:50:23,500

tough and unfortunately we hit the

891

00:50:30,780 --> 00:50:25,990

shutter which was being designed and

892

00:50:33,630 --> 00:50:30,790

built out out of you so to speak outside

893

00:50:36,539 --> 00:50:33,640

people became impatient enormous you

894

00:50:40,970 --> 00:50:36,549

know people about Mars and so up sprung

895

00:50:44,190 --> 00:50:40,980

a number a whole numerous number of

896

00:50:47,280 --> 00:50:44,200

miles underground activities it was

897

00:50:51,539 --> 00:50:47,290

called the mouse underground external

898

00:50:54,240 --> 00:50:51,549

study activities they had Mouse symposia

899

00:50:57,329 --> 00:50:54,250

the case of mouth symposia which we

900

00:51:00,900 --> 00:50:57,339

monitor autor set in on but for NASA

901
00:51:02,880 --> 00:51:00,910
there wasn't really much to do NASA

902
00:51:05,849 --> 00:51:02,890
didn't really have any long-range plans

903
00:51:09,329 --> 00:51:05,859
beyond Apollo as I just said we just

904
00:51:11,640 --> 00:51:09,339
continued into Skylit using a upper

905
00:51:15,420 --> 00:51:11,650
stage that's the s4b state from Sedin

906
00:51:19,109 --> 00:51:15,430
and using these the last 71 be for the

907
00:51:23,010 --> 00:51:19,119
apollo-soyuz test project so I was

908
00:51:25,289 --> 00:51:23,020
brought up in 74 from Marshall to do

909
00:51:27,809 --> 00:51:25,299
long-range planning they had no idea

910
00:51:30,870 --> 00:51:27,819
what what it is how to do how to go

911
00:51:33,809 --> 00:51:30,880
about it the future looked like a big

912
00:51:35,099 --> 00:51:33,819
black hole you know everyone sort what

913
00:51:37,260 --> 00:51:35,109

we should have this we should have that

914

00:51:40,500 --> 00:51:37,270

we should have a space station and you

915

00:51:42,630 --> 00:51:40,510

had to put a structure into that future

916

00:51:45,539 --> 00:51:42,640

United structure it and so I came up

917

00:51:49,260 --> 00:51:45,549

with this railroad switching yard I

918

00:51:51,990 --> 00:51:49,270

called it which was not supposed to you

919

00:51:55,500 --> 00:51:52,000

know happen all in parallel but it at

920

00:51:57,690 --> 00:51:55,510

least told us where to put certain

921

00:51:59,410 --> 00:51:57,700

things there was on the bottom the

922

00:52:01,990 --> 00:51:59,420

transportation line coming from

923

00:52:05,589 --> 00:52:02,000

the shutter with large lift reheated

924

00:52:08,260 --> 00:52:05,599

there and the OTV which was the orbiter

925

00:52:10,599 --> 00:52:08,270

transfer vehicle or tag which also had

926
00:52:13,180 --> 00:52:10,609
an advanced version their lunar

927
00:52:14,799 --> 00:52:13,190
logistics lander advanced lunar lander

928
00:52:17,410 --> 00:52:14,809
and it's a bottom nuclear propulsion

929
00:52:21,039 --> 00:52:17,420
stages that in the middle a space

930
00:52:24,430 --> 00:52:21,049
station evolution coming from Skylab and

931
00:52:26,770 --> 00:52:24,440
from space lab on the left side is where

932
00:52:29,859 --> 00:52:26,780
we were that was what I call support to

933
00:52:31,660 --> 00:52:29,869
push things pushing us forward and on

934
00:52:34,690 --> 00:52:31,670
the way on the right side was pulled

935
00:52:37,120 --> 00:52:34,700
lots of ideas which people wanted to see

936
00:52:40,180 --> 00:52:37,130
in their future one day and we couldn't

937
00:52:42,490 --> 00:52:40,190
just single out one we couldn't just say

938
00:52:45,339 --> 00:52:42,500

well we all want to do this so I had to

939

00:52:47,829 --> 00:52:45,349

leave it open and put the major ones

940

00:52:50,109 --> 00:52:47,839

here earth of its base community solar

941

00:52:52,750 --> 00:52:50,119

power plants in space lunar colony in

942

00:52:55,990 --> 00:52:52,760

five colony and my settlement and then

943

00:52:58,930 --> 00:52:56,000

show you know the vector relationships

944

00:53:00,849 --> 00:52:58,940

in that tree of relevance to show what

945

00:53:06,240 --> 00:53:00,859

needs to go where and what needs to be

946

00:53:09,280 --> 00:53:06,250

developed first that still would apply

947

00:53:11,559 --> 00:53:09,290

you know without any years or on top

948

00:53:14,380 --> 00:53:11,569

because essentially that's what you need

949

00:53:16,030 --> 00:53:14,390

you need precursors in order to do the

950

00:53:20,039 --> 00:53:16,040

very large steps and if you want to go

951
00:53:24,160 --> 00:53:20,049
to Mars you do need a space station and

952
00:53:26,920 --> 00:53:24,170
the other things too so it gave us a

953
00:53:29,799 --> 00:53:26,930
structure of which we can use in to put

954
00:53:32,319 --> 00:53:29,809
studies go out to industry and do

955
00:53:34,569 --> 00:53:32,329
contracted studies mostly space

956
00:53:37,690 --> 00:53:34,579
industrialization studies in on the

957
00:53:44,500 --> 00:53:37,700
Earth's orbit line there well that was

958
00:53:46,599 --> 00:53:44,510
in the 70s and mass but played a role

959
00:53:49,299 --> 00:53:46,609
mostly external as I said with mouse

960
00:53:51,250 --> 00:53:49,309
under ground and not so much in NASA

961
00:53:54,839 --> 00:53:51,260
except for that one study I mentioned

962
00:53:58,000 --> 00:53:54,849
where we redid the 69 study of fun brown

963
00:54:00,609 --> 00:53:58,010

now we come to the 1980s the first

964

00:54:04,450 --> 00:54:00,619

decade and it was a decade of Ronald

965

00:54:10,030 --> 00:54:04,460

Reagan from who was president for 1981

966

00:54:12,769 --> 00:54:10,040

to 1989 again the crest was what next

967

00:54:16,200 --> 00:54:12,779

what should we do now

968

00:54:20,549 --> 00:54:16,210

his vice president was the editor bush

969

00:54:25,079 --> 00:54:20,559

and he set up a n course national

970

00:54:27,480 --> 00:54:25,089

commission on space in 1985 headed by

971

00:54:30,599 --> 00:54:27,490

Thomas Paine again formerly NASA

972

00:54:34,529 --> 00:54:30,609

Administrator to take a look at the next

973

00:54:36,390 --> 00:54:34,539

50 years in space to kind of structure

974

00:54:40,200 --> 00:54:36,400

the future which had never been done

975

00:54:41,849 --> 00:54:40,210

before your show where things had their

976
00:54:44,670 --> 00:54:41,859
proper place and what needs to be done

977
00:54:46,519 --> 00:54:44,680
first so they came up with out with a

978
00:54:50,759 --> 00:54:46,529
report on the next 50 years in space

979
00:54:53,400 --> 00:54:50,769
which was a very very good very

980
00:54:56,970 --> 00:54:53,410
realistic in certain areas but also very

981
00:55:00,950 --> 00:54:56,980
idealistic in other areas kind of

982
00:55:05,250 --> 00:55:00,960
free-thinking type ideas and it came

983
00:55:06,839 --> 00:55:05,260
unfortunately out in May 1986 just three

984
00:55:09,960 --> 00:55:06,849
or four months after the Challenger

985
00:55:12,630 --> 00:55:09,970
accident so it came out in a time they

986
00:55:17,279 --> 00:55:12,640
couldn't have been worse for was an

987
00:55:22,039 --> 00:55:17,289
effort like that that was a handicap but

988
00:55:25,970 --> 00:55:22,049

we had a report which was real pretty

989

00:55:29,519 --> 00:55:25,980

you know all inclusive so to speak so

990

00:55:33,870 --> 00:55:29,529

Fletcher who was our administrator at

991

00:55:36,420 --> 00:55:33,880

that time asked the female after now the

992

00:55:40,559 --> 00:55:36,430

first American woman in orbit Sally

993

00:55:43,230 --> 00:55:40,569

right to collect a group of people and

994

00:55:45,870 --> 00:55:43,240

do and single out you know what can be

995

00:55:48,299 --> 00:55:45,880

done with the Tom Paine report so she

996

00:55:52,319 --> 00:55:48,309

came up with a committee I was a member

997

00:55:57,210 --> 00:55:52,329

of that and in 1987 put out the right

998

00:55:59,460 --> 00:55:57,220

report which had boiled down the end

999

00:56:02,759 --> 00:55:59,470

course report to for alternative

1000

00:56:08,160 --> 00:56:02,769

long-range long-term initiatives with

1001
00:56:10,349 --> 00:56:08,170
the first human on Mars set for 2005 the

1002
00:56:12,450 --> 00:56:10,359
other alternatives were more down to

1003
00:56:16,380 --> 00:56:12,460
earth it was particularly mission planet

