
NASA

1
00:00:04,870 --> 00:00:03,270
right our third speaker is eric conway

2
00:00:07,190 --> 00:00:04,880
who's a historian at the jet propulsion

3
00:00:08,790 --> 00:00:07,200
laboratory eric is the author of several

4
00:00:10,709 --> 00:00:08,800
books in the history of space technology

5
00:00:12,230 --> 00:00:10,719
and aeronautical engineering

6
00:00:14,629 --> 00:00:12,240
including the techno-politics of

7
00:00:16,550 --> 00:00:14,639
supersonic transportation atmospheric

8
00:00:19,029 --> 00:00:16,560
science at nasa and a book on blind

9
00:00:21,109 --> 00:00:19,039
landings among other last year eric won

10
00:00:22,550 --> 00:00:21,119
the davis prize from the society for the

11
00:00:24,550 --> 00:00:22,560
history of science

12
00:00:26,150 --> 00:00:24,560
for extraordinary writing for the public

13
00:00:27,349 --> 00:00:26,160

domain but i should also note that his

14
00:00:28,870 --> 00:00:27,359
work in the history of science and

15
00:00:30,230 --> 00:00:28,880
technology and in the history of space

16
00:00:32,069 --> 00:00:30,240
exploration has been both foundational

17
00:00:33,990 --> 00:00:32,079
and extremely influential

18
00:00:35,750 --> 00:00:34,000
so eric is currently working on a

19
00:00:37,830 --> 00:00:35,760
history of mars exploration since the

20
00:00:42,549 --> 00:00:37,840
1970s and he'll be speaking to us today

21
00:00:45,990 --> 00:00:43,990
first i have to thank the previous

22
00:00:48,470 --> 00:00:46,000
speakers today you've made my problem of

23
00:00:49,910 --> 00:00:48,480
getting through this talk on time much

24
00:00:51,910 --> 00:00:49,920
easier because i don't have to cover

25
00:00:53,670 --> 00:00:51,920
some programmatic stuff that's essential

26
00:00:57,029 --> 00:00:53,680
to the story i actually want to tell

27
00:00:59,189 --> 00:00:57,039
which is about really engineering for

28
00:01:01,110 --> 00:00:59,199
mars sample return

29
00:01:03,029 --> 00:01:01,120
now you've also heard this mentioned

30
00:01:05,750 --> 00:01:03,039
many times this is the mars science

31
00:01:07,590 --> 00:01:05,760
laboratory curiosity landing what story

32
00:01:09,990 --> 00:01:07,600
you probably don't know is that this

33
00:01:13,190 --> 00:01:10,000
architecture was the loser of a sample

34
00:01:15,429 --> 00:01:13,200
return study done in 2000 around jpl and

35
00:01:18,230 --> 00:01:15,439
then won again a few years later and

36
00:01:20,070 --> 00:01:18,240
that's the story i want to tell

37
00:01:21,429 --> 00:01:20,080
there are samples of mars on earth most

38
00:01:23,350 --> 00:01:21,439

audiences i give this talk to don't

39
00:01:24,789 --> 00:01:23,360
realize that we have these meteorites

40
00:01:27,270 --> 00:01:24,799
that were collected from antarctica this

41
00:01:28,870 --> 00:01:27,280
is the famous one from 1996 that was

42
00:01:30,789 --> 00:01:28,880
supposed to have been found to have

43
00:01:32,870 --> 00:01:30,799
signatures of life on it the reason i

44
00:01:34,630 --> 00:01:32,880
bring it up is to get across the idea

45
00:01:36,789 --> 00:01:34,640
that what scientists want is not just

46
00:01:39,429 --> 00:01:36,799
any old sample of mars what they want is

47
00:01:40,469 --> 00:01:39,439
to pick them and that's important

48
00:01:41,830 --> 00:01:40,479
because

49
00:01:43,590 --> 00:01:41,840
you heard from rich zurich how

50
00:01:45,590 --> 00:01:43,600
frustrating the viking missions were to

51
00:01:47,270 --> 00:01:45,600
some scientists because they could see

52
00:01:49,590 --> 00:01:47,280
some wonderful rocks that they wanted to

53
00:01:51,990 --> 00:01:49,600
reach out and grab and test and couldn't

54
00:01:54,230 --> 00:01:52,000
they couldn't get to them so when this

55
00:01:56,069 --> 00:01:54,240
strategy for exploration of the inner

56
00:01:58,950 --> 00:01:56,079
planets is published by the complex

57
00:02:01,109 --> 00:01:58,960
committee in 1978 it's

58
00:02:04,149 --> 00:02:01,119
contains a discussion of mars sample

59
00:02:06,069 --> 00:02:04,159
return that favors doing it with some

60
00:02:07,910 --> 00:02:06,079
sort of rover either a short range rover

61
00:02:09,109 --> 00:02:07,920
that could go maybe only a few meters

62
00:02:10,630 --> 00:02:09,119
but what they make clear is what they

63
00:02:13,430 --> 00:02:10,640

really wanted was a long range one that

64
00:02:14,949 --> 00:02:13,440
might cover hundreds of kilometers

65
00:02:16,630 --> 00:02:14,959
now the threads of my story are design

66
00:02:18,229 --> 00:02:16,640
and engineering in support of science

67
00:02:20,470 --> 00:02:18,239
there's a second thread of competition

68
00:02:22,070 --> 00:02:20,480
for funds i'll get to at the end and

69
00:02:23,510 --> 00:02:22,080
ultimately i want to leave you with the

70
00:02:25,750 --> 00:02:23,520
thought that you've already heard today

71
00:02:27,830 --> 00:02:25,760
that nasa has this dual self-image

72
00:02:30,630 --> 00:02:27,840
sometimes i call it schizophrenia as a

73
00:02:32,869 --> 00:02:30,640
scientific agency and also the agency

74
00:02:35,110 --> 00:02:32,879
that's an agent of human expansion into

75
00:02:36,869 --> 00:02:35,120
the solar system

76
00:02:38,949 --> 00:02:36,879
now that complex study led to a set of

77
00:02:41,030 --> 00:02:38,959
studies at jpl that i'm not going to

78
00:02:43,030 --> 00:02:41,040
talk about i had there are actually four

79
00:02:44,550 --> 00:02:43,040
separate sets of sample return studies

80
00:02:46,390 --> 00:02:44,560
major ones anyways that i talk about in

81
00:02:47,589 --> 00:02:46,400
the full length of this paper i can't do

82
00:02:49,830 --> 00:02:47,599
them all in 20 minutes so i'm going to

83
00:02:51,990 --> 00:02:49,840
do two i'm going to skip merrily over

84
00:02:53,509 --> 00:02:52,000
this period of time and get on to the

85
00:02:55,350 --> 00:02:53,519
second act

86
00:02:58,630 --> 00:02:55,360
of the simple return in the faster

87
00:03:00,070 --> 00:02:58,640
better cheaper era during the 1990s

88
00:03:01,910 --> 00:03:00,080

one of the other speakers already

89
00:03:04,710 --> 00:03:01,920
introduced one of my favorite poster

90
00:03:06,309 --> 00:03:04,720
boys the mars observer mission um this

91
00:03:07,910 --> 00:03:06,319
has become legendary in the planetary

92
00:03:09,830 --> 00:03:07,920
science community for being over cost

93
00:03:11,350 --> 00:03:09,840
and then not returning anything uh one

94
00:03:13,509 --> 00:03:11,360
corrective to a previous speaker is that

95
00:03:15,350 --> 00:03:13,519
the primary overrun came from the launch

96
00:03:16,869 --> 00:03:15,360
delay of 26 months not from the

97
00:03:19,030 --> 00:03:16,879
instruments they were the second largest

98
00:03:21,190 --> 00:03:19,040
piece of the overrun either way we got

99
00:03:22,869 --> 00:03:21,200
nothing essentially out of this except

100
00:03:24,550 --> 00:03:22,879
the value of the systems engineering

101
00:03:27,509 --> 00:03:24,560
which contributed to a number of

102
00:03:29,990 --> 00:03:27,519
missions later on um once dan golden and

103
00:03:32,149 --> 00:03:30,000
west huntress have reformulated the idea

104
00:03:35,670 --> 00:03:32,159
of a faster better cheaper and then b

105
00:03:37,350 --> 00:03:35,680
the idea of a mars program

106
00:03:40,149 --> 00:03:37,360
um this is the mars program that came

107
00:03:41,350 --> 00:03:40,159
out of their work in the early 1990s and

108
00:03:43,910 --> 00:03:41,360
i show this

109
00:03:46,630 --> 00:03:43,920
because sample return over here oh this

110
00:03:48,869 --> 00:03:46,640
is very weak unfortunately appears

111
00:03:50,630 --> 00:03:48,879
the idea of the surveyor program it was

112
00:03:52,949 --> 00:03:50,640
called is there would be an orbiter and

113
00:03:55,509 --> 00:03:52,959

land two missions sent every 26 months

114
00:03:57,589 --> 00:03:55,519
every launch period to mars the first

115
00:03:59,350 --> 00:03:57,599
pair would be an orbiter and a lander

116
00:04:03,350 --> 00:03:59,360
the second pair again an orbiter and a

117
00:04:04,710 --> 00:04:03,360
lander going in 2001 and then in 2003

118
00:04:06,949 --> 00:04:04,720
you would get the beginning of the

119
00:04:08,949 --> 00:04:06,959
sample return campaign

120
00:04:10,949 --> 00:04:08,959
this was challenging technologically

121
00:04:13,110 --> 00:04:10,959
because the missions were supposed to be

122
00:04:14,949 --> 00:04:13,120
implemented by contract they were also

123
00:04:17,030 --> 00:04:14,959
supposed to be competed except for

124
00:04:19,430 --> 00:04:17,040
sample return which meant they didn't

125
00:04:21,110 --> 00:04:19,440
lead up to a technologically coherent

126
00:04:23,110 --> 00:04:21,120
mission set in other words they didn't

127
00:04:24,710 --> 00:04:23,120
build towards sample return from the

128
00:04:28,870 --> 00:04:24,720
standpoint of the engineers that had to

129
00:04:31,830 --> 00:04:30,150
there we go

130
00:04:33,189 --> 00:04:31,840
at the same time outside the mars

131
00:04:34,550 --> 00:04:33,199
program this of course is mars

132
00:04:36,390 --> 00:04:34,560
pathfinder which was done under the

133
00:04:37,990 --> 00:04:36,400
discovery program

134
00:04:40,710 --> 00:04:38,000
was set up to

135
00:04:41,990 --> 00:04:40,720
demonstrate low-cost mars landings uh

136
00:04:44,310 --> 00:04:42,000
this is a famous picture of the

137
00:04:46,550 --> 00:04:44,320
sojourner rover starting to deliver the

138
00:04:48,790 --> 00:04:46,560

technical promise of of the ability to

139