1004
00:56:20,089 --> 00:56:16,390
Earth which was quite important at that

1005
00:56:23,220 --> 00:56:20,099
time and kind of spawned a lot of

1006
00:56:24,210 --> 00:56:23,230
initiatives having to do with the

1007
00:56:27,480 --> 00:56:24,220
environment

1008
00:56:31,520 --> 00:56:27,490
and an hour our own ecology down on

1009
00:56:36,480 --> 00:56:31,530
earth but mouse was still in there and

1010
00:56:40,530 --> 00:56:36,490
at the end when President Reagan

1011
00:56:45,990 --> 00:56:40,540
finished in 89 january and the george HW

1012
00:56:49,500 --> 00:56:46,000
bush took over as president he was

1013
00:56:52,170 --> 00:56:49,510

headed with SDI which President Reagan

1014

00:56:55,710 --> 00:56:52,180

had come up with space space Defense

1015

00:56:58,859 --> 00:56:55,720

Initiative where he wanted to use space

1016

00:57:02,089 --> 00:56:58,869

developments in a big defensive posture

1017

00:57:05,550 --> 00:57:02,099

with better stations in orbit and so on

1018

00:57:10,070 --> 00:57:05,560

and had already turned on industry to

1019

00:57:12,780 --> 00:57:10,080

that a lot so when Bush came he had 22

1020

00:57:15,150 --> 00:57:12,790

concerns first of all what to do in

1021

00:57:18,630 --> 00:57:15,160

space what can we do with Shelly rights

1022

00:57:22,470 --> 00:57:18,640

report and secondly how can I help all

1023

00:57:25,530 --> 00:57:22,480

those victims of SDI after that program

1024

00:57:28,829 --> 00:57:25,540

collapsed you know industry or the the

1025

00:57:32,070 --> 00:57:28,839

workforce SDI people so put a president

1026
00:57:34,710 --> 00:57:32,080
bush on july twenty nineteen eighty nine

1027
00:57:38,460 --> 00:57:34,720
exactly twenty years after Apollo 11

1028
00:57:43,440 --> 00:57:38,470
landing not not a coincidence presented

1029
00:57:47,130 --> 00:57:43,450
the sei just changed one letter from d

1030
00:57:51,690 --> 00:57:47,140
to e space exploration initiative which

1031
00:57:54,120 --> 00:57:51,700
put a peaceful evolutionary concept long

1032
00:57:57,420 --> 00:57:54,130
range concept very very good very

1033
00:58:01,440 --> 00:57:57,430
rational instead of this SDI idea and

1034
00:58:04,680 --> 00:58:01,450
instead essentially said that a if we do

1035
00:58:07,290 --> 00:58:04,690
ssei we can keep all the people in work

1036
00:58:11,400 --> 00:58:07,300
and just you know redirect them a little

1037
00:58:14,579 --> 00:58:11,410
bit where did he get the sei material

1038
00:58:18,810 --> 00:58:14,589

well from a 90 days study which NASA did

1039

00:58:22,470 --> 00:58:18,820

pretty quickly a few months earlier in

1040

00:58:25,980 --> 00:58:22,480

late 88 or early nineteen eighty nine a

1041

00:58:29,550 --> 00:58:25,990

ninety 90 days study to which included

1042

00:58:33,780 --> 00:58:29,560

Moon and Mars and that was then kind of

1043

00:58:37,650 --> 00:58:33,790

folded into the sei but Ross push into

1044

00:58:40,630 --> 00:58:37,660

five different reference programs

1045

00:58:45,220 --> 00:58:40,640

again you know a whole collection of

1046

00:58:52,000 --> 00:58:45,230

ideas and let's see what we go vote in

1047

00:58:56,170 --> 00:58:52,010

pictures no yeah I'll go to that so the

1048

00:58:57,850 --> 00:58:56,180

FBI had a whole bunch of ideas so Bush

1049

00:59:02,370 --> 00:58:57,860

turned to his vice president day and

1050

00:59:04,930 --> 00:59:02,380

created it said well you handle it and

1051
00:59:06,760 --> 00:59:04,940
took a little while for Dan Quayle to

1052
00:59:10,120 --> 00:59:06,770
realize what a tremendous has dropped

1053
00:59:14,170 --> 00:59:10,130
this AC I really meant and so he came to

1054
00:59:17,260 --> 00:59:14,180
NASA for help and said we need a public

1055
00:59:19,300 --> 00:59:17,270
outreach know if you don't know if you

1056
00:59:22,180 --> 00:59:19,310
don't know what to do you always say

1057
00:59:24,480 --> 00:59:22,190
let's clue in let's go do an outreach

1058
00:59:27,580 --> 00:59:24,490
and ask people outside what they want

1059
00:59:30,240 --> 00:59:27,590
and so NASA did a public outreach they

1060
00:59:33,120 --> 00:59:30,250
see our outreach took to collect

1061
00:59:36,220 --> 00:59:33,130
alternative ideas from the public

1062
00:59:38,290 --> 00:59:36,230
thousands came in of ideas and we are

1063
00:59:41,500 --> 00:59:38,300

all evaluated for us by the rent

1064

00:59:44,350 --> 00:59:41,510

cooperation there are lots of science

1065

00:59:47,110 --> 00:59:44,360

fiction ideas in there very few made

1066

00:59:48,640 --> 00:59:47,120

really sense because we had already in

1067

00:59:50,530 --> 00:59:48,650

the previous years covered the

1068

00:59:53,920 --> 00:59:50,540

waterfront we had all the ideas already

1069

00:59:55,930 --> 00:59:53,930

there were no big surprises but or

1070

01:00:01,720 --> 00:59:55,940

incorporation organised them properly

1071

01:00:05,020 --> 01:00:01,730

and we set up a special committee headed

1072

01:00:08,080 --> 01:00:05,030

by General Thomas Stepford Apollo 10

1073

01:00:11,650 --> 01:00:08,090

astronaut and a STP astronaut very

1074

01:00:14,350 --> 01:00:11,660

respected men even today still around

1075

01:00:16,840 --> 01:00:14,360

and helping us with the Russians the

1076

01:00:18,550 --> 01:00:16,850

so-called synthesis group and the

1077

01:00:21,100 --> 01:00:18,560

synthesis group under Tom Stafford

1078

01:00:23,830 --> 01:00:21,110

distill it all the results of the rain

1079

01:00:27,570 --> 01:00:23,840

study down into four prime alternative

1080

01:00:35,230 --> 01:00:27,580

exploration architectures which now

1081

01:00:38,590 --> 01:00:35,240

brings us to 1990 this is takes me back

1082

01:00:40,900 --> 01:00:38,600

to the inner via picture earlier because

1083

01:00:43,420 --> 01:00:40,910

the mouse underground people the

1084

01:00:44,790 --> 01:00:43,430

external people got together with the

1085

01:00:48,360 --> 01:00:44,800

Russians

1086

01:00:50,730 --> 01:00:48,370

in Grosskopf ego Gorshkov who had come

1087

01:00:52,530 --> 01:00:50,740

up with their own Mouse plans and so our

1088

01:00:55,950 --> 01:00:52,540

people thought he might be a great idea

1089

01:00:59,930 --> 01:00:55,960

to use a Russian energy as a launch

1090

01:01:03,560 --> 01:00:59,940

vehicle heavy launcher for a mouse and

1091

01:01:07,890 --> 01:01:03,570

so they distributed all kinds of ads

1092

01:01:12,860 --> 01:01:07,900

looking like that what semyonov in

1093

01:01:15,360 --> 01:01:12,870

Grosskopf back in the 80s had developed

1094

01:01:18,000 --> 01:01:15,370

and you can you can actually get it on

1095

01:01:22,230 --> 01:01:18,010

online the owner gear people put it on

1096

01:01:25,080 --> 01:01:22,240

their internet is this mouse concept

1097

01:01:31,860 --> 01:01:25,090

using only electric propulsion where you

1098

01:01:35,280 --> 01:01:31,870

have to spiral out from Earth on the

1099

01:01:37,350 --> 01:01:35,290

here on the right lower corner and once

1100

01:01:39,930 --> 01:01:37,360

you are fast enough I do have to spiral

1101

01:01:43,370 --> 01:01:39,940

out because electric propulsion has is

1102

01:01:45,450 --> 01:01:43,380

so much low thrust it's just you know

1103

01:01:48,120 --> 01:01:45,460

blowing against the sheet of paper

1104

01:01:51,660 --> 01:01:48,130

almost but it goes for days and weeks

1105

01:01:53,880 --> 01:01:51,670

and months so the thrust force adds up

1106

01:01:56,280 --> 01:01:53,890

and the velocity adds up which means

1107

01:01:58,800 --> 01:01:56,290

they have to work a long time electric

1108

01:02:01,170 --> 01:01:58,810

propulsion but they do add up to very

1109

01:02:03,300 --> 01:02:01,180

high velocities and so you need to

1110

01:02:05,820 --> 01:02:03,310

spiral out until we were fast enough to

1111

01:02:08,280 --> 01:02:05,830

break away and go to trans mass

1112

01:02:11,070 --> 01:02:08,290

injection and then do the same on mass

1113

01:02:13,530 --> 01:02:11,080

spiral in and land and then come back to

1114

01:02:15,570 --> 01:02:13,540

earth it was what Simeon of an gorshkov

1115

01:02:19,010 --> 01:02:15,580

at that time proposed and our people

1116

01:02:22,620 --> 01:02:19,020

thought hey we could use the energy ax

1117

01:02:28,380 --> 01:02:22,630

rocket that big power pack with our own

1118

01:02:31,350 --> 01:02:28,390

spaceship nuclear developments I got

1119

01:02:34,410 --> 01:02:31,360

that from a Russian presentation a few

1120

01:02:36,300 --> 01:02:34,420

weeks ago we're going on in both

1121

01:02:39,450 --> 01:02:36,310

countries on the left our Nova

1122

01:02:42,570 --> 01:02:39,460

development on the right as a Russian

1123

01:02:44,010 --> 01:02:42,580

nuclear rocket engine with parameters

1124

01:02:46,620 --> 01:02:44,020

which showed that both of them had

1125

01:02:49,920 --> 01:02:46,630

already undergone quite a number of

1126

01:02:52,770 --> 01:02:49,930

tests and power on different power

1127

01:02:54,550 --> 01:02:52,780

levels we called our program first free

1128

01:02:58,530 --> 01:02:54,560

booze the fables program

1129

01:03:03,430 --> 01:02:58,540

and the Nova engine nuclear engine

1130

01:03:07,090 --> 01:03:03,440

rocket of vehicle application Nerva ner

1131

01:03:10,330 --> 01:03:07,100

VA and we put it into a rocket stage

1132

01:03:12,550 --> 01:03:10,340

called lift rocket reactor in flight

1133

01:03:15,580 --> 01:03:12,560

test that we actually had a program

1134

01:03:18,540 --> 01:03:15,590

office at Marshall which designed the

1135

01:03:21,220 --> 01:03:18,550

rift stage for an upper stage for the 75

1136

01:03:24,700 --> 01:03:21,230

the Russians did it similarly with their

1137

01:03:27,940 --> 01:03:24,710

NR e and then of course the nuclear test

1138

01:03:31,120 --> 01:03:27,950

ban treaty later on put a stop to all of

1139

01:03:33,220 --> 01:03:31,130

that those tests were not done in open

1140

01:03:36,010 --> 01:03:33,230

air they were done in enclosed

1141

01:03:37,510 --> 01:03:36,020

environments underground and so on so we

1142

01:03:39,520 --> 01:03:37,520

didn't really in danger the atmosphere

1143

01:03:42,640 --> 01:03:39,530

with our testing and we never would have

1144

01:03:45,580 --> 01:03:42,650

ignited a nuclear engine while still in

1145

01:03:48,550 --> 01:03:45,590

the atmosphere all the program plans for

1146

01:03:50,620 --> 01:03:48,560

Mars always assumed that the upper

1147

01:03:53,200 --> 01:03:50,630

stages in nuclear propulsion would be

1148

01:03:56,740 --> 01:03:53,210

ignited way away from the atmosphere out

1149

01:03:58,780 --> 01:03:56,750

in empty space but still we fail under

1150

01:04:01,980 --> 01:03:58,790

that nuclear test ban treaty and so at

1151
01:04:05,680 --> 01:04:01,990
that time or the nuclear efforts stopped

1152
01:04:08,500 --> 01:04:05,690
today the Russians have this type of

1153
01:04:13,350 --> 01:04:08,510
concept they are using a combination of

1154
01:04:17,740 --> 01:04:13,360
nuclear and electric this particular one

1155
01:04:20,470 --> 01:04:17,750
uses in on the the rocket engine is on

1156
01:04:23,500 --> 01:04:20,480
the far right and the electric

1157
01:04:30,000 --> 01:04:23,510
propulsion units are there those red

1158
01:04:33,010 --> 01:04:30,010
little red thrusters which are the Marty

1159
01:04:35,140 --> 01:04:33,020
in-flight propulsion which go on for

1160
01:04:38,740 --> 01:04:35,150
weeks and weeks the payload is green

1161
01:04:41,430 --> 01:04:38,750
number one and the blue area is the

1162
01:04:44,320 --> 01:04:41,440
radiator for cooling the nuclear

1163
01:04:46,810 --> 01:04:44,330

propulsion system in this particular

1164

01:04:50,320 --> 01:04:46,820

case it's using a droplet radiator

1165

01:04:53,110 --> 01:04:50,330

cooling and in this one it's the same

1166

01:04:57,850 --> 01:04:53,120

way heated but it uses a radiating

1167

01:05:00,820 --> 01:04:57,860

cooler using a normal and normal

1168

01:05:05,440 --> 01:05:00,830

radiator like we have on thank you like

1169

01:05:07,500 --> 01:05:05,450

we have on on the ISS for

1170

01:05:10,050 --> 01:05:07,510

cooling the engine so this is what

1171

01:05:19,770 --> 01:05:10,060

Russian devices are showing right now

1172

01:05:23,800 --> 01:05:19,780

mr. coat f of the Kelly dish Research

1173

01:05:26,380 --> 01:05:23,810

Corporation has shown that around in his

1174

01:05:28,300 --> 01:05:26,390

presentation so they aren't they are

1175

01:05:31,089 --> 01:05:28,310

doing it they're working it and we are

1176

01:05:33,160 --> 01:05:31,099

actually thinking of talking to them

1177

01:05:36,640 --> 01:05:33,170

about nuclear rocket development or or

1178

01:05:38,589 --> 01:05:36,650

in in orbit propulsion so we are not

1179

01:05:42,040 --> 01:05:38,599

really limiting to lukla area we also

1180

01:05:44,530 --> 01:05:42,050

mean electric propulsion and if they are

1181

01:05:48,280 --> 01:05:44,540

already ahead of us because they are not

1182

01:05:51,970 --> 01:05:48,290

so much limited by popular you know

1183

01:05:55,079 --> 01:05:51,980

antipathy we auto get together and so

1184

01:06:00,910 --> 01:05:55,089

some talks are being done in that area

1185

01:06:03,579 --> 01:06:00,920

well this takes us now into the 1980s no

1186

01:06:06,550 --> 01:06:03,589

no no this is still 90 80 here we had

1187

01:06:09,670 --> 01:06:06,560

internal studies those are some books I

1188

01:06:15,670 --> 01:06:09,680

got a collected back in at Marshall in

1189

01:06:19,569 --> 01:06:15,680

86 where we had symposia where we came

1190

01:06:22,120 --> 01:06:19,579

up with a mouse NASA reference mission

1191

01:06:24,880 --> 01:06:22,130

and that really basically hasn't changed

1192

01:06:27,370 --> 01:06:24,890

too much when when we wanted to fly to

1193

01:06:32,859 --> 01:06:27,380

Mars we are talking about two launches

1194

01:06:35,859 --> 01:06:32,869

one flying in the first year with a

1195

01:06:39,339 --> 01:06:35,869

cargo flight which deposits deposits

1196

01:06:42,069 --> 01:06:39,349

some equipment or Mouse a habitat or

1197

01:06:45,220 --> 01:06:42,079

baby even a kind of a little factory

1198

01:06:48,670 --> 01:06:45,230

which uses a zoo in situ resource

1199

01:06:52,690 --> 01:06:48,680

utilization is are you and Pope and

1200

01:06:58,839 --> 01:06:52,700

actually goes to work producing oxygen

1201

01:07:02,500 --> 01:06:58,849

or hydrogen particularly methane CH_4 S_4S

1202

01:07:05,140 --> 01:07:02,510

propellant and about two and A two and a

1203

01:07:08,109 --> 01:07:05,150

half years to point 13 years later the

1204

01:07:10,809 --> 01:07:08,119

second launch vehicle would carry people

1205

01:07:15,099 --> 01:07:10,819

behind it so we have two flights

1206

01:07:17,710 --> 01:07:15,109

separated by a sea nautic period when

1207

01:07:20,650 --> 01:07:17,720

you fly to Mars those

1208

01:07:23,950 --> 01:07:20,660

optimum constellation opportunities

1209

01:07:25,930 --> 01:07:23,960

repeat only every two years and then you

1210

01:07:27,609 --> 01:07:25,940

have to wait so once you're sitting on

1211

01:07:30,790 --> 01:07:27,619

Mars and waiting for the next resupply

1212

01:07:33,940 --> 01:07:30,800

you have to wait for two point 13 years

1213

01:07:35,740 --> 01:07:33,950

until the constellation you know the the

1214

01:07:38,250 --> 01:07:35,750

positions of Earth and Mars are just

1215

01:07:40,990 --> 01:07:38,260

right to get to you with minimum energy

1216

01:07:43,660 --> 01:07:41,000

so basically that another reference

1217

01:07:50,440 --> 01:07:43,670

mission is still around and it's still

1218

01:07:54,400 --> 01:07:50,450

being used today those studies came up

1219

01:07:57,160 --> 01:07:54,410

with habitat concepts like here what

1220

01:08:03,550 --> 01:07:57,170

I've done is I cut this panorama picture

1221

01:08:05,770 --> 01:08:03,560

in half so the lower left rim of the

1222

01:08:08,770 --> 01:08:05,780

picture should be attached to the upper

1223

01:08:10,780 --> 01:08:08,780

right one of the picture then you get

1224

01:08:14,680 --> 01:08:10,790

kind of a feeling of what they were

1225

01:08:19,329 --> 01:08:14,690

talking about in those years those

1226

01:08:21,760 --> 01:08:19,339

studies develop those concepts they were