00:04:50,790 --> 00:04:48,800
reach out and get samples from distant

140
00:04:52,790 --> 00:04:50,800
areas the mars pathfinder mission of

141
00:04:55,189 --> 00:04:52,800
course was enormously popular with the

142
00:04:57,670 --> 00:04:55,199
general public so it validated the idea

143
00:04:59,909 --> 00:04:57,680
of having a mars program

144
00:05:02,230 --> 00:04:59,919
it also validated the idea faster better

145
00:05:04,790 --> 00:05:02,240
cheaper the lander cost about 150

146
00:05:06,790 --> 00:05:04,800
million dollars the project overall 310

147
00:05:11,590 --> 00:05:06,800
million dollars which is about one tenth

148
00:05:13,029 --> 00:05:11,600
of what the nation spent on viking

149
00:05:15,189 --> 00:05:13,039
it was supposed to be followed by this

150
00:05:17,350 --> 00:05:15,199
mission the mars polar lander

151
00:05:18,550 --> 00:05:17,360
jpl selected as its contract partner

152
00:05:20,230 --> 00:05:18,560
lockheed

153
00:05:23,110 --> 00:05:20,240
the polar lander was to be of their

154
00:05:25,110 --> 00:05:23,120
design this was a pulsed jet lander not

155
00:05:27,430 --> 00:05:25,120
a throttle liquid the way viking had

156
00:05:30,870 --> 00:05:27,440
been done the idea was to land near the

157
00:05:31,909 --> 00:05:30,880
martian north pole take samples and test

158
00:05:34,390 --> 00:05:31,919
of

159
00:05:37,189 --> 00:05:34,400
more polar but not necessarily on ice

160
00:05:39,430 --> 00:05:37,199
samples this mission was implemented the

161
00:05:41,430 --> 00:05:39,440
contract value for this project was 120

162
00:05:44,310 --> 00:05:41,440
million dollars the project budget

163
00:05:45,990 --> 00:05:44,320

overall was a bit over 250 million so

164
00:05:47,510 --> 00:05:46,000
nasa was asking jpl to deliver two

165
00:05:49,990 --> 00:05:47,520
spacecraft for

166
00:05:52,790 --> 00:05:50,000
less than it spent on one in mars

167
00:05:54,390 --> 00:05:52,800
pathfinder

168
00:05:56,309 --> 00:05:54,400
and the sample return architecture was

169
00:05:57,990 --> 00:05:56,319
then based to be based on the lockheed

170
00:05:59,830 --> 00:05:58,000
lander

171
00:06:02,469 --> 00:05:59,840
the sample return architecture was it

172
00:06:04,710 --> 00:06:02,479
was a three-way effort of jpl

173
00:06:07,430 --> 00:06:04,720
lockheed in denver really and the french

174
00:06:10,230 --> 00:06:07,440
space agency canes was to start off in

175
00:06:11,909 --> 00:06:10,240
2003 with either a delta or atlas launch

176
00:06:12,950 --> 00:06:11,919
putting up the lockheed lander with a

177
00:06:14,550 --> 00:06:12,960
small

178
00:06:16,870 --> 00:06:14,560
sojourner derived but larger than

179
00:06:19,189 --> 00:06:16,880
sojourn or more of an athena sized rover

180
00:06:21,270 --> 00:06:19,199
of around 120 kilograms that would go

181
00:06:22,870 --> 00:06:21,280
out and collect samples and then shoot

182
00:06:24,150 --> 00:06:22,880
them off into space you can barely see

183
00:06:27,749 --> 00:06:24,160
it you'll see this better on the next

184
00:06:30,629 --> 00:06:27,759
diagram and into low mars orbit in 2005

185
00:06:32,710 --> 00:06:30,639
an arianny 5 with two more spacecraft

186
00:06:35,590 --> 00:06:32,720
another lander and a french-built

187
00:06:37,670 --> 00:06:35,600
orbiter would be sent to mars as well

188
00:06:40,390 --> 00:06:37,680

collect samples shoot them into orbit

189
00:06:42,950 --> 00:06:40,400
and then the orbiter would collect them

190
00:06:46,550 --> 00:06:42,960
and send them back to earth via an earth

191
00:06:51,350 --> 00:06:48,870
this is the scaled up lockheed sample

192
00:06:52,870 --> 00:06:51,360
return lander i pulled this out of a

193
00:06:54,550 --> 00:06:52,880
presentation by ed euler who is the

194
00:06:55,990 --> 00:06:54,560
lockheed program manager for it

195
00:06:56,950 --> 00:06:56,000
presented at one of the a double a

196
00:06:58,710 --> 00:06:56,960
meetings

197
00:07:00,710 --> 00:06:58,720
back in 2000

198
00:07:02,469 --> 00:07:00,720
excuse me in 99 this is the landing

199
00:07:04,070 --> 00:07:02,479
configuration you can see the mars

200
00:07:07,110 --> 00:07:04,080
ascent vehicle that's to shoot it into

201
00:07:10,230 --> 00:07:07,120
orbit here the rover and the platform is

202
00:07:11,430 --> 00:07:10,240
supposed to come down uh drill envelope

203
00:07:13,270 --> 00:07:11,440
for

204
00:07:14,710 --> 00:07:13,280
in case the rover didn't work or failed

205
00:07:16,150 --> 00:07:14,720
before coming back to the lander it had

206
00:07:19,110 --> 00:07:16,160
the ability to just grab a sample from

207
00:07:22,950 --> 00:07:19,120
where it landed and send that back

208
00:07:25,029 --> 00:07:22,960
as a technical problem this lander was

209
00:07:27,270 --> 00:07:25,039
substantial because it had to be scaled

210
00:07:29,189 --> 00:07:27,280
up considerably the polar lander was

211
00:07:30,870 --> 00:07:29,199
supposed to have a mass of about 290

212
00:07:32,950 --> 00:07:30,880
kilograms this thing had to be a bit

213
00:07:35,270 --> 00:07:32,960

about bit over a thousand

214
00:07:37,270 --> 00:07:35,280
anytime you scale up a piece of hardware

215
00:07:40,150 --> 00:07:37,280
to that degree you have to do a lot of

216
00:07:42,070 --> 00:07:40,160
redesign work and it as this project is

217
00:07:44,710 --> 00:07:42,080
set up at jpl the engineers begin to

218
00:07:46,950 --> 00:07:44,720
realize that they have they have

219
00:07:48,790 --> 00:07:46,960
technical issues with these legs because

220
00:07:51,589 --> 00:07:48,800
they're a bit fragile because the launch

221
00:07:53,749 --> 00:07:51,599
vehicle shrouds would not allow a long

222
00:07:55,510 --> 00:07:53,759
enough leg to give any substantial

223
00:07:56,629 --> 00:07:55,520
ground clearance so then you have the

224
00:07:58,230 --> 00:07:56,639
problem with well they're going to flex

225
00:08:00,230 --> 00:07:58,240
during impact when it hits the surface

226
00:08:01,670 --> 00:08:00,240
how much space can we have for that

227
00:08:03,350 --> 00:08:01,680
they ran into troubles with the load

228
00:08:05,510 --> 00:08:03,360
pass that would carry this down to the

229
00:08:08,150 --> 00:08:05,520
launch vehicle and so on and they began

230
00:08:10,790 --> 00:08:08,160
to question whether this design was

231
00:08:11,990 --> 00:08:10,800
actually sound they also began to

232
00:08:14,070 --> 00:08:12,000
question whether they're really going to

233
00:08:15,909 --> 00:08:14,080
have enough money under the 200 million

234
00:08:18,469 --> 00:08:15,919
a year budget that that this the

235
00:08:20,230 --> 00:08:18,479
surveyor project could give them

236
00:08:22,309 --> 00:08:20,240
but it's not in the end the money that

237
00:08:24,390 --> 00:08:22,319
gets them into deep trouble it's the

238
00:08:26,629 --> 00:08:24,400

loss of the polar lander

239
00:08:28,469 --> 00:08:26,639
when the polar lander is lost it's lost

240
00:08:29,350 --> 00:08:28,479
without any returning any telemetry at

241
00:08:32,310 --> 00:08:29,360
all

242
00:08:34,230 --> 00:08:32,320
so there is a study that of its failure

243
00:08:36,070 --> 00:08:34,240
they came to a set of conclusions that

244
00:08:37,829 --> 00:08:36,080
it was probably a touchdown flag that

245
00:08:39,589 --> 00:08:37,839
was miss set um

246
00:08:41,750 --> 00:08:39,599
jpl that's almost you know i think

247
00:08:43,350 --> 00:08:41,760
universally understood to be unlikely it

248
00:08:45,110 --> 00:08:43,360
failed for other reasons that were found

249
00:08:46,630 --> 00:08:45,120
by a project later on called mars

250
00:08:49,350 --> 00:08:46,640
phoenix when they took the o1 lander

251
00:08:50,710 --> 00:08:49,360
hardware to rework but at the time no

252
00:08:51,990 --> 00:08:50,720
one knew that

253
00:08:55,269 --> 00:08:52,000
all they knew is that the lockheed

254
00:08:57,509 --> 00:08:55,279
lander had failed and i didn't know why

255
00:08:59,509 --> 00:08:57,519
and that ended this sample return effort

256
00:09:02,870 --> 00:08:59,519
because it was based fundamentally on

257
00:09:03,990 --> 00:09:02,880
the success of the polar lander

258
00:09:06,710 --> 00:09:04,000
act three

259
00:09:09,030 --> 00:09:06,720
so i've now said that around jpl the

260
00:09:10,790 --> 00:09:09,040
sample return idea the architecture was

261
00:09:12,949 --> 00:09:10,800
already in trouble and the laboratory

262
00:09:14,550 --> 00:09:12,959
sets up a couple of design teams to

263
00:09:16,790 --> 00:09:14,560

revisit this

264
00:09:19,030 --> 00:09:16,800
as the sample return project itself is

265
00:09:20,710 --> 00:09:19,040
being shut down

266
00:09:22,389 --> 00:09:20,720
it starts out in the leadership of brian

267
00:09:24,230 --> 00:09:22,399
muirhead who had been the pathfinder

268
00:09:27,509 --> 00:09:24,240
project manager and had a number of the

269
00:09:29,269 --> 00:09:27,519
pathfinder veterans on these teams the

270
00:09:31,910 --> 00:09:29,279
idea of the bubble team study initially

271
00:09:33,670 --> 00:09:31,920
was to review each element of the

272
00:09:35,829 --> 00:09:33,680
architecture individually

273
00:09:37,990 --> 00:09:35,839
your head's team reviewed the lander

274
00:09:39,430 --> 00:09:38,000
they then morphed into a different set

275
00:09:41,590 --> 00:09:39,440
of studies but essentially the same

276
00:09:43,829 --> 00:09:41,600
people under another program manager by

277
00:09:45,350 --> 00:09:43,839
the name of jim graf known as a large

278
00:09:46,389 --> 00:09:45,360
lander study

279