1227

01:08:26,800 --> 01:08:21,770

done at various places with on by NASA

1228

01:08:28,420 --> 01:08:26,810

people with sponsorship by on the left

1229

01:08:35,380 --> 01:08:28,430

side the lunar and planetary institute

1230

01:08:39,809 --> 01:08:35,390

in Houston in 1992 and by Ames in 1993

1231

01:08:43,240 --> 01:08:39,819

so we did get other centers involved

1232

01:08:46,599 --> 01:08:43,250

that's another concept which came out of

1233

01:08:50,979 --> 01:08:46,609

those years showing two habitats we

1234

01:08:54,130 --> 01:08:50,989

still always were talking to things in

1235

01:08:58,059 --> 01:08:54,140

order to have a backup capability there

1236

01:09:02,890 --> 01:08:58,069

was later reduced when some more cuts

1237

01:09:08,380 --> 01:09:02,900

were done before I get to this a few

1238

01:09:11,920 --> 01:09:08,390

words no skill to the sei by george bush

1239

01:09:15,789 --> 01:09:11,930

by george HW bush it was farsighted and

1240

01:09:19,660 --> 01:09:15,799

logically a good road map but there was

1241

01:09:23,649 --> 01:09:19,670

no funding link to it in Kristen I think

1242

01:09:32,180 --> 01:09:28,030

Bush jr. did the same thing to us

1243

01:09:36,079 --> 01:09:32,190

estimates by NASA were in the in the

1244

01:09:40,249 --> 01:09:36,089

range of 400 to 500 billion spread over

1245

01:09:45,079 --> 01:09:40,259

30 years but that immediately you know

1246

01:09:46,970 --> 01:09:45,089

kind of you know was rejected by

1247

01:09:50,030 --> 01:09:46,980

Congress a it didn't receive any

1248

01:09:52,370 --> 01:09:50,040

favorable comments 400 billion what are

1249

01:09:54,709 --> 01:09:52,380

you talking about and we were hey it's

1250

01:09:56,959 --> 01:09:54,719

right over 30 years Oh 400 mean it is so

1251

01:09:58,819 --> 01:09:56,969

much and today when you look at the

1252

01:10:00,439 --> 01:09:58,829

economic crisis what some of the banks

1253

01:10:02,510 --> 01:10:00,449

have been doing you know for them

1254

01:10:07,129 --> 01:10:02,520

hundreds of billions is you know peanuts

1255

01:10:09,859 --> 01:10:07,139

so at that time 1980 looked like a lot

1256

01:10:14,089 --> 01:10:09,869

of money and it did away unfortunately

1257

01:10:16,220 --> 01:10:14,099

with a beautiful old map we maybe

1258

01:10:20,870 --> 01:10:16,230

shouldn't have costed out the whole

1259

01:10:23,479 --> 01:10:20,880

thing the whole piece of potato the

1260

01:10:25,280 --> 01:10:23,489

whole 30 years we should have NASA

1261

01:10:30,140 --> 01:10:25,290

should have probably approached it in a

1262

01:10:31,879 --> 01:10:30,150

different way to get it across in 93 in

1263

01:10:36,040 --> 01:10:31,889

the Clinton administration which

1264

01:10:39,919 --> 01:10:36,050

followed the bush senior administration

1265

01:10:43,120 --> 01:10:39,929

SAE kicked the bucket but it wasn't

1266

01:10:46,609 --> 01:10:43,130

really dead at NASA particularly at JSC

1267

01:10:50,479 --> 01:10:46,619

se I did not entirely disappear it

1268

01:10:55,700 --> 01:10:50,489

mutated in all kinds of mostly in how

1269

01:11:03,589 --> 01:10:55,710

studies first came a fellow flow first

1270

01:11:06,859 --> 01:11:03,599

lunar of outpost done it at JSC and mike

1271

01:11:11,240 --> 01:11:06,869

griffin who we all fondly remember was

1272

01:11:14,780 --> 01:11:11,250

at that time head of exploration here at

1273

01:11:18,080 --> 01:11:14,790

headquarters so my griffin extended flow

1274

01:11:20,899 --> 01:11:18,090

of first lunar outpost to include mouse

1275

01:11:24,680 --> 01:11:20,909

because he felt like we did many years

1276

01:11:27,109 --> 01:11:24,690

before that commonality of engineering

1277

01:11:28,970 --> 01:11:27,119

developments could save money and if you

1278

01:11:32,390 --> 01:11:28,980

develop anything for the lunar outpost

1279

01:11:35,089 --> 01:11:32,400

you might as well use it also for mars

1280

01:11:35,810 --> 01:11:35,099

and so he folded mouse into it and the

1281

01:11:38,839 --> 01:11:35,820

outcome

1282

01:11:43,459 --> 01:11:38,849

was the first of several DRMs design

1283

01:11:45,109 --> 01:11:43,469

reference mission when he been my cliff

1284

01:11:48,530 --> 01:11:45,119

and headed exploration here at the

1285

01:11:51,709 --> 01:11:48,540

headquarters the drm one design

1286

01:11:55,280 --> 01:11:51,719

reference mission one still needed an

1287

01:11:56,660 --> 01:11:55,290

heavy lifter you cannot go beyond

1288

01:11:59,810 --> 01:11:56,670

Earth's orbit without a heavy-lift

1289

01:12:04,220 --> 01:11:59,820

launch vehicle and the one they came up

1290

01:12:07,339 --> 01:12:04,230

with was launched 240 tons to earth

1291

01:12:10,479 --> 01:12:07,349

orbit double of what the 75 could have

1292

01:12:13,459 --> 01:12:10,489

done that was the idea ee said and five

1293

01:12:17,089 --> 01:12:13,469

capability and it would have bought 100

1294

01:12:19,850 --> 01:12:17,099

tons to mouse stated there was no

1295

01:12:23,000 --> 01:12:19,860

station involved no orbital assembly in

1296

01:12:25,910 --> 01:12:23,010

or in Earth orbit required a crew of six

1297

01:12:28,850 --> 01:12:25,920

and they would rely they would use that

1298

01:12:31,850 --> 01:12:28,860

particular mode I just indicated first

1299

01:12:33,800 --> 01:12:31,860

cargo launch and then several car loans

1300

01:12:37,399 --> 01:12:33,810

in fact three cargo launches and then

1301

01:12:39,970 --> 01:12:37,409

people with a force afterwards and they

1302

01:12:44,169 --> 01:12:39,980

used is are you they would have to

1303

01:12:46,879 --> 01:12:44,179

depend on in situ resource utilization

1304

01:12:48,800 --> 01:12:46,889

that means the first cargo flights had

1305

01:12:51,830 --> 01:12:48,810

to prove the pudding that actually

1306

01:12:53,660 --> 01:12:51,840

something could be done about it and if

1307

01:12:55,520 --> 01:12:53,670

not then they would have had to take nor

1308

01:13:02,120 --> 01:12:55,530

the return propellant along instead of

1309

01:13:06,109 --> 01:13:02,130

manufacturing it on Mars that was in the

1310

01:13:08,390 --> 01:13:06,119

90s and things were going really slowly

1311

01:13:10,160 --> 01:13:08,400

we had sudden flight photo shutter

1312

01:13:16,280 --> 01:13:10,170

flights going on we had the space

1313

01:13:20,000 --> 01:13:16,290

station when all of a sudden a is a

1314

01:13:25,629 --> 01:13:20,010

meteorite was found in 1996 a mouse

1315

01:13:31,129 --> 01:13:25,639

meteoroid aah 8400 one which had

1316

01:13:34,280 --> 01:13:31,139

allegedly Mike robic life or science or

1317

01:13:36,800 --> 01:13:34,290

former microbial I've inside which

1318

01:13:39,290 --> 01:13:36,810

indicated to a lot of people hate there

1319

01:13:41,649 --> 01:13:39,300

could have been life on Mars if that mal

1320

01:13:44,750 --> 01:13:41,659

if that matter meteorite came from us

1321

01:13:46,819 --> 01:13:44,760

those microbes inside could prove that

1322

01:13:49,460 --> 01:13:46,829

there's life on Mars which immediately

1323

01:13:51,980 --> 01:13:49,470

raised public interest in mass

1324

01:13:55,010 --> 01:13:51,990

particularly in Bill Clinton and he made

1325

01:13:58,720 --> 01:13:55,020

a big you know White House announcement

1326

01:14:02,680 --> 01:13:58,730

out of that that nASA has found mouse

1327

01:14:05,810 --> 01:14:02,690

living mouse beings in a mouse meteoroid

1328

01:14:08,330 --> 01:14:05,820

never no never was proven that this was

1329

01:14:12,260 --> 01:14:08,340

actually microbes there were all kinds

1330

01:14:15,410 --> 01:14:12,270

of opposing explanations so even up to

1331

01:14:17,990 --> 01:14:15,420

today we don't really know what what it

1332

01:14:20,140 --> 01:14:18,000

was what they found in there but it did

1333

01:14:23,390 --> 01:14:20,150

raise public interest tremendously and

1334

01:14:25,520 --> 01:14:23,400

it did particularly do as good in that

1335

01:14:28,160 --> 01:14:25,530

the exploration office at JSC was

1336

01:14:30,200 --> 01:14:28,170

reestablished JSC wound up with a new

1337