00:09:48,310 --> 00:09:46,399
and this is where they begin to

280
00:09:50,550 --> 00:09:48,320
reformulate a different architecture for

281
00:09:52,790 --> 00:09:50,560
sample return this is the way the

282
00:09:54,550 --> 00:09:52,800
engineers like to tell their story this

283
00:09:56,630 --> 00:09:54,560
this is the polar lander the polar

284
00:09:59,590 --> 00:09:56,640
lander has a series of review boards

285
00:10:01,670 --> 00:09:59,600
that try to examine its failure

286
00:10:03,269 --> 00:10:01,680
this idea of robust rover egress here at

287
00:10:04,550 --> 00:10:03,279
the bottom for sample return was never

288
00:10:06,550 --> 00:10:04,560

addressed because they'd begun thinking

289
00:10:08,150 --> 00:10:06,560
about this egress problem and that leads

290
00:10:09,430 --> 00:10:08,160
them into this next phase which will

291
00:10:11,030 --> 00:10:09,440
eventually be called the mars

292
00:10:12,310 --> 00:10:11,040
smartlander

293
00:10:14,150 --> 00:10:12,320
now

294
00:10:15,590 --> 00:10:14,160
in this side this bubblehead team they

295
00:10:17,670 --> 00:10:15,600
come up with a variety of different

296
00:10:19,269 --> 00:10:17,680
potential architectures and this slide

297
00:10:21,190 --> 00:10:19,279
then one of the engineers built and i

298
00:10:23,509 --> 00:10:21,200
grabbed out of the presentation shows

299
00:10:26,150 --> 00:10:23,519
their of the evolution of their thinking

300
00:10:28,389 --> 00:10:26,160
from this tripod lander to what becomes

301
00:10:30,550 --> 00:10:28,399
the baseline or one of the baselines

302
00:10:32,790 --> 00:10:30,560
from this study and that is the idea of

303
00:10:34,710 --> 00:10:32,800
a pallet lander the pallet lander is an

304
00:10:36,790 --> 00:10:34,720
idea from the 1960s the idea is a

305
00:10:38,389 --> 00:10:36,800
crushable substructure five ten minutes

306
00:10:40,150 --> 00:10:38,399
okay thanks janet i'm doing pretty good

307
00:10:42,710 --> 00:10:40,160
then the idea is you have a crushable

308
00:10:44,630 --> 00:10:42,720
substructure that

309
00:10:45,990 --> 00:10:44,640
allows means you don't have a very large

310
00:10:47,509 --> 00:10:46,000
ground clearance once the thing is

311
00:10:49,190 --> 00:10:47,519
sitting on the ground and that's

312
00:10:51,509 --> 00:10:49,200
desirable from the standpoint of getting

313
00:10:53,670 --> 00:10:51,519

a big rover off the deck if you have it

314
00:10:56,069 --> 00:10:53,680
sitting very high standing which you on

315
00:10:57,990 --> 00:10:56,079
a leg lander you want for rock avoidance

316
00:11:00,069 --> 00:10:58,000
as the rover moves across the surface of

317
00:11:01,670 --> 00:11:00,079
the thing the whole spacecraft will try

318
00:11:03,269 --> 00:11:01,680
to tip and if you are unfortunate and

319
00:11:04,870 --> 00:11:03,279
either landed on a slope or on a big

320
00:11:07,190 --> 00:11:04,880
rock you can flip the whole darn thing

321
00:11:09,269 --> 00:11:07,200
over this pallet lander is a little more

322
00:11:10,710 --> 00:11:09,279
immune to this its drawback is that your

323
00:11:12,630 --> 00:11:10,720
the fuel tanks are down here on the

324
00:11:14,870 --> 00:11:12,640
bottom and the structure has to protect

325
00:11:17,269 --> 00:11:14,880
those because the fuel we use hydrazine

326
00:11:19,990 --> 00:11:17,279
is both toxic and corrosive and we don't

327
00:11:20,870 --> 00:11:20,000
want it all over the guts of the lander

328
00:11:21,670 --> 00:11:20,880
so

329
00:11:24,150 --> 00:11:21,680
that's

330
00:11:26,310 --> 00:11:24,160
one idea they come up with

331
00:11:27,590 --> 00:11:26,320
second idea airbag system we've already

332
00:11:29,110 --> 00:11:27,600
seen the use of airbags on mars

333
00:11:30,389 --> 00:11:29,120
pathfinder why not continue with that

334
00:11:31,910 --> 00:11:30,399
success

335
00:11:33,110 --> 00:11:31,920
except in this case because it's a much

336
00:11:35,269 --> 00:11:33,120
larger lander again you're trying to

337
00:11:36,710 --> 00:11:35,279
land a thousand kilograms they needed

338
00:11:38,790 --> 00:11:36,720

more they decided they needed more

339
00:11:41,509 --> 00:11:38,800
controllability and here's the idea is

340
00:11:43,750 --> 00:11:41,519
to use a throttleable liquid

341
00:11:45,910 --> 00:11:43,760
descent stage to

342
00:11:47,750 --> 00:11:45,920
to lower the lander down more gently

343
00:11:49,829 --> 00:11:47,760
than pathfinder had but they still

344
00:11:51,670 --> 00:11:49,839
thought they needed these airbags to

345
00:11:54,389 --> 00:11:51,680
protect it at the final at the as

346
00:11:56,470 --> 00:11:54,399
towards terminal descent um at the end

347
00:11:58,150 --> 00:11:56,480
again you see the the descent stage will

348
00:11:59,430 --> 00:11:58,160
fly away at the end and crash the

349
00:12:00,949 --> 00:11:59,440
advantage of that is you don't have to

350
00:12:02,470 --> 00:12:00,959
protect the fuel tanks because you don't

351
00:12:04,310 --> 00:12:02,480
care what happens the descent stage

352
00:12:05,990 --> 00:12:04,320
after it hits the ground um there are a

353
00:12:08,629 --> 00:12:06,000
number of advantages and disadvantages

354
00:12:11,829 --> 00:12:08,639
the airbags provided writing ability a

355
00:12:13,910 --> 00:12:11,839
disadvantage um that they didn't quite

356
00:12:14,790 --> 00:12:13,920
realize very thoroughly yet

357
00:12:15,590 --> 00:12:14,800
because

358
00:12:17,829 --> 00:12:15,600
well

359
00:12:19,670 --> 00:12:17,839
is how to get heat out of the spacecraft

360
00:12:21,670 --> 00:12:19,680
in cruise these airbags are insulators

361
00:12:23,430 --> 00:12:21,680
the aeroshell will be an insulator and

362
00:12:26,790 --> 00:12:23,440
if this is a particularly big problem if

363
00:12:28,470 --> 00:12:26,800

nasa decides to use an rtg power source

364
00:12:30,389 --> 00:12:28,480
because there's much more heat to be

365
00:12:34,069 --> 00:12:30,399
dissipated through all these layers of

366
00:12:36,069 --> 00:12:34,079
insulation while it's in flight to mars

367
00:12:37,509 --> 00:12:36,079
so advantages descent stage never has to

368
00:12:38,710 --> 00:12:37,519
be shut off the propulsion hardware

369
00:12:41,110 --> 00:12:38,720
doesn't have to be protected better

370
00:12:44,150 --> 00:12:41,120
velocity control disadvantages interface

371
00:12:46,230 --> 00:12:44,160
complexity how do you get the rover off

372
00:12:48,389 --> 00:12:46,240
and self-writing

373
00:12:49,910 --> 00:12:48,399
so someone at this meeting

374
00:12:51,190 --> 00:12:49,920
i've interviewed six people all six

375
00:12:52,550 --> 00:12:51,200
people in the room no one will take

376
00:12:55,430 --> 00:12:52,560
credit for this

377
00:12:56,790 --> 00:12:55,440
or assign blame um and and by the way

378
00:12:58,949 --> 00:12:56,800
while i've presented this as kind of a

379
00:13:00,310 --> 00:12:58,959
jpl story the reality is a very senior

380
00:13:01,990 --> 00:13:00,320
lockheed engineer by the name of steve

381
00:13:03,829 --> 00:13:02,000
jolly was in this as well and i've

382
00:13:05,269 --> 00:13:03,839
interviewed him too someone comes up

383
00:13:08,069 --> 00:13:05,279
with the idea was why we don't just

384
00:13:09,910 --> 00:13:08,079
dispense with the darn airbags

385
00:13:12,150 --> 00:13:09,920
and the reason and they don't and the

386
00:13:14,310 --> 00:13:12,160
reason they decide they can't yet is

387
00:13:17,110 --> 00:13:14,320
they can't answer this problem that's

388
00:13:22,550 --> 00:13:18,870

that's what's known as a controllability

389
00:13:23,750 --> 00:13:22,560
problem they didn't understand

390
00:13:25,430 --> 00:13:23,760
an answer to the question is what

391
00:13:27,670 --> 00:13:25,440
happens if the rover starts to swing in

392
00:13:29,750 --> 00:13:27,680
the wind on its way down to the surface

393
00:13:31,829 --> 00:13:29,760
can any reasonable control system handle

394
00:13:33,670 --> 00:13:31,839
that and the answer actually was yes but

395
00:13:35,030 --> 00:13:33,680
they didn't know it because the people

396
00:13:37,430 --> 00:13:35,040
in the room were mostly mechanical

397
00:13:39,430 --> 00:13:37,440
engineers a systems engineer

398
00:13:40,790 --> 00:13:39,440
and a program manager they weren't

399
00:13:42,230 --> 00:13:40,800
aeronautical engineers and they

400
00:13:43,189 --> 00:13:42,240
certainly weren't guidance and control

401
00:13:46,389 --> 00:13:43,199
people

402
00:13:48,870 --> 00:13:46,399
so they shoved this idea and baselined

403
00:13:51,509 --> 00:13:48,880
the other two to go forward into the

404
00:13:53,350 --> 00:13:51,519
next set of studies in fact the favored

405
00:13:55,430 --> 00:13:53,360
sample that came out of this was the

406
00:13:58,389 --> 00:13:55,440
pallet lander and here you see a later

407
00:14:00,069 --> 00:13:58,399
slide um from the an early phase of what

408
00:14:03,910 --> 00:14:00,079
becomes known as the mars smartlander

409
00:14:07,590 --> 00:14:05,750
planning a new mars program that's going

410
00:14:09,189 --> 00:14:07,600
on at the engineering level while ferris

411
00:14:11,350 --> 00:14:09,199
dairy and scott hubbard and some others

412
00:14:14,310 --> 00:14:11,360
are trying to plan a new program to

413
00:14:16,470 --> 00:14:14,320

replace the now dead surveyor program

414
00:14:18,389 --> 00:14:16,480
at jpl a physicist by the name of mark

415
00:14:20,389 --> 00:14:18,399
adler proposed this mission the mars

416
00:14:21,990 --> 00:14:20,399
mobile pathfinder that slo that actually

417
00:14:23,750 --> 00:14:22,000
very quickly floats to the top was

418
00:14:25,110 --> 00:14:23,760
proposed first in may

419
00:14:27,189 --> 00:14:25,120
and finally approved as the mars

420
00:14:28,470 --> 00:14:27,199
exploration rover mission in august of

421
00:14:29,910 --> 00:14:28,480
2000

422
00:14:31,189 --> 00:14:29,920
i don't know how they managed to do it

423
00:14:33,269 --> 00:14:31,199
but mark spokes forgot to put the

424
00:14:35,750 --> 00:14:33,279
airbags on um

425
00:14:37,509 --> 00:14:35,760
but that goes forward and becomes the

426
00:14:38,949 --> 00:14:37,519
short-range solution of what do we do

427
00:14:42,069 --> 00:14:38,959
next for mars

428
00:14:43,509 --> 00:14:42,079
longer term they create this program

429
00:14:45,430 --> 00:14:43,519
again we have the mars exploration

430
00:14:47,269 --> 00:14:45,440
rovers down here and now we have this

431
00:14:48,949 --> 00:14:47,279
thing called the mars smart landing

432
00:14:50,870 --> 00:14:48,959
smartlander is that pallet lander you

433
00:14:52,550 --> 00:14:50,880
saw before its initial purpose was

434
00:14:54,230 --> 00:14:52,560
simply to demonstrate that you can land

435
00:14:56,550 --> 00:14:54,240
a very large payload this thousand

436
00:14:59,509 --> 00:14:56,560
kilogram thing for sample return on the

437
00:15:01,030 --> 00:14:59,519
surface safely they didn't yet conceive

438
00:15:03,189 --> 00:15:01,040

it because again there's largely

439
00:15:05,189 --> 00:15:03,199
engineers as a high science return

440
00:15:07,990 --> 00:15:05,199
mission and then following the smart

441
00:15:12,629 --> 00:15:08,000
lander proving that

442
00:15:16,069 --> 00:15:14,150
um also on this you see the mars

443
00:15:17,910 --> 00:15:16,079
reconnaissance orbiter that mission has

444
00:15:19,670 --> 00:15:17,920
a engineering purpose i'm sure you've

445
00:15:22,310 --> 00:15:19,680
all heard about its scientific purpose

446
00:15:24,230 --> 00:15:22,320
but it's important to to illuminate one

447
00:15:26,949 --> 00:15:24,240
of the questions about

448
00:15:28,550 --> 00:15:26,959
how to land more safely on mars at jpl

449
00:15:30,470 --> 00:15:28,560
there's been a long-standing conflict

450
00:15:33,430 --> 00:15:30,480
between the advanced technology sections

451
00:15:36,629 --> 00:15:33,440
and the flight sections over how to make

452
00:15:38,870 --> 00:15:36,639
for a a more a safer landing there's an

453
00:15:40,470 --> 00:15:38,880
active hazard avoidance group at the lab

454
00:15:42,230 --> 00:15:40,480
who wants the spacecraft to look down

455
00:15:43,910 --> 00:15:42,240
see what's going on figure out for

456
00:15:46,069 --> 00:15:43,920
itself what to do

457
00:15:47,670 --> 00:15:46,079
and another faction at the lab who

458
00:15:51,030 --> 00:15:47,680
thinks that's a horrible awful idea

459
00:15:53,509 --> 00:15:51,040
because our rules require every possible

460
00:15:54,550 --> 00:15:53,519
decision that the lander can make to be

461
00:15:56,310 --> 00:15:54,560
tested

462
00:15:57,829 --> 00:15:56,320
and as the number of options increase in

463
00:16:00,150 --> 00:15:57,839

the mars surface is complicated as you

464
00:16:01,910 --> 00:16:00,160
heard from richard the option space for

465
00:16:04,069 --> 00:16:01,920
its selection becomes infinite and your

466
00:16:05,430 --> 00:16:04,079
test program becomes enormous

467
00:16:07,749 --> 00:16:05,440
so

468
00:16:10,069 --> 00:16:07,759
the mro that comes out of this has the

469
00:16:12,230 --> 00:16:10,079
engineering purpose

470
00:16:13,990 --> 00:16:12,240
of that's the large camera that's to do

471
00:16:15,829 --> 00:16:14,000
this is to photograph the surface at

472
00:16:17,350 --> 00:16:15,839
such high resolution that they will be

473
00:16:19,829 --> 00:16:17,360
able to find places that simply don't

474
00:16:22,790 --> 00:16:19,839
have any hazards to worry about and thus

475
00:16:24,710 --> 00:16:22,800
this hazard problem is solved

476
00:16:26,550 --> 00:16:24,720
with the smartlander

477
00:16:28,710 --> 00:16:26,560
so i said that the part pallet lander

478
00:16:30,710 --> 00:16:28,720
was the became the baseline for the

479
00:16:32,629 --> 00:16:30,720
smart lander program this is one of the

480
00:16:35,749 --> 00:16:32,639
test models of tom rolini the engineer

481
00:16:37,910 --> 00:16:35,759
assigned to figure out this pallet thing

482
00:16:39,509 --> 00:16:37,920
very quickly though

483
00:16:41,350 --> 00:16:39,519
the smart lander ceases to be a

484
00:16:43,590 --> 00:16:41,360
technology development man

485
00:16:46,230 --> 00:16:43,600
program and becomes a high science

486
00:16:47,749 --> 00:16:46,240
return mission a science

487
00:16:50,230 --> 00:16:47,759
definition team was put had been put

488
00:16:51,749 --> 00:16:50,240

together when they concluded they came

489
00:16:53,670 --> 00:16:51,759
out with an argument for making the

490
00:16:55,990 --> 00:16:53,680
smart lander the capstone scientific

491
00:16:57,749 --> 00:16:56,000
mission for the decade

492
00:17:00,389 --> 00:16:57,759
which meant uh an expansion of the

493
00:17:01,749 --> 00:17:00,399
budget from the project from the 750

494
00:17:03,590 --> 00:17:01,759
million dollar smart lander to the

495
00:17:06,230 --> 00:17:03,600
billion and a half dollar science

496
00:17:08,230 --> 00:17:06,240
laboratory and the name was changed too

497
00:17:10,710 --> 00:17:08,240
at the same time well a little bit after

498
00:17:14,309 --> 00:17:10,720
this goat happens they the engineers

499
00:17:15,590 --> 00:17:14,319
revisit this selection of the pallet

500
00:17:17,029 --> 00:17:15,600
they do it because they learned a lot

501
00:17:18,230 --> 00:17:17,039
during the mars exploration rover

502
00:17:20,390 --> 00:17:18,240
mission one thing they learned is that

503
00:17:22,069 --> 00:17:20,400
this control problem is not a problem

504
00:17:23,829 --> 00:17:22,079
there are solutions for it they could

505
00:17:24,789 --> 00:17:23,839
get them they could essentially buy them

506
00:17:26,230 --> 00:17:24,799
they'd been solved by other

507
00:17:27,829 --> 00:17:26,240
organizations

508
00:17:30,070 --> 00:17:27,839
they discovered this in all the testing

509
00:17:33,029 --> 00:17:30,080
program that they did for murr that they

510
00:17:34,710 --> 00:17:33,039
had not done very much of for

511
00:17:36,710 --> 00:17:34,720
for pathfinder

512
00:17:38,710 --> 00:17:36,720
they also become much more afraid of

513
00:17:40,549 --> 00:17:38,720

this egress problem the picture over

514
00:17:42,789 --> 00:17:40,559
here of one of the

515
00:17:44,470 --> 00:17:42,799
rover prototypes with the lander hung up

516
00:17:46,950 --> 00:17:44,480
on a rock

517
00:17:49,590 --> 00:17:46,960
mortified them because very often they

518
00:17:50,870 --> 00:17:49,600
had these rovers simply flop

519
00:17:53,190 --> 00:17:50,880
which would have been a very expensive

520
00:17:54,789 --> 00:17:53,200
and embarrassing mission failure on the

521
00:17:56,870 --> 00:17:54,799
day of landing

522
00:17:58,549 --> 00:17:56,880
um so this egress challenge rose in

523
00:18:00,390 --> 00:17:58,559
their minds to be a much worse problem

524
00:18:02,710 --> 00:18:00,400
than this controllability problem sort

525
00:18:05,430 --> 00:18:02,720
of design review in 2004

526
00:18:07,510 --> 00:18:05,440
they revisit this up trade space as they

527
00:18:10,150 --> 00:18:07,520
call it and eventually come back to the

528
00:18:11,350 --> 00:18:10,160
conclusion that they had rejected before

529
00:18:14,710 --> 00:18:11,360
that they should just get rid of the

530
00:18:17,029 --> 00:18:14,720
bloody airbags and the lander and land

531
00:18:19,669 --> 00:18:17,039
straight on the wheels

532
00:18:21,430 --> 00:18:19,679
the demise of sample return

533
00:18:24,470 --> 00:18:21,440
i commented earlier today and i'm

534
00:18:27,990 --> 00:18:26,230
nasa has tried repeatedly to develop a

535
00:18:29,750 --> 00:18:28,000
new punch vehicle and it has not

536
00:18:31,669 --> 00:18:29,760
succeeded at it

537
00:18:33,430 --> 00:18:31,679
those are the first those are four

538
00:18:35,990 --> 00:18:33,440

here's the fifth one in the vision for

539
00:18:37,590 --> 00:18:36,000
space exploration

540
00:18:38,870 --> 00:18:37,600
it was called aries you probably all

541
00:18:39,669 --> 00:18:38,880
remember it because it's not that long

542
00:18:41,029 --> 00:18:39,679
ago

543
00:18:43,669 --> 00:18:41,039
it was supposed to

544
00:18:45,029 --> 00:18:43,679
be the basis for sending humans back to

545
00:18:46,390 --> 00:18:45,039
mars

546
00:18:48,470 --> 00:18:46,400
but it was not it was supposed to be

547
00:18:50,710 --> 00:18:48,480
funded by an increase in the nasa budget

548
00:18:52,630 --> 00:18:50,720
of about three billion per year plus the

549
00:18:53,830 --> 00:18:52,640
shutdown federal which goes down at this

550
00:18:55,029 --> 00:18:53,840
point

551
00:18:56,789 --> 00:18:55,039
that three billion a year never

552
00:18:58,789 --> 00:18:56,799
materialized nasa actually got about a

553
00:19:00,710 --> 00:18:58,799
billion and a half and what happened

554
00:19:02,950 --> 00:19:00,720
around headquarters is that they then

555
00:19:05,270 --> 00:19:02,960
went looking around for donations from

556
00:19:07,350 --> 00:19:05,280
the other programs to

557
00:19:09,510 --> 00:19:07,360
finish constellation

558
00:19:12,070 --> 00:19:09,520
the mars program was told in may 2005

559
00:19:13,830 --> 00:19:12,080
that its contribution to constellation