01:14:33,500 --> 01:14:30,210

exploration of his because mostly of

1338

01:14:37,280 --> 01:14:33,510

that meteorite well they immediately

1339

01:14:40,640 --> 01:14:37,290

went into the dr amin came up with new

1340

01:14:45,500 --> 01:14:40,650

design reference missions particularly

1341

01:14:49,370 --> 01:14:45,510

number three drm three was done by

1342

01:14:53,150 --> 01:14:49,380

scrubbing dm1 down make it more modest

1343

01:14:58,880 --> 01:14:53,160

in nineteen nineteen ninety-seven it had

1344

01:15:00,890 --> 01:14:58,890

a nuclear thermal rocket stage it had a

1345

01:15:04,640 --> 01:15:00,900

Saturday high floor heater but not a

1346

01:15:07,490 --> 01:15:04,650

heavy lift launch later it had in situ

1347

01:15:10,910 --> 01:15:07,500

resource utilization and launched only

1348

01:15:14,180 --> 01:15:10,920

one habitat to Mars instead of two so it

1349

01:15:18,320 --> 01:15:14,190

used half of the launch vehicles on

1350

01:15:22,400 --> 01:15:18,330

earth and then we went in came to the

1351

01:15:25,430 --> 01:15:22,410

year two thousand and drm for was the

1352

01:15:28,700 --> 01:15:25,440

next one which was a new iteration on

1353

01:15:33,560 --> 01:15:28,710

the design reference mission which

1354

01:15:37,700 --> 01:15:33,570

helped President George W Bush who was

1355

01:15:40,520 --> 01:15:37,710

president now president in january 2004

1356

01:15:43,220 --> 01:15:40,530

to come in here in that auditorium up

1357

01:15:45,890 --> 01:15:43,230

front and proposed the constellation

1358

01:15:47,420 --> 01:15:45,900

program I remember that day was we were

1359

01:15:49,850 --> 01:15:47,430

all totally excited we over the whole

1360

01:15:52,070 --> 01:15:49,860

bunch of genuine astronauts sitting

1361

01:15:54,840 --> 01:15:52,080

there in their flight suits Gene Cernan

1362

01:15:57,810 --> 01:15:54,850

was air and and

1363

01:16:01,050 --> 01:15:57,820

President Bush went to him and that gene

1364

01:16:04,479 --> 01:16:01,060

you when you were on moon with Apollo 17

1365

01:16:06,940 --> 01:16:04,489

you were the last man on the moon and I

1366

01:16:09,430 --> 01:16:06,950

tell you you are not going to remain the

1367

01:16:12,850 --> 01:16:09,440

last man on the moon so he promised it

1368

01:16:16,270 --> 01:16:12,860

but there was no money attached to those

1369

01:16:22,420 --> 01:16:16,280

beautiful plans so we got constellation

1370

01:16:23,950 --> 01:16:22,430

which spawned a vase one and RS 5 the

1371

01:16:28,780 --> 01:16:23,960

outside would have been the heavy lifter

1372

01:16:31,540 --> 01:16:28,790

which we need desperately and they went

1373

01:16:36,340 --> 01:16:31,550

through this particular architectural

1374

01:16:39,970 --> 01:16:36,350

trade tree and when you see all those

1375

01:16:42,940 --> 01:16:39,980

red crosses that's where you know

1376

01:16:45,729 --> 01:16:42,950

developments were mixed were not used

1377

01:16:50,040 --> 01:16:45,739

but the light blue line is what finally

1378

01:16:52,150 --> 01:16:50,050

was settled on after going through 48

1379

01:16:55,660 --> 01:16:52,160

configurations at the bottom you see all

1380

01:16:59,979 --> 01:16:55,670

the different configurations which come

1381

01:17:02,320 --> 01:16:59,989

from combining the various options in

1382

01:17:04,479 --> 01:17:02,330

the various areas I can't read it from

1383

01:17:08,760 --> 01:17:04,489

here all the time but you see that

1384

01:17:13,060 --> 01:17:08,770

propulsion decisions were made and that

1385

01:17:16,000 --> 01:17:13,070

a pre deploy missions were selected

1386

01:17:19,420 --> 01:17:16,010

redeploy means you launch your unmanned

1387

01:17:21,220 --> 01:17:19,430

payload first and so finally they round

1388

01:17:25,540 --> 01:17:21,230

up with in light blue line which is

1389

01:17:28,750 --> 01:17:25,550

essentially what the dr a5 is all about

1390

01:17:31,420 --> 01:17:28,760

and probably hopefully remains this is

1391

01:17:34,600 --> 01:17:31,430

what the flight plan looked looks like

1392

01:17:38,650 --> 01:17:34,610

and hopefully will look like in a very

1393

01:17:44,410 --> 01:17:38,660

reasonable time frame departure on earth

1394

01:17:48,580 --> 01:17:44,420

in 20 35 for the cargo flight and

1395

01:17:53,140 --> 01:17:48,590

landing in twenty thirty six on Mars and

1396

01:17:56,380 --> 01:17:53,150

then the second flight with the people

1397

01:18:01,660 --> 01:17:56,390

on board launching in August twenty

1398

01:18:05,880 --> 01:18:01,670

thirty seven and returning in February

1399

01:18:08,020 --> 01:18:05,890

2038 so even today when you talk to

1400

01:18:10,750 --> 01:18:08,030

President Obama or

1401

01:18:12,940 --> 01:18:10,760

anyone they all say well I think by the

1402

01:18:17,200 --> 01:18:12,950

1930s we should be able to do it and

1403

01:18:19,510 --> 01:18:17,210

it's based on the idea idea i'm dr a 5

1404

01:18:23,650 --> 01:18:19,520

the architecture it's not m it's a

1405

01:18:25,390 --> 01:18:23,660

picture so let's cling to that let's

1406

01:18:32,860 --> 01:18:25,400

hope that we can make something out of

1407

01:18:36,250 --> 01:18:32,870

it the Russians i mentioned that are

1408

01:18:40,750 --> 01:18:36,260

working at the same time they are doing

1409

01:18:42,940 --> 01:18:40,760

their work in a very more visible way

1410

01:18:46,690 --> 01:18:42,950

they have a simulation program going on

1411

01:18:50,590 --> 01:18:46,700

called mass 500 which we visited some

1412

01:18:54,000 --> 01:18:50,600

time ago in Moscow it's one by IBM p

1413

01:18:57,100 --> 01:18:54,010

Institute of biomedical problems and

1414

01:18:59,890 --> 01:18:57,110

there are six crewmen members locked up

1415

01:19:03,060 --> 01:18:59,900

in a mass ship simulation with various

1416

01:19:06,600 --> 01:19:03,070

modules they landed on Mouse simulated

1417

01:19:09,250 --> 01:19:06,610

and actually exited into another module

1418

01:19:11,740 --> 01:19:09,260

which had a simulated mouth surface

1419

01:19:13,750 --> 01:19:11,750

leaded in spacesuits and they did

1420

01:19:15,640 --> 01:19:13,760

various things went back on board and

1421

01:19:18,970 --> 01:19:15,650

they are now on their flight back to

1422

01:19:21,760 --> 01:19:18,980

earth which takes 280 days or

1423

01:19:26,560 --> 01:19:21,770

thereabouts there are six guys are

1424

01:19:35,590 --> 01:19:26,570

locked up in there three Russians one

1425

01:19:38,890 --> 01:19:35,600

European one Chinese and yeah in South

1426

01:19:40,960 --> 01:19:38,900

China and for our sins so they are on

1427

01:19:43,270 --> 01:19:40,970

the return trip the mission will end

1428

01:19:46,810 --> 01:19:43,280

that means a land on Earth in November

1429

01:19:48,820 --> 01:19:46,820

2011 a few months from now and there may

1430

01:19:51,250 --> 01:19:48,830

be followers they've been talking to us

1431

01:19:53,710 --> 01:19:51,260

and we to them how can we use their

1432

01:19:57,280 --> 01:19:53,720

experience in locking up these people

1433

01:19:58,630 --> 01:19:57,290

for you know well over a year and they

1434

01:20:01,810 --> 01:19:58,640

are still alive apparently I haven't

1435

01:20:04,390 --> 01:20:01,820

killed each other yet I'm following that

1436

01:20:06,310 --> 01:20:04,400

every time a board they have every time

1437

01:20:11,800 --> 01:20:06,320

and I when I talk to these people they

1438

01:20:13,330 --> 01:20:11,810

are in good shape and the the

1439

01:20:15,940 --> 01:20:13,340

information being collected by the

1440

01:20:18,460 --> 01:20:15,950

doctors particularly and the nutrition

1441

01:20:20,080 --> 01:20:18,470

people and so on is tremendous we should

1442

01:20:24,129 --> 01:20:20,090

make use of that one day

1443

01:20:29,320 --> 01:20:24,139

you can get together in similar similar

1444

01:20:37,890 --> 01:20:29,330

things so we have now essentially this

1445

01:21:03,399 --> 01:20:59,950

course okay anyway you see there are two

1446

01:21:05,470 --> 01:21:03,409

other two ships and they are 26 months a

1447

01:21:07,510 --> 01:21:05,480

separate which is the Nordic period i