560
00:19:15,990 --> 00:19:13,840
would be about three billion dollars

561
00:19:17,190 --> 00:19:16,000
over the next five years

562
00:19:18,630 --> 00:19:17,200
which

563
00:19:20,310 --> 00:19:18,640

looks like this

564
00:19:25,430 --> 00:19:20,320
this was the budget they were expecting

565
00:19:29,830 --> 00:19:27,830
that actually was cut even worse

566
00:19:31,029 --> 00:19:29,840
so the sample return

567
00:19:33,190 --> 00:19:31,039
went away

568
00:19:34,630 --> 00:19:33,200
as one aviation week reporter a cut of

569
00:19:36,630 --> 00:19:34,640
this magnitude

570
00:19:39,750 --> 00:19:36,640
pushed temple return off the table and

571
00:19:41,110 --> 00:19:39,760
onto the floor

572
00:19:44,310 --> 00:19:41,120
so i probably don't have much time for

573
00:20:02,230 --> 00:19:44,320
conclusions or ruminations but

574
00:20:02,240 --> 00:20:15,590
oh

575
00:20:19,029 --> 00:20:16,710
so

576
00:20:22,149 --> 00:20:19,039
i mentioned the schizophrenia of nasa

577
00:20:24,230 --> 00:20:22,159
that it's both a scientific agency

578
00:20:26,470 --> 00:20:24,240
doing a lots of doing sciences across

579
00:20:28,470 --> 00:20:26,480
many different disciplines and an agency

580
00:20:31,430 --> 00:20:28,480
that seizes its mission the human

581
00:20:33,990 --> 00:20:31,440
colonization of the solar system i think

582
00:20:36,230 --> 00:20:34,000
um and as you've seen just in my talk

583
00:20:37,669 --> 00:20:36,240
but in some of the other talks these two

584
00:20:39,430 --> 00:20:37,679
things sometimes

585
00:20:41,909 --> 00:20:39,440
work together pretty well and other

586
00:20:43,510 --> 00:20:41,919
times they rate each other's budgets

587
00:20:46,230 --> 00:20:43,520
and so there's a constant conflict

588
00:20:48,710 --> 00:20:46,240

around nasa that i often have to explain

589
00:20:51,190 --> 00:20:48,720
to audiences the science directorate in

590
00:20:52,710 --> 00:20:51,200
my view plays sort of a round-robin game

591
00:20:55,029 --> 00:20:52,720
since it never gets as much money for

592
00:20:57,350 --> 00:20:55,039
all its ambitions it feeds some things

593
00:21:00,070 --> 00:20:57,360
well for a while and starves others and

594
00:21:02,630 --> 00:21:00,080
that circle always goes around and so

595
00:21:04,390 --> 00:21:02,640
one of my ruminations is is it ever

596
00:21:06,630 --> 00:21:04,400
going to be possible to do sample return

597
00:21:08,390 --> 00:21:06,640
given how much it's going to cost

598
00:21:10,789 --> 00:21:08,400
because you can't sustain a funding

599
00:21:12,710 --> 00:21:10,799
profile in the science directorate for

600
00:21:14,230 --> 00:21:12,720
more than three or four years and that's

601
00:21:15,750 --> 00:21:14,240
not enough time to get sample return

602
00:21:18,710 --> 00:21:15,760
done on the amount of

603
00:21:21,190 --> 00:21:18,720
of peak budget that's available

604
00:21:22,630 --> 00:21:21,200
so that's one of my questions

605
00:21:24,470 --> 00:21:22,640
and i can't answer it because of course

606
00:21:25,830 --> 00:21:24,480
as a historian i only deal with the past

607
00:21:27,270 --> 00:21:25,840
it's jim green's job to deal with the

608
00:21:29,110 --> 00:21:27,280
future

609
00:21:31,029 --> 00:21:29,120
but i wonder about that

610
00:21:33,430 --> 00:21:31,039
so that's one of my ruminations another

611
00:21:35,029 --> 00:21:33,440
i'm in the reason i picked this subject

612
00:21:36,630 --> 00:21:35,039
and mars exploration overall from an

613
00:21:38,230 --> 00:21:36,640

engineering perspective is i'm

614
00:21:39,909 --> 00:21:38,240
interested in the way engineers take

615
00:21:41,029 --> 00:21:39,919
lessons from one project forward to the

616
00:21:42,870 --> 00:21:41,039
next one

617
00:21:44,390 --> 00:21:42,880
if i had more time i would tell you that

618
00:21:46,070 --> 00:21:44,400
the folks who were on this bubble team

619
00:21:48,230 --> 00:21:46,080
study were almost all pathfinder people

620
00:21:49,750 --> 00:21:48,240
except for steve jolly from lockheed

621
00:21:52,070 --> 00:21:49,760
who was involved with the global

622
00:21:53,510 --> 00:21:52,080
surveyor and uh

623
00:21:54,470 --> 00:21:53,520
sorry polar lander missions to some

624
00:21:56,789 --> 00:21:54,480
degree

625
00:21:59,990 --> 00:21:56,799
um and so their experience the reason

626
00:22:02,710 --> 00:22:00,000
they had one that bubble team

627
00:22:05,350 --> 00:22:02,720
study came from the pathfinder gang's

628
00:22:07,270 --> 00:22:05,360
experience and then after they all get

629
00:22:09,909 --> 00:22:07,280
drafted into the mars exploration rover

630
00:22:11,590 --> 00:22:09,919
mission it gets reinformed by that that

631
00:22:13,270 --> 00:22:11,600
was suggested in here but not made

632
00:22:15,029 --> 00:22:13,280
terribly clear because i'm in enough of

633
00:22:18,549 --> 00:22:15,039
a hurry to get off the stage

634
00:22:20,950 --> 00:22:18,559
oh and i see i guess i have a question

635
00:22:24,310 --> 00:22:20,960
nobody i decided to be

636
00:22:30,710 --> 00:22:26,950
are you going to return sample from some

637
00:22:35,270 --> 00:22:30,720
specific landing site or just to collect

638
00:22:39,270 --> 00:22:38,149

area around the landing site with the

639
00:22:41,830 --> 00:22:39,280
capable

640
00:22:44,230 --> 00:22:41,840
rover equipped with manipulator and

641
00:22:46,630 --> 00:22:44,240
possibly even drilling in order just to

642
00:22:48,310 --> 00:22:46,640
return deep-seated

643
00:22:50,070 --> 00:22:48,320
you know probes

644
00:22:51,830 --> 00:22:50,080
oh i guess the answer is that jim green

645
00:22:54,549 --> 00:22:51,840
has to answer that question what the

646
00:22:56,470 --> 00:22:54,559
scientists clearly want the most is a

647
00:22:58,710 --> 00:22:56,480
long range rover they can go hundreds of

648
00:23:00,630 --> 00:22:58,720
kilometers collect many samples from

649
00:23:02,149 --> 00:23:00,640
many different terrains if they can

650
00:23:03,350 --> 00:23:02,159
figure out how to do it a drill that

651
00:23:04,950 --> 00:23:03,360
will actually pull them up i think

652
00:23:06,710 --> 00:23:04,960
there's a drill on curiosity but i don't

653
00:23:08,549 --> 00:23:06,720
know what its capability is

654
00:23:10,549 --> 00:23:08,559
because i only study the past so that's

655
00:23:12,950 --> 00:23:10,559
clearly what they want what they're

656
00:23:14,950 --> 00:23:12,960
going to get is whatever the science

657
00:23:16,789 --> 00:23:14,960
director can afford

658
00:23:19,110 --> 00:23:16,799
which might be nothing more than the

659
00:23:21,270 --> 00:23:19,120
grab sampling i just don't know again i

660
00:23:23,110 --> 00:23:21,280
deal with the past not the future

661
00:23:24,710 --> 00:23:23,120
but i think that's that's your trade

662
00:23:26,789 --> 00:23:24,720
space there's what the scientists want

663
00:23:28,950 --> 00:23:26,799

so part of my story is ambition and then

664
00:23:31,669 --> 00:23:28,960
there's what we're actually able to get

665
00:23:33,830 --> 00:23:31,679
out of congress to pay for um and that's

666
00:23:36,870 --> 00:23:33,840
the other end of the the

667
00:23:41,029 --> 00:23:38,710
heidi hamill from aura

668
00:23:43,029 --> 00:23:41,039
i can think of an astrophysics example

669
00:23:44,390 --> 00:23:43,039
where it has benefited from its

670
00:23:46,310 --> 00:23:44,400
interaction with human space flight

671
00:23:48,549 --> 00:23:46,320
program and that would be hubble

672
00:23:50,149 --> 00:23:48,559
which we serviced a thousand times

673
00:23:51,029 --> 00:23:50,159
that's an exaggeration but you get the

674
00:23:54,390 --> 00:23:51,039
idea

675
00:23:56,149 --> 00:23:54,400
um but i'm i'm struggling to s five

676
00:23:58,149 --> 00:23:56,159
actually right um

677
00:24:01,430 --> 00:23:58,159
there is one was twice well uh but i'm

678
00:24:04,230 --> 00:24:01,440
struggling to think of ones that

679
00:24:06,710 --> 00:24:04,240
where the planetary science community

680
00:24:09,750 --> 00:24:06,720
benefited from interactions with the

681
00:24:13,269 --> 00:24:09,760
human space flight program can you

682
00:24:15,990 --> 00:24:13,279
can you think of some or some examples

683
00:24:18,470 --> 00:24:16,000
a small degree

684
00:24:20,390 --> 00:24:18,480
mars 01 project

685
00:24:22,549 --> 00:24:20,400
had some instruments

686
00:24:24,070 --> 00:24:22,559
uh that were supposed to contribute to

687
00:24:25,510 --> 00:24:24,080
the human program

688
00:24:26,950 --> 00:24:25,520

the reason i'm not willing to say that's

689
00:24:28,549 --> 00:24:26,960
an unalloyed good is that the human

690
00:24:29,590 --> 00:24:28,559
program ultimately wasn't willing to pay

691
00:24:31,269 --> 00:24:29,600
for them

692
00:24:33,350 --> 00:24:31,279
and

693
00:24:35,190 --> 00:24:33,360
folks at headquarters had to go begging

694
00:24:37,190 --> 00:24:35,200
around congress to get some extra money

695
00:24:39,190 --> 00:24:37,200
in order to actually put them on the

696
00:24:40,310 --> 00:24:39,200
vehicles and then of course the lander

697
00:24:42,710 --> 00:24:40,320
was cancelled

698
00:24:44,549 --> 00:24:42,720
so only the i think it's the marie

699
00:24:47,830 --> 00:24:44,559
instrument on the odyssey orbiter the

700
00:24:49,909 --> 00:24:47,840
2001 orbiter actually flies um and

701
00:24:51,590 --> 00:24:49,919
that's uh that's clearly a contribution

702
00:24:53,590 --> 00:24:51,600
to understanding mars well enough to

703
00:24:54,870 --> 00:24:53,600
send people there um

704
00:24:55,750 --> 00:24:54,880
it but it's

705
00:25:00,789 --> 00:24:55,760
it's

706
00:25:02,630 --> 00:25:00,799
example as hubble is um which you're

707
00:25:04,149 --> 00:25:02,640
right clearly benefited from being

708
00:25:06,149 --> 00:25:04,159
shuttle serviceable because the

709
00:25:08,310 --> 00:25:06,159
planetary stuff because we send it

710
00:25:09,750 --> 00:25:08,320
off and don't get it back um there

711
00:25:11,029 --> 00:25:09,760
hasn't been quite that strength of

712
00:25:12,789 --> 00:25:11,039
interaction

713
00:25:35,830 --> 00:25:12,799

to my knowledge

714
00:25:39,750 --> 00:25:37,909
yeah that's right so he's talking about

715
00:25:41,029 --> 00:25:39,760
the surveyor lander program for which

716
00:25:42,950 --> 00:25:41,039
there hasn't been history written and

717
00:25:43,909 --> 00:25:42,960
i've actually came out here early to dig

718
00:25:45,350 --> 00:25:43,919
through some of

719
00:25:47,350 --> 00:25:45,360
the records from that because that's the

720
00:25:49,029 --> 00:25:47,360
next project i want or program really

721
00:25:53,750 --> 00:25:49,039
that i want to write about it

722
00:25:53,760 --> 00:26:01,190
else

723
00:26:04,230 --> 00:26:02,470
fabulous so we've heard about the

724
00:26:05,430 --> 00:26:04,240
missions the science the engineering and

725
00:26:06,870 --> 00:26:05,440
now let's take a turn towards

726
00:26:09,269 --> 00:26:06,880
headquarters and those people behind the

727
00:26:10,710 --> 00:26:09,279
scenes so harry lambright is professor

728
00:26:12,149 --> 00:26:10,720
of public administration and

729
00:26:13,350 --> 00:26:12,159
international affairs and political

730
00:26:15,669 --> 00:26:13,360
science at the maxwell school of

731
00:26:17,669 --> 00:26:15,679
syracuse university he's authored many

732
00:26:19,750 --> 00:26:17,679
works including a biography of james

733
00:26:21,590 --> 00:26:19,760
webb called powering apollo and his

734
00:26:23,669 --> 00:26:21,600
editor of space policy in the 21st

735
00:26:25,190 --> 00:26:23,679
century harry is also a fellow of the

736
00:26:27,029 --> 00:26:25,200
american association for the advancement

737
00:26:36,470 --> 00:26:27,039
of science and the national academy of

738
00:26:42,070 --> 00:26:39,190

well i wish i had some pretty pictures

739
00:26:44,310 --> 00:26:42,080
of men at least but uh i don't though we

740
00:26:46,390 --> 00:26:44,320
have what four administrators sitting

741
00:26:48,310 --> 00:26:46,400
behind desks and suits i don't think

742
00:26:50,710 --> 00:26:48,320
would go over very well with this

743
00:26:53,029 --> 00:26:50,720
audience

744
00:26:54,710 --> 00:26:53,039
so or so nate if i tried it out on a

745
00:26:58,230 --> 00:26:54,720
female graduate student and she said

746
00:27:00,630 --> 00:26:59,669
well anyway i'm going to talk about

747
00:27:02,789 --> 00:27:00,640
people

748
00:27:04,950 --> 00:27:02,799
uh you you said are individuals

749
00:27:07,830 --> 00:27:04,960
important uh yes of course they are but

750
00:27:08,630 --> 00:27:07,840
the nasa administrator is important

751
00:27:10,950 --> 00:27:08,640
it's

752
00:27:14,149 --> 00:27:10,960
an interesting question i had occasion

753
00:27:17,190 --> 00:27:14,159
to interview a scientist

754
00:27:19,669 --> 00:27:17,200
at jpl named dan mclease who was told me

755
00:27:22,630 --> 00:27:19,679
about experience he had with dan golden

756
00:27:25,269 --> 00:27:22,640
after the meteorite

757
00:27:27,029 --> 00:27:25,279
situation in 1996

758
00:27:29,350 --> 00:27:27,039
dan golden

759
00:27:31,269 --> 00:27:29,360
was very excited about the meteorite

760
00:27:33,909 --> 00:27:31,279
and he wanted to know from the

761
00:27:35,669 --> 00:27:33,919
scientists what is what's the next step

762
00:27:37,430 --> 00:27:35,679
what's the next step what do we do next

763
00:27:38,470 --> 00:27:37,440

and they said well the only way you're

764
00:27:41,190 --> 00:27:38,480
going to find out if you're going to

765
00:27:44,230 --> 00:27:41,200
have life is mars sample return he said

766
00:27:46,870 --> 00:27:44,240
great let's do it now

767
00:27:49,110 --> 00:27:46,880
and he kept pressing them for given

768
00:27:51,510 --> 00:27:49,120
particular years and all of them work

769
00:27:53,190 --> 00:27:51,520
you know sinus said we can't just send

770
00:27:54,310 --> 00:27:53,200
something up there we've got to know

771
00:27:56,789 --> 00:27:54,320
where to go

772
00:27:59,510 --> 00:27:56,799
and they reminded him of viking where

773
00:28:01,190 --> 00:27:59,520
the answer had come out and it had hurt

774
00:28:02,870 --> 00:28:01,200
the program so we've got to be

775
00:28:04,310 --> 00:28:02,880
systematic

776
00:28:06,149 --> 00:28:04,320
incremental

777
00:28:09,269 --> 00:28:06,159
comprehensive et cetera et cetera et

778
00:28:11,510 --> 00:28:09,279
cetera he said fine okay do what's right

779
00:28:15,110 --> 00:28:11,520
by science but remember

780
00:28:18,710 --> 00:28:15,120
the pace will be determined by politics

781
00:28:20,070 --> 00:28:18,720
true now how does it it seems to me the

782
00:28:22,470 --> 00:28:20,080
role of the science the role of the

783
00:28:24,630 --> 00:28:22,480
administrator the nasa administrator is

784
00:28:27,029 --> 00:28:24,640
somehow to

785
00:28:28,950 --> 00:28:27,039
sort of cross those boundaries between

786
00:28:31,830 --> 00:28:28,960
the worlds of science and technology and

787
00:28:34,230 --> 00:28:31,840
nasa and the worlds of politics in the

788
00:28:36,230 --> 00:28:34,240

vernacular of political science

789
00:28:37,590 --> 00:28:36,240
the nasa administrator falls into a

790
00:28:40,070 --> 00:28:37,600
class of people that are called

791
00:28:41,990 --> 00:28:40,080
political executives what that means

792
00:28:44,710 --> 00:28:42,000
essentially is they are executives that

793
00:28:47,590 --> 00:28:44,720
is they run organizations they have

794
00:28:49,430 --> 00:28:47,600
executive jobs they deal with personnel

795
00:28:51,430 --> 00:28:49,440
they deal with budgets they deal with

796
00:28:53,990 --> 00:28:51,440
organizations and reorganizations but

797
00:28:56,389 --> 00:28:54,000
they're politicians that is to say they

798
00:28:58,870 --> 00:28:56,399
are appointed by the president and

799
00:29:01,110 --> 00:28:58,880
confirmed by the senate and are expected

800
00:29:02,470 --> 00:29:01,120
to play advocacy roles on behalf of

801
00:29:04,549 --> 00:29:02,480
their agencies

802
00:29:06,870 --> 00:29:04,559
so they have inside jobs

803
00:29:08,870 --> 00:29:06,880
and they have outside jobs and they have

804
00:29:10,470 --> 00:29:08,880
to do them both

805
00:29:12,389 --> 00:29:10,480
to be effective

806
00:29:14,310 --> 00:29:12,399
as as administrators

807
00:29:17,350 --> 00:29:14,320
and this is this has always been the

808
00:29:18,230 --> 00:29:17,360
case and some are more effective than

809
00:29:19,110 --> 00:29:18,240
others

810
00:29:27,029 --> 00:29:19,120
uh

811
00:29:29,269 --> 00:29:27,039
it takes to be effective in both of

812
00:29:31,750 --> 00:29:29,279
those roles and to combine them in one

813
00:29:34,389 --> 00:29:31,760

man it's rare there aren't really many

814
00:29:37,830 --> 00:29:34,399
people at nasa or other places who have

815
00:29:40,549 --> 00:29:37,840
had the the gifts that go with playing

816
00:29:42,950 --> 00:29:40,559
that kind of total role the closest you

817
00:29:44,310 --> 00:29:42,960
come at nasa was james webb

818
00:29:47,510 --> 00:29:44,320
and uh

819
00:29:48,310 --> 00:29:47,520
there is a fascinating uh story about

820
00:29:50,389 --> 00:29:48,320
webb

821
00:29:52,310 --> 00:29:50,399
and playing that role and it's coming

822
00:29:55,029 --> 00:29:52,320
out with the kennedy tapes

823
00:29:55,830 --> 00:29:55,039
when in the early days of apollo

824
00:29:58,789 --> 00:29:55,840
the

825
00:30:01,350 --> 00:29:58,799
president kennedy uh was dealing with a

826
00:30:03,669 --> 00:30:01,360
dispute a power struggle within nasa

827
00:30:06,870 --> 00:30:03,679
between the head of the human space

828
00:30:09,909 --> 00:30:06,880
space program human space flight program

829
00:30:11,990 --> 00:30:09,919
who wanted all the money for apollo and

830
00:30:13,510 --> 00:30:12,000
webb who wanted some of the money to go

831
00:30:16,070 --> 00:30:13,520
to the science program that he was

832
00:30:18,070 --> 00:30:16,080
beginning to build up and it came to

833
00:30:19,510 --> 00:30:18,080
kennedy at the end of the day to make

834
00:30:21,830 --> 00:30:19,520
the decision

835
00:30:24,310 --> 00:30:21,840
in kennedy and this is something that

836
00:30:26,630 --> 00:30:24,320
bothers a lot of people basically said i

837
00:30:28,549 --> 00:30:26,640
don't really care that much about space

838
00:30:29,750 --> 00:30:28,559

or science i care about beating the

839
00:30:31,029 --> 00:30:29,760
russians

840
00:30:33,269 --> 00:30:31,039
and uh

841
00:30:36,149 --> 00:30:33,279
webb had to make the point that apollo

842
00:30:38,870 --> 00:30:36,159
was a means to an end at the end was

843
00:30:41,590 --> 00:30:38,880
preeminence leadership

844
00:30:43,909 --> 00:30:41,600
and he said sciences is also that way

845
00:30:45,669 --> 00:30:43,919
science is a means to an end the end

846
00:30:48,789 --> 00:30:45,679
being preeminence

847
00:30:50,789 --> 00:30:48,799
not apollo for its so to say and he and

848
00:30:53,029 --> 00:30:50,799
kennedy said well i want you to uh i'm

849
00:30:54,710 --> 00:30:53,039