1448

01:21:11,379 --> 01:21:07,520

mentioned they land on Earth in their

1449

01:21:14,229 --> 01:21:11,389

comeback and the whole trip takes fifty

1450

01:21:15,760 --> 01:21:14,239

six months and it's very reasonable

1451

01:21:18,729 --> 01:21:15,770

there is nothing you can improve on it

1452

01:21:21,040 --> 01:21:18,739

basically it's the same approach from

1453

01:21:24,760 --> 01:21:21,050

brown used and we all used in the 60s

1454

01:21:26,260 --> 01:21:24,770

it's never changed in 60 years we just

1455

01:21:29,680 --> 01:21:26,270

you know fiddle around with propulsion

1456

01:21:32,160 --> 01:21:29,690

systems and have better life support

1457

01:21:36,220 --> 01:21:32,170

systems today we have a better grip on

1458

01:21:38,589 --> 01:21:36,230

reliabilities on safety of course so

1459

01:21:41,410 --> 01:21:38,599

masses have come down things don't have

1460

01:21:43,479 --> 01:21:41,420

to be so heavy with all what we have

1461

01:21:49,660 --> 01:21:43,489

learned but there are still a whole

1462

01:21:52,870 --> 01:21:49,670

bunch of unknown things which I've

1463

01:21:56,320 --> 01:21:52,880

pulled together here well this is you

1464

01:21:58,629 --> 01:21:56,330

know what the dr a5 kind of had in mind

1465

01:22:01,810 --> 01:21:58,639

a little bit it's on their report that

1466

01:22:04,229 --> 01:22:01,820

pictured title picture this essentially

1467

01:22:07,439 --> 01:22:04,239

what we still need to do what is

1468

01:22:10,300 --> 01:22:07,449

critical transportation and propulsion

1469

01:22:13,060 --> 01:22:10,310

local resource utilization cryogenic

1470

01:22:15,550 --> 01:22:13,070

liquid gas systems storage for example

1471

01:22:19,959 --> 01:22:15,560

long-term storage co ji handling and

1472

01:22:22,600 --> 01:22:19,969

transfer EV a systems which you protect

1473

01:22:25,359 --> 01:22:22,610

against dust a lot long-lasting

1474

01:22:27,280 --> 01:22:25,369

lightweight highly flexible space suits

1475

01:22:29,740 --> 01:22:27,290

and gloves lightweight and serviceable

1476
01:22:32,630 --> 01:22:29,750
EV a life-support system regenerative

1477
01:22:37,250 --> 01:22:32,640
life support systems hopefully closed

1478
01:22:39,950 --> 01:22:37,260
cycles for most of what we need surface

1479
01:22:41,510 --> 01:22:39,960
habitats and building techniques human

1480
01:22:43,670 --> 01:22:41,520
health and productivity co chodzi

1481
01:22:45,350 --> 01:22:43,680
adaptation and countermeasures human

1482
01:22:47,600 --> 01:22:45,360
factors health maintenance radiation

1483
01:22:50,870 --> 01:22:47,610
protection energy production and storage

1484
01:22:53,450 --> 01:22:50,880
with regenerative fuel sales in surface

1485
01:22:56,240 --> 01:22:53,460
nuclear power systems mouse is further

1486
01:22:59,180 --> 01:22:56,250
away from the Sun so we cannot really

1487
01:23:03,890 --> 01:22:59,190
Bank on solar electric power if you want

1488
01:23:06,650 --> 01:23:03,900

to run issue in situ resource

1489

01:23:11,120 --> 01:23:06,660

utilization machinery there we do need a

1490

01:23:13,970 --> 01:23:11,130

do clear energy source on them on on

1491

01:23:16,100 --> 01:23:13,980

Mars Taylor operation is hella robotics

1492

01:23:18,250 --> 01:23:16,110

remote control operations fine control

1493

01:23:21,380 --> 01:23:18,260

manipulator so I used operator training

1494

01:23:23,180 --> 01:23:21,390

with the large distance it takes like 20

1495

01:23:25,580 --> 01:23:23,190

minutes for a radio signal to come back

1496

01:23:27,860 --> 01:23:25,590

to earth and then we have to react and

1497

01:23:30,470 --> 01:23:27,870

send pic our commands takes another 20

1498

01:23:35,720 --> 01:23:30,480

minutes in their time you know they may

1499

01:23:38,090 --> 01:23:35,730

have already driven or somehow made a

1500

01:23:44,120 --> 01:23:38,100

mistake so people the crews have to be

1501

01:23:45,980 --> 01:23:44,130

much more independent much more sales on

1502

01:23:48,890 --> 01:23:45,990

the day and we can simulate that already

1503

01:23:51,440 --> 01:23:48,900

on the ISS for example by cutting down

1504

01:23:54,800 --> 01:23:51,450

on communications and by putting more

1505

01:23:56,630 --> 01:23:54,810

reliance more safe determination on crew

1506

01:23:58,580 --> 01:23:56,640

members so that they don't have to rely

1507

01:24:01,520 --> 01:23:58,590

on Mission Control centers all the time

1508

01:24:03,950 --> 01:24:01,530

with every little bit and our computers

1509

01:24:05,720 --> 01:24:03,960

so those are some typical things we can

1510

01:24:09,680 --> 01:24:05,730

already simulate and the space station

1511

01:24:12,910 --> 01:24:09,690

ISS lends itself in a tremendous way for

1512

01:24:15,950 --> 01:24:12,920

a lot of these things which need gog and

1513

01:24:17,750 --> 01:24:15,960

also the psychology behind it you know

1514

01:24:21,950 --> 01:24:17,760

of being locked up in space and doing

1515

01:24:24,470 --> 01:24:21,960

certain things planetary rovers motor

1516

01:24:27,590 --> 01:24:24,480

oil lubrication materials for a long

1517

01:24:29,420 --> 01:24:27,600

term use best control advanced

1518

01:24:31,340 --> 01:24:29,430

operational tasks automatic systems

1519

01:24:32,860 --> 01:24:31,350

control systems management and

1520

01:24:35,980 --> 01:24:32,870

scheduling and simulation and training

1521

01:24:39,230 --> 01:24:35,990

maybe better virtual realities in behave

1522

01:24:43,310 --> 01:24:39,240

so that is what where we need to do

1523

01:24:46,100 --> 01:24:43,320

where we have have to get working and so

1524

01:24:48,530 --> 01:24:46,110

if not much it's a flight area

1525

01:24:50,630 --> 01:24:48,540

the next few years this is really where

1526

01:24:52,220 --> 01:24:50,640

people put their brains and where they

1527

01:25:00,170 --> 01:24:52,230

are work behind the scenery and where

1528

01:25:02,960 --> 01:25:00,180

things will be continuing to go on this

1529

01:25:06,020 --> 01:25:02,970

is before I have a few words of

1530

01:25:10,250 --> 01:25:06,030

conclusion here sweet nice quotes from

1531

01:25:12,350 --> 01:25:10,260

visionaries no one can know what humans

1532

01:25:15,050 --> 01:25:12,360

will find when they land on Mars all

1533

01:25:17,720 --> 01:25:15,060

that can be said with certainty is this

1534

01:25:20,540 --> 01:25:17,730

the trip can be made and will be made

1535

01:25:27,170 --> 01:25:20,550

some day that's what burner from brown

1536

01:25:31,790 --> 01:25:27,180

said to in Colliers magazine 1954 in

1537

01:25:33,800 --> 01:25:31,800

april edition secondly the expedition to

1538

01:25:36,620 --> 01:25:33,810

Mars should be seen as a crowning

1539

01:25:38,720 --> 01:25:36,630

achievement of a stepwise and often

1540

01:25:41,120 --> 01:25:38,730

painfully slow development of human

1541

01:25:44,360 --> 01:25:41,130

space flight which may require many

1542

01:25:46,970 --> 01:25:44,370

decades Wernher von Braun 1956 in

1543

01:25:50,120 --> 01:25:46,980

Frankfurt in the polls Cathedral and

1544

01:25:54,380 --> 01:25:50,130

then at the bottom what seemed to be

1545

01:25:57,080 --> 01:25:54,390

unrealizable for centuries and yesterday

1546

01:25:59,500 --> 01:25:57,090

was daring dream now becomes a real

1547

01:26:02,420 --> 01:25:59,510

challenge but tomorrow an accomplishment

1548

01:26:07,280 --> 01:26:02,430

there are no barriers to human thought

1549

01:26:09,680 --> 01:26:07,290

sergey pavlovich korolyov 1966 Pravda so

1550

01:26:11,630 --> 01:26:09,690

I would fully support what they're

1551

01:26:15,230 --> 01:26:11,640

saying but particularly the painfully

1552

01:26:21,170 --> 01:26:15,240

slow thing is something which I think he

1553

01:26:24,140 --> 01:26:21,180

hit it right there in conclusion in the

1554

01:26:27,500 --> 01:26:24,150

u.s. today the air is five the errors

1555

01:26:30,470 --> 01:26:27,510

one may have bitten the dust but a

1556

01:26:33,380 --> 01:26:30,480

heavy-lift waiter named TBD is being

1557

01:26:35,580 --> 01:26:33,390

studied maybe we should call it TBD you

1558