not sure we're on the same wavelength

850
00:30:56,630 --> 00:30:54,720
you go back and write me a memo and

851
00:30:59,430 --> 00:30:56,640
explain what you're talking about

852
00:31:01,269 --> 00:30:59,440
and he did that and

853
00:31:03,590 --> 00:31:01,279
we have never heard back

854
00:31:05,590 --> 00:31:03,600
uh and as a result the head of the

855
00:31:09,029 --> 00:31:05,600
apollo program was fired

856
00:31:12,470 --> 00:31:10,950
he bridged the gap

857
00:31:14,230 --> 00:31:12,480
he explained to the president why

858
00:31:15,909 --> 00:31:14,240
science was important

859
00:31:17,110 --> 00:31:15,919
and science continues and we're here

860
00:31:18,950 --> 00:31:17,120
today

861
00:31:20,870 --> 00:31:18,960
now

862
00:31:22,389 --> 00:31:20,880
there aren't many people who can do that

863
00:31:24,630 --> 00:31:22,399

i found actually one person in

864
00:31:27,430 --> 00:31:24,640
washington today who seems to have those

865
00:31:29,750 --> 00:31:27,440
skills if you want to see what it takes

866
00:31:32,070 --> 00:31:29,760
take a look at francis collins francis

867
00:31:34,230 --> 00:31:32,080
collins was head of the genome project

868
00:31:36,310 --> 00:31:34,240
and now he's head of nih

869
00:31:39,190 --> 00:31:36,320
and he seems to have those

870
00:31:40,870 --> 00:31:39,200
unusual combination of skills

871
00:31:42,950 --> 00:31:40,880
but they're rare and there aren't many

872
00:31:45,269 --> 00:31:42,960
and have been that many in nasa history

873
00:31:47,430 --> 00:31:45,279
who have had the blending that it takes

874
00:31:49,990 --> 00:31:47,440
to be both a solid and manager and a

875
00:31:52,310 --> 00:31:50,000
solid politician at the same time

876
00:31:54,789 --> 00:31:52,320
because most people don't have them in

877
00:31:56,549 --> 00:31:54,799
any event what i'm the what i'm going to

878
00:31:58,549 --> 00:31:56,559
talk about are

879
00:32:01,590 --> 00:31:58,559
our four guys

880
00:32:02,789 --> 00:32:01,600
as they relate to the mars program now

881
00:32:04,870 --> 00:32:02,799
in connection when you're dealing with

882
00:32:07,509 --> 00:32:04,880
the nasa administrator remember you're

883
00:32:09,750 --> 00:32:07,519
dealing like like with the equivalent of

884
00:32:13,350 --> 00:32:09,760
a ceo of a corporation or the president

885
00:32:15,110 --> 00:32:13,360
of a university they have many programs

886
00:32:17,990 --> 00:32:15,120
mars is just one of them

887
00:32:19,990 --> 00:32:18,000
and all in all all all nasa

888
00:32:21,269 --> 00:32:20,000

administrators have focused mainly on

889
00:32:22,870 --> 00:32:21,279
the human space

890
00:32:23,669 --> 00:32:22,880
program because that's where the money

891
00:32:25,830 --> 00:32:23,679
is

892
00:32:27,430 --> 00:32:25,840
and that's where most of the political

893
00:32:28,870 --> 00:32:27,440
issues are

894
00:32:31,029 --> 00:32:28,880
so mars

895
00:32:33,430 --> 00:32:31,039
so the question is how do how do how do

896
00:32:35,110 --> 00:32:33,440
astronaut ministers deal with mars

897
00:32:37,509 --> 00:32:35,120
well essentially they don't deal with it

898
00:32:38,710 --> 00:32:37,519
very much but they do deal with it once

899
00:32:40,310 --> 00:32:38,720
in a while

900
00:32:41,750 --> 00:32:40,320
and when they deal with it usually it's

901
00:32:43,190 --> 00:32:41,760
because they're dealing with the biggest

902
00:32:46,710 --> 00:32:43,200
decisions

903
00:32:48,870 --> 00:32:46,720
ultimately come up to the desk of the

904
00:32:51,110 --> 00:32:48,880
administrator and these are the biggest

905
00:32:54,070 --> 00:32:51,120
these are decisions like as in a human

906
00:32:57,029 --> 00:32:54,080
life they're the decisions of

907
00:32:59,830 --> 00:32:57,039
a program getting born a program being

908
00:33:02,310 --> 00:32:59,840
significantly reoriented or programmed

909
00:33:04,310 --> 00:33:02,320
to being terminated or being in danger

910
00:33:06,070 --> 00:33:04,320
of being terminated and that's where

911
00:33:08,149 --> 00:33:06,080
that's when nasa administrators get

912
00:33:11,029 --> 00:33:08,159
involved with science and get involved

913
00:33:12,070 --> 00:33:11,039

with with with mars in particular

914
00:33:14,149 --> 00:33:12,080
so

915
00:33:16,230 --> 00:33:14,159
we'll start with dan golden

916
00:33:18,789 --> 00:33:16,240
and golden uh

917
00:33:20,630 --> 00:33:18,799
uh you know was uh probably the most

918
00:33:22,870 --> 00:33:20,640
controversial

919
00:33:25,269 --> 00:33:22,880
nasa administrator in history

920
00:33:26,789 --> 00:33:25,279
uh and

921
00:33:28,710 --> 00:33:26,799
you can get a different view of dan

922
00:33:30,870 --> 00:33:28,720
golden depending on whether you're

923
00:33:33,590 --> 00:33:30,880
looking at dan golden and the shuttle

924
00:33:35,830 --> 00:33:33,600
program or the space station program or

925
00:33:38,070 --> 00:33:35,840
the mars program when it comes to the

926
00:33:39,350 --> 00:33:38,080
mars program i think dan golden looks

927
00:33:40,230 --> 00:33:39,360
pretty good

928
00:33:43,350 --> 00:33:40,240
now

929
00:33:46,070 --> 00:33:43,360
why do i say that well i say that is is

930
00:33:48,549 --> 00:33:46,080
that it is that he it was a passion for

931
00:33:49,509 --> 00:33:48,559
him he was genuinely interested in it we

932
00:33:51,509 --> 00:33:49,519
all know

933
00:33:54,470 --> 00:33:51,519
that when you deal with leaders it's a

934
00:33:56,149 --> 00:33:54,480
mix of personality and and situation we

935
00:33:58,149 --> 00:33:56,159
all know that now the question the

936
00:34:00,149 --> 00:33:58,159
personality of dan golden was was

937
00:34:02,710 --> 00:34:00,159
dynamic intense and

938
00:34:04,310 --> 00:34:02,720

intimidating for anyone who ever met at

939
00:34:08,149 --> 00:34:04,320
my first time ever met him i thought he

940
00:34:10,550 --> 00:34:08,159
was going to explode on me oh

941
00:34:11,909 --> 00:34:10,560
you got you got an hour he told me you

942
00:34:13,190 --> 00:34:11,919
got an hour

943
00:34:15,030 --> 00:34:13,200
boy i

944
00:34:16,149 --> 00:34:15,040
jumped up and i started asking questions

945
00:34:18,230 --> 00:34:16,159
real fast

946
00:34:21,909 --> 00:34:18,240
but that was dan golden and that was my

947
00:34:23,909 --> 00:34:21,919
introduction to him uh and uh next i'll

948
00:34:25,829 --> 00:34:23,919
say i'm so full of anecdotes on there

949
00:34:27,750 --> 00:34:25,839
and gold as i was leaving he grabbed me

950
00:34:30,389 --> 00:34:27,760
by the lapels and you know what's wrong

951
00:34:32,389 --> 00:34:30,399
with nasa nasa young guys don't work

952
00:34:33,990 --> 00:34:32,399
hard enough i was on an airplane at six

953
00:34:36,149 --> 00:34:34,000
in the morning and my guys were all

954
00:34:38,629 --> 00:34:36,159
sleeping well i was working hard

955
00:34:40,550 --> 00:34:38,639
and that was dan goldman anyway any of

956
00:34:42,950 --> 00:34:40,560
you know him you know this is this is

957
00:34:46,310 --> 00:34:42,960
dan gold intense man

958
00:34:48,869 --> 00:34:46,320
terribly intense and and and uh he loved

959
00:34:51,829 --> 00:34:48,879
mars

960
00:34:54,230 --> 00:34:51,839
he spent most of his time on the space

961
00:34:56,389 --> 00:34:54,240
station and the human space program

962
00:34:59,670 --> 00:34:56,399
human space flight program but what he

963
00:35:02,069 --> 00:34:59,680

loved was mars and it was a love affair

964
00:35:03,390 --> 00:35:02,079
he if you recall when he was hired back

965
00:35:05,109 --> 00:35:03,400
in 92

966
00:35:08,630 --> 00:35:05,119
1992

967
00:35:11,109 --> 00:35:08,640
bush one had had this moon mars program

968
00:35:13,030 --> 00:35:11,119
it didn't go anywhere but that's one of

969
00:35:14,950 --> 00:35:13,040
the reasons golden took the job he

970
00:35:17,750 --> 00:35:14,960
thought he wanted was going to run this

971
00:35:19,430 --> 00:35:17,760
moon mars program it was a human program

972
00:35:21,030 --> 00:35:19,440
he found out very quickly it wasn't

973
00:35:22,950 --> 00:35:21,040
going anywhere

974
00:35:25,670 --> 00:35:22,960
but he still wanted to do mars he still

975
00:35:26,950 --> 00:35:25,680
wanted to do mars and so he looked

976
00:35:29,670 --> 00:35:26,960
at mars

977
00:35:32,950 --> 00:35:29,680
as pre he looked it questioned about

978
00:35:35,670 --> 00:35:32,960
human and unmanned he looked at mars at

979
00:35:38,630 --> 00:35:35,680
from the standpoint of precursory to man

980
00:35:40,950 --> 00:35:38,640
space if i can't get a man program

981
00:35:43,109 --> 00:35:40,960
i can do what we did in the moon program

982
00:35:44,710 --> 00:35:43,119
which have a precursory program so

983
00:35:46,470 --> 00:35:44,720
that's how he saw it that's how a lot of

984
00:35:47,990 --> 00:35:46,480
administrators see it incidentally

985
00:35:49,349 --> 00:35:48,000
because they come at it from the human

986
00:35:51,190 --> 00:35:49,359
space program

987
00:35:53,270 --> 00:35:51,200
now

988
00:35:55,750 --> 00:35:53,280

the big decision he made

989
00:35:57,430 --> 00:35:55,760
came after mars observer

990
00:35:58,790 --> 00:35:57,440
he made he made a number of decisions

991
00:36:00,950 --> 00:35:58,800
but i'm going to deal just with what i

992
00:36:02,550 --> 00:36:00,960
think are the biggest ones first

993
00:36:04,710 --> 00:36:02,560
decision he made have to do with was

994
00:36:06,069 --> 00:36:04,720
after mars observer

995
00:36:09,190 --> 00:36:06,079
went down

996
00:36:11,510 --> 00:36:09,200
and and essentially uh

997
00:36:14,870 --> 00:36:11,520
oh he didn't want it to go

998
00:36:16,710 --> 00:36:14,880
he he spent time talking to his science

999
00:36:19,109 --> 00:36:16,720
at his science administrator who was

1000
00:36:22,630 --> 00:36:19,119
wesley huntress i think is sitting here

1001
00:36:24,150 --> 00:36:22,640
and i he talked to carl sagan oh no 10

1002
00:36:28,470 --> 00:36:24,160
minutes i've only gotten to start a

1003
00:36:32,069 --> 00:36:30,710
all right so here we go all right real

1004
00:36:33,829 --> 00:36:32,079
quick

1005
00:36:36,390 --> 00:36:33,839
basically what what happened is

1006
00:36:38,790 --> 00:36:36,400
essentially these decisions are made by

1007
00:36:41,190 --> 00:36:38,800
a hundred people but the guy who's in

1008
00:36:43,190 --> 00:36:41,200
charge at the bar at the top has to sign

1009
00:36:44,550 --> 00:36:43,200
off on them has to make the decision and

1010
00:36:46,790 --> 00:36:44,560
then he has to sell them to the

1011
00:36:49,109 --> 00:36:46,800
political community basically decisions

1012
00:36:51,589 --> 00:36:49,119
may be going we're going programmatic

1013
00:36:53,750 --> 00:36:51,599

not just a one-shot affair mars like

1014
00:36:55,430 --> 00:36:53,760
mars observer but a program with many

1015
00:36:57,990 --> 00:36:55,440
missions that would be integrated and

1016
00:37:00,150 --> 00:36:58,000
coordinated and it was sold as such

1017
00:37:01,670 --> 00:37:00,160
wesley hunter is very important in this

1018
00:37:04,710 --> 00:37:01,680
whole story

1019
00:37:08,310 --> 00:37:04,720
but golden but the deal that was made

1020
00:37:10,630 --> 00:37:08,320
is you omb which they don't like omb

1021
00:37:12,150 --> 00:37:10,640
congress doesn't like these programs

1022
00:37:14,710 --> 00:37:12,160
they'd like to keep them separate they

1023
00:37:16,950 --> 00:37:14,720
have more power that way but if you let

1024
00:37:19,270 --> 00:37:16,960
us have a program it'll be faster better

1025
00:37:21,430 --> 00:37:19,280
cheaper faster better people is the way

1026
00:37:23,589 --> 00:37:21,440
you're selling it it'll cost you less

1027
00:37:25,670 --> 00:37:23,599
over a period of years so it was

1028
00:37:28,150 --> 00:37:25,680
accepted program gets started next

1029
00:37:30,470 --> 00:37:28,160
decision reorientation is in the with

1030
00:37:32,550 --> 00:37:30,480
the moon rock with the mars rock and

1031
00:37:35,270 --> 00:37:32,560
essentially this is the idea of speeding

1032
00:37:37,589 --> 00:37:35,280
up the mars sample return as fast as we

1033
00:37:40,630 --> 00:37:37,599
can faster better cheaper even faster

1034
00:37:41,910 --> 00:37:40,640
better cheaper applied to mars a last

1035
00:37:44,310 --> 00:37:41,920
decision

1036
00:37:47,510 --> 00:37:44,320
problems with faster better cheaper two

1037
00:37:48,950 --> 00:37:47,520
probes go down what are we going to do

1038
00:37:52,230 --> 00:37:48,960

he says to

1039
00:37:53,990 --> 00:37:52,240
his uh nasa is a a i get aaa at that

1040
00:37:57,190 --> 00:37:54,000
point that we got to save the mars

1041
00:37:58,630 --> 00:37:57,200
program he brings in uh mr hubbard from

1042
00:37:59,910 --> 00:37:58,640
california

1043
00:38:01,349 --> 00:37:59,920
and he

1044
00:38:03,510 --> 00:38:01,359
tells give me

1045
00:38:05,030 --> 00:38:03,520
reinvent the program

1046
00:38:07,510 --> 00:38:05,040
give me another program that isn't

1047
00:38:09,589 --> 00:38:07,520
faster better i'll use those words but i

1048
00:38:10,630 --> 00:38:09,599
think it i wanted to be

1049
00:38:11,829 --> 00:38:10,640
more

1050
00:38:14,630 --> 00:38:11,839
realistic

1051
00:38:16,710 --> 00:38:14,640
uh and part and and his last decision

1052
00:38:19,190 --> 00:38:16,720
was essentially spirit and opportunity

1053
00:38:22,230 --> 00:38:19,200
as well i am told by everybody that the

1054
00:38:24,470 --> 00:38:22,240
decision to have two is his decision

1055
00:38:26,310 --> 00:38:24,480
and that goes way against faster better

1056
00:38:29,670 --> 00:38:26,320
cheaper so how are you going to pay for

1057
00:38:32,470 --> 00:38:29,680
it mars is important he taxed other

1058
00:38:34,790 --> 00:38:32,480
divisions of nasa to pay for spirit and

1059
00:38:37,510 --> 00:38:34,800
opportunity and then he goes

1060
00:38:40,470 --> 00:38:37,520
and so you have the next one and he is

1061
00:38:41,829 --> 00:38:40,480
sean o'keefe he i know him well he comes

1062
00:38:44,470 --> 00:38:41,839
from my place

1063
00:38:46,630 --> 00:38:44,480

he is a budget man that's number two in

1064
00:38:48,950 --> 00:38:46,640
the budget he's hired to deal with the

1065
00:38:51,109 --> 00:38:48,960
space station cost overrun

1066
00:38:53,190 --> 00:38:51,119
and then he has to deal with the crisis

1067
00:38:54,950 --> 00:38:53,200
of the columbia going down out of that

1068
00:38:57,270 --> 00:38:54,960
comes the

1069
00:39:01,109 --> 00:38:57,280
moon mars decision of bush ii

1070
00:39:01,910 --> 00:39:01,119
and he as he's and he says

1071
00:39:04,710 --> 00:39:01,920
well

1072
00:39:05,829 --> 00:39:04,720
again mars is a pre is precursory to

1073
00:39:08,550 --> 00:39:05,839
this human

1074
00:39:11,510 --> 00:39:08,560
mission and i am going to enlarge the

1075
00:39:14,069 --> 00:39:11,520
budget of the mars program

1076
00:39:16,790 --> 00:39:14,079
priority uh he comes from omb his view

1077
00:39:18,710 --> 00:39:16,800
of life is you deal it's better to have

1078
00:39:21,190 --> 00:39:18,720
priorities and do something well than do

1079
00:39:23,589 --> 00:39:21,200
a bunch of things not so well and so he

1080
00:39:25,349 --> 00:39:23,599
says i'm going to put money into mars

1081
00:39:27,349 --> 00:39:25,359
but money is going to come from human

1082
00:39:29,270 --> 00:39:27,359
space flight as well as from the science

1083
00:39:31,109 --> 00:39:29,280
division and it's going to grow to the

1084
00:39:31,990 --> 00:39:31,119
billion-dollar class over a period of

1085
00:39:33,589 --> 00:39:32,000
time

1086
00:39:35,109 --> 00:39:33,599
he goes

1087
00:39:37,109 --> 00:39:35,119
o'keefe comes in

1088
00:39:39,670 --> 00:39:37,119

o'keefe deals with the backlash from all

1089
00:39:40,390 --> 00:39:39,680
the other scientists who say why are you

1090
00:39:44,870 --> 00:39:40,400
we

1091
00:39:46,550 --> 00:39:44,880
balance not priority

1092
00:39:48,550 --> 00:39:46,560
so okay so

1093
00:39:50,630 --> 00:39:48,560
i think griffin is so interested in

1094
00:39:52,470 --> 00:39:50,640
constellation he doesn't want to deal

1095
00:39:55,190 --> 00:39:52,480
with uh with the scientific community

1096
00:39:56,790 --> 00:39:55,200
well you can tell about that mr hunters

1097
00:39:58,390 --> 00:39:56,800
but he doesn't want to deal with the

1098
00:40:01,349 --> 00:39:58,400
scientists he wants to deal with

1099
00:40:03,670 --> 00:40:01,359
constellation and he says you science

1100
00:40:05,670 --> 00:40:03,680
administrators you you worry about i'll

1101
00:40:07,589 --> 00:40:05,680
give you money leave me alone i want to

1102
00:40:12,150 --> 00:40:07,599
deal with constellation so basically

1103
00:40:17,109 --> 00:40:14,150
essentially he hires a science

1104
00:40:19,510 --> 00:40:17,119
administrator named stern who's gets him

1105
00:40:20,950 --> 00:40:19,520
in trouble with the scientific community

1106
00:40:23,510 --> 00:40:20,960
and jpl

1107
00:40:26,069 --> 00:40:23,520
alan stern is convinced there's a cabal

1108
00:40:29,190 --> 00:40:26,079
between jpl and the scientific community

1109
00:40:30,710 --> 00:40:29,200
to to to create this monster called mars

1110
00:40:32,710 --> 00:40:30,720
science laboratory which is going to

1111
00:40:34,630 --> 00:40:32,720
cost billions of dollars and he points

1112
00:40:36,390 --> 00:40:34,640
to a national academy of sciences study

1113
00:40:38,390 --> 00:40:36,400

a decadal study that says it's going to

1114
00:40:41,910 --> 00:40:38,400
cost x number of dollars which is far

1115
00:40:44,790 --> 00:40:41,920
fewer so how did it go from a to z

1116
00:40:47,829 --> 00:40:44,800
and obviously you you guys down at jpl

1117
00:40:50,230 --> 00:40:47,839
in the community must be doing something

1118
00:40:52,950 --> 00:40:50,240
wrong and he's going to be tough and

1119
00:40:54,550 --> 00:40:52,960
he's real tough and griffin says i go we

1120
00:40:55,670 --> 00:40:54,560
got to do we got to keep the mars

1121
00:40:57,109 --> 00:40:55,680
science

1122
00:41:00,390 --> 00:40:57,119
laboratory going

1123
00:41:02,870 --> 00:41:00,400
uh get the money to pay for it he he

1124
00:41:04,950 --> 00:41:02,880
looks at spirit and opportunity and he's

1125
00:41:06,550 --> 00:41:04,960
going to cut spirit and opportunity

1126
00:41:08,550 --> 00:41:06,560
he doesn't tell griffin that he's going

1127
00:41:09,990 --> 00:41:08,560
to talk spirit and opportunity there's a

1128
00:41:12,790 --> 00:41:10,000
huge

1129
00:41:14,790 --> 00:41:12,800
backlash from that griffin says

1130
00:41:17,109 --> 00:41:14,800
uh you didn't tell me

1131
00:41:19,750 --> 00:41:17,119
that's too bad bye-bye and that's the

1132
00:41:22,309 --> 00:41:19,760
end of stern and so he brings in another

1133
00:41:23,190 --> 00:41:22,319
brings wiler back weiler is very very

1134
00:41:23,990 --> 00:41:23,200
very

1135
00:41:27,589 --> 00:41:24,000
uh

1136
00:41:30,150 --> 00:41:27,599
canny bureaucratic politician and he put

1137
00:41:32,710 --> 00:41:30,160
and weiler basically is the man behind

1138
00:41:34,950 --> 00:41:32,720

the look looks