01:26:41,350 --> 01:26:38,800

you know because the ISS ISS because

1559

01:26:44,830 --> 01:26:41,360

nobody could recruit kind of find a good

1560

01:26:47,170 --> 01:26:44,840

name for it anyway so a heavy lift

1561

01:26:50,590 --> 01:26:47,180

vehicle name TBD is being studied for

1562

01:26:54,220 --> 01:26:50,600

development Orion is still alive in the

1563

01:26:56,770 --> 01:26:54,230

form of the MPC V and NASA support that

1564

01:26:59,740 --> 01:26:56,780

cuts efforts are underway to provide a

1565

01:27:02,860 --> 01:26:59,750

crude launcher to take the place vacated

1566

01:27:05,980 --> 01:27:02,870

by Alice one besides the starboard so

1567

01:27:08,350 --> 01:27:05,990

use in looking back over 60 years of

1568

01:27:13,300 --> 01:27:08,360

manned Mars mission studies what can we

1569

01:27:17,140 --> 01:27:13,310

see the view shows first of all that by

1570

01:27:20,170 --> 01:27:17,150

necessity near-term oriented politics is

1571

01:27:23,830 --> 01:27:20,180

ill-suited for deciding on such a

1572

01:27:25,780 --> 01:27:23,840

farsighted complex of questions but

1573

01:27:28,600 --> 01:27:25,790

visionary political leaders are

1574

01:27:33,790 --> 01:27:28,610

necessary and will again raise our

1575

01:27:37,660 --> 01:27:33,800

sights to more distant vistas the demise

1576

01:27:39,820 --> 01:27:37,670

of sei and constellation has not removed

1577

01:27:44,170 --> 01:27:39,830

Mars from NASA's field of view

1578

01:27:47,470 --> 01:27:44,180

especially that of its advanced planners

1579

01:27:50,350 --> 01:27:47,480

who on the one hand see NASA's

1580

01:27:52,630 --> 01:27:50,360

undisputed leadership and impetus giving

1581

01:27:55,870 --> 01:27:52,640

role in space science and space

1582

01:27:59,320 --> 01:27:55,880

exploration as a moral obligation to

1583

01:28:02,380 --> 01:27:59,330

future human generations and who on the

1584

01:28:05,170 --> 01:28:02,390

other hand realize how crucial for us

1585

01:28:08,850 --> 01:28:05,180

economy and strengths in aerospace and

1586

01:28:11,620 --> 01:28:08,860

other key industries it is to force

1587

01:28:14,370 --> 01:28:11,630

technological advances which in turn

1588

01:28:16,360 --> 01:28:14,380

provide new development momentum

1589

01:28:19,270 --> 01:28:16,370

multinational participation is

1590

01:28:22,090 --> 01:28:19,280

increasingly desirable not just for

1591

01:28:24,430 --> 01:28:22,100

economic reasons but more importantly

1592

01:28:27,670 --> 01:28:24,440

for raising levels of mutual

1593

01:28:31,030 --> 01:28:27,680

understanding tolerance and fearless in

1594

01:28:35,230 --> 01:28:31,040

the dependencies this calls for a common

1595

01:28:38,320 --> 01:28:35,240

cause on neutral uncontested grounds and

1596

01:28:42,370 --> 01:28:38,330

space is probably the only subscales we

1597

01:28:44,890 --> 01:28:42,380

have neutral and uncontested the ISS a

1598

01:28:48,160 --> 01:28:44,900

shining demonstration of a common cause

1599

01:28:50,729 --> 01:28:48,170

has already brought 60 nations peace

1600

01:28:54,010 --> 01:28:50,739

surely together over the past 11 years

1601
01:28:56,860 --> 01:28:54,020
now we will need a new and bigger common

1602
01:29:00,700 --> 01:28:56,870
cause with its aura with its sources and

1603
01:29:04,290 --> 01:29:00,710
man math provides it the reasons why

1604
01:29:08,740 --> 01:29:04,300
mayn't Mars are pretty straightforward

1605
01:29:10,780 --> 01:29:08,750
looking first of all looking for signs

1606
01:29:14,560 --> 01:29:10,790
of former or present day life on a

1607
01:29:16,780 --> 01:29:14,570
planet other than Earth second studying

1608
01:29:19,510 --> 01:29:16,790
Mars and its natural processes in

1609
01:29:21,580 --> 01:29:19,520
history to become smarter about our own

1610
01:29:25,209 --> 01:29:21,590
earth it's called comparative

1611
01:29:27,790 --> 01:29:25,219
planetology thirdly establishing a

1612
01:29:31,959 --> 01:29:27,800
foothold for humans to eventually live

1613
01:29:34,689 --> 01:29:31,969

on Mars force providing us with a new

1614

01:29:37,240 --> 01:29:34,699

source of economic returns and technol

1615

01:29:41,070 --> 01:29:37,250

scientific knowledge similar to the

1616

01:29:43,780 --> 01:29:41,080

Apollo program and five last not least

1617

01:29:46,689 --> 01:29:43,790

using the challenge of this unique

1618

01:29:50,650 --> 01:29:46,699

neighborly word as a common cause for

1619

01:29:52,840 --> 01:29:50,660

Earth's people to tackle together when

1620

01:29:55,630 --> 01:29:52,850

we'll be ready for project humans to

1621

01:30:03,580 --> 01:29:55,640

Mars in addition to the social political

1622

01:30:05,860 --> 01:30:03,590

and financial readiness it will require

1623

01:30:07,720 --> 01:30:05,870

the development of specific technologies

1624

01:30:10,450 --> 01:30:07,730

which have indicated they are such as

1625

01:30:12,370 --> 01:30:10,460

aerobraking cayo genic fuel stores and

1626
01:30:15,040 --> 01:30:12,380
equipment nuclear thermal and nuclear

1627
01:30:17,320 --> 01:30:15,050
electric propulsion systems photovoltaic

1628
01:30:20,140 --> 01:30:17,330
and nuclear energy sources for the base

1629
01:30:22,660 --> 01:30:20,150
operation closed-cycle life-support

1630
01:30:25,540 --> 01:30:22,670
systems automatic information systems

1631
01:30:28,600 --> 01:30:25,550
scientific instruments EV a systems

1632
01:30:31,570 --> 01:30:28,610
surface rovers and much more not in the

1633
01:30:35,620 --> 01:30:31,580
least it also requires substantial work

1634
01:30:37,780 --> 01:30:35,630
on and in the present day ISS which has

1635
01:30:40,180 --> 01:30:37,790
evolved from relatively modest

1636
01:30:42,310 --> 01:30:40,190
beginnings to a powerful and

1637
01:30:46,330 --> 01:30:42,320
sophisticated international world class

1638
01:30:49,450 --> 01:30:46,340

research facility all in all to be able

1639

01:30:52,000 --> 01:30:49,460

to conduct the mouse expedition in all

1640

01:30:54,850 --> 01:30:52,010

its phases with a high degree of mission

1641

01:30:57,370 --> 01:30:54,860

success probability a technological

1642

01:31:00,240 --> 01:30:57,380

capacity will be required which today is

1643

01:31:03,150 --> 01:31:00,250

still far from accessible to us

1644

01:31:05,840 --> 01:31:03,160

but its mastery will open incredibly new

1645

01:31:08,750 --> 01:31:05,850

possibilities for tomorrow's humankind

1646

01:31:11,910 --> 01:31:08,760

it's a most fundamental human level

1647

01:31:15,030 --> 01:31:11,920

those 60 years are telling me are

1648

01:31:16,700 --> 01:31:15,040

telling us here at NASA if you are in

1649

01:31:34,590 --> 01:31:16,710

the business of getting people to Mars

1650

01:31:36,300 --> 01:31:34,600

never give up thank you yeah I have to

1651
01:31:45,540 --> 01:31:36,310
be glad to take questions I can answer

1652
01:32:02,800 --> 01:31:45,550
of course anyone did I say anyone

1653
01:32:02,810 --> 01:32:15,400
new address

1654
01:32:22,310 --> 01:32:19,220
yeah I did still an open issue a final

1655
01:32:25,340 --> 01:32:22,320
word has not been said yet it takes it

1656
01:32:28,880 --> 01:32:25,350
takes experiment experimentation in situ

1657
01:32:30,830 --> 01:32:28,890
in space in co ji a lot you know they

1658
01:32:34,460 --> 01:32:30,840
are talks about actually putting a

1659
01:32:36,650 --> 01:32:34,470
centrifuge on the ISS eventually I think

1660
01:32:41,960 --> 01:32:36,660
this will be pursued I know it's going

1661
01:32:44,990 --> 01:32:41,970
on and you either are able to get away

1662
01:32:49,270 --> 01:32:45,000
with living in weightlessness all the

1663
01:32:51,800 --> 01:32:49,280

time by doing your proper exercise our

1664

01:32:54,320 --> 01:32:51,810

space station crew has to exercise two

1665

01:32:57,410 --> 01:32:54,330

hours a day which is pretty boring and

1666

01:32:58,760 --> 01:32:57,420

they just not have to you know sit on

1667

01:33:01,280 --> 01:32:58,770

one machine they have to use several

1668

01:33:02,780 --> 01:33:01,290

machines in order to get aerobics and an

1669

01:33:05,570 --> 01:33:02,790

aerobics and so on it's pretty

1670

01:33:07,390 --> 01:33:05,580

sophisticated and they have stayed up

1671

01:33:10,970 --> 01:33:07,400

there for many months without any

1672

01:33:13,820 --> 01:33:10,980

detrimental results so it works and one

1673

01:33:15,380 --> 01:33:13,830

guy won a Russian Polyakov doctor polio

1674

01:33:18,260 --> 01:33:15,390

coffee estates there for the duration of

1675

01:33:21,260 --> 01:33:18,270

a mouse slide in beer in came back and

1676

01:33:23,660 --> 01:33:21,270

still jumping around you know so I think

1677

01:33:38,939 --> 01:33:23,670

that basically you may not need it but

1678

01:33:44,939 --> 01:33:42,520

that was a mistake I you know it's a

1679

01:33:47,919 --> 01:33:44,949

typically now so you know in a naive way

1680

01:33:49,870 --> 01:33:47,929

the the guys there the ACI guy said hey

1681

01:33:51,939 --> 01:33:49,880

Gaza tell us how much it's going to cost

1682

01:33:54,339 --> 01:33:51,949

and so now sup you know being good

1683

01:33:58,660 --> 01:33:54,349

soldiers came up and said always worried

1684

01:34:01,810 --> 01:33:58,670

about 400 to 500 billion you know sure I

1685

01:34:03,790 --> 01:34:01,820

mean this you know you could have found

1686

01:34:05,680 --> 01:34:03,800

to find a different way so it would have

1687

01:34:09,310 --> 01:34:05,690

caused it but so what I mean over 30

1688

01:34:11,229 --> 01:34:09,320

years and you should include also the

1689

01:34:13,209 --> 01:34:11,239

returns in the meantime is also the

1690

01:34:16,000 --> 01:34:13,219

years you do get returns back so it's

1691

01:34:17,879 --> 01:34:16,010

not a closed expenditure thing where you

1692

01:34:21,100 --> 01:34:17,889

pull out 400 million and give it away

1693

01:34:23,709 --> 01:34:21,110

its investments you know with paychecks

1694

01:34:26,549 --> 01:34:23,719

and and so on so it's not sewing money

1695

01:34:30,850 --> 01:34:26,559

out into space but those decision-makers

1696

01:34:34,479 --> 01:34:30,860

here in Washington kind of floored by it

1697

01:34:39,430 --> 01:34:34,489

and NASA always makes the same mistakes

1698

01:34:42,819 --> 01:34:39,440

of not properly telling you know what

1699

01:34:44,589 --> 01:34:42,829

what's what and and we are very bad in

1700

01:34:47,200 --> 01:34:44,599

that area we may be great scientists and

1701

01:34:49,600 --> 01:34:47,210

engineers and in program managers but

1702

01:34:53,470 --> 01:34:49,610

somehow we cannot properly explain what

1703

01:34:55,209 --> 01:34:53,480

it is all about who would I mean who in

1704

01:34:58,029 --> 01:34:55,219

NASA would they are talking about common

1705

01:35:00,700 --> 01:34:58,039

cause with Russia it hope but I think

1706

01:35:02,979 --> 01:35:00,710

it's something or China sums up these

1707

01:35:05,919 --> 01:35:02,989

things need to be now faced upfront

1708

01:35:08,850 --> 01:35:05,929

otherwise we won't go anywhere in my

1709

01:35:13,120 --> 01:35:08,860

opinion so now that should in my opinion

1710

01:35:16,540 --> 01:35:13,130

learn from those past naive mistakes

1711

01:35:20,620 --> 01:35:16,550

where you know we try to you know kind

1712

01:35:22,450 --> 01:35:20,630

of be nice and and go back and iterate

1713

01:35:26,259 --> 01:35:22,460

so started all the way back down to what

1714

01:35:27,970 --> 01:35:26,269

it is now we wait were times when we

1715

01:35:30,040 --> 01:35:27,980

probably could have stemmed our foot and

1716

01:35:31,359 --> 01:35:30,050

said hey wait a minute if you cut us

1717

01:35:33,189 --> 01:35:31,369

even more with the shuttle we are

1718

01:35:35,740 --> 01:35:33,199

getting into dangerous areas of but we

1719

01:35:37,720 --> 01:35:35,750

never did you know we got through the

1720

01:35:41,319 --> 01:35:37,730

solid boosters because they looked

1721

01:35:45,040 --> 01:35:41,329

cheaper at that time and did away with

1722

01:35:47,439 --> 01:35:45,050

most of the reusability so away you know

1723

01:35:49,209 --> 01:35:47,449

the tanks and so on the tank was

1724

01:35:51,480 --> 01:35:49,219

supposed to be cheap but it turned out

1725

01:35:54,100 --> 01:35:51,490

to be about two billion or so Appy

1726

01:35:59,600 --> 01:35:54,110

later on so all of those nice

1727

01:36:38,990 --> 01:35:59,610

predictions wherever just pie in the sky

1728

01:36:43,790 --> 01:36:41,630

back in the 50s when he did that that

1729

01:36:48,020 --> 01:36:43,800

giant study know that he didn't attach

1730

01:36:50,570 --> 01:36:48,030

any years to that he went out and made a

1731

01:36:53,020 --> 01:36:50,580

cost estimate I mean this was all mr.

1732

01:36:56,930 --> 01:36:53,030

technology he used for a Mars expedition

1733

01:36:59,990 --> 01:36:56,940

imagine v2 engines 12 of them in each

1734

01:37:01,880 --> 01:37:00,000

that boosts into Mars there was no way

1735

01:37:03,800 --> 01:37:01,890

he reasonably could have put any dollars

1736

01:37:07,870 --> 01:37:03,810

to it but he said it's gonna cost about

1737

01:37:10,730 --> 01:37:07,880

10 billion airlifts you know that most

1738

01:37:13,220 --> 01:37:10,740

something people understood so he went

1739

01:37:14,990 --> 01:37:13,230

and said hey guys it may sound a lot but

1740

01:37:17,270 --> 01:37:15,000

look I'll give you ten ships you know

1741

01:37:19,910 --> 01:37:17,280

it's a your expedition it's earth it's

1742

01:37:35,670 --> 01:37:19,920

mankind doing it and it's going to cost

1743

01:37:35,680 --> 01:37:45,870

oh yeah

1744

01:37:53,890 --> 01:37:51,400

exactly exactly I think I think even

1745

01:37:55,930 --> 01:37:53,900

even Reagan realized pretty late then

1746

01:37:57,340 --> 01:37:55,940

that the SDI didn't go anywhere and all

1747

01:37:59,410 --> 01:37:57,350

the scientists told him hey it's not

1748

01:38:01,420 --> 01:37:59,420

going to work better stations in orbit

1749

01:38:03,340 --> 01:38:01,430

and the Russians were already doing

1750

01:38:08,620 --> 01:38:03,350

their own better station development so

1751

01:38:13,540 --> 01:38:08,630

this was a totally insane idea which was

1752

01:38:15,760 --> 01:38:13,550

kind of typically Hollywood yeah and so

1753

01:38:18,580 --> 01:38:15,770

what Bush who was the vice president at

1754

01:38:20,020 --> 01:38:18,590

a time when he became president he was

1755

01:38:23,080 --> 01:38:20,030

pretty smart I don't know who came up

1756

01:38:25,230 --> 01:38:23,090

with earlier but he said okay that's

1757

01:38:28,240 --> 01:38:25,240

great we got all these industries now

1758

01:38:30,720 --> 01:38:28,250

fired up worked for everything is

1759

01:38:33,790 --> 01:38:30,730

everyone is doing STI why don't we just

1760

01:38:37,810 --> 01:38:33,800

slightly shift it and make a CI out of

1761

01:38:40,600 --> 01:38:37,820

it lost much Martin it's so silly that

1762

01:38:44,050 --> 01:38:40,610

this whole is se I went away it was such

1763

01:38:49,180 --> 01:38:44,060

a great idea and this 400 to 500 billion

1764

01:38:50,590 --> 01:38:49,190

killed it that the costing thing but

1765

01:38:52,750 --> 01:38:50,600

it's essentially what will be done

1766

01:38:55,390 --> 01:38:52,760

anyway the same with the integrated

1767

01:38:57,340 --> 01:38:55,400

program plan instead of doing things in

1768

01:38:59,890 --> 01:38:57,350

parallel like Miller and from brown

1769

01:39:01,720 --> 01:38:59,900

bonded because of commonality we are

1770

01:39:03,610 --> 01:39:01,730

doing the same things but in secret in

1771

01:39:04,840 --> 01:39:03,620

sequence one after the other we're

1772

01:39:06,730 --> 01:39:04,850

building a shout later we're building

1773

01:39:09,190 --> 01:39:06,740

space station and doing one after the

1774

01:39:10,390 --> 01:39:09,200

other which of course means every time

1775

01:39:12,670 --> 01:39:10,400

we hope to have to go back to our

1776

01:39:18,730 --> 01:39:12,680

drawing boards and start all over again

1777

01:39:21,719 --> 01:39:18,740

instead of having commonality you had no

1778

01:39:36,310 --> 01:39:30,790

ok anywhere any other questions dan but

1779

01:39:42,360 --> 01:39:36,320

you're Chris I need that guy from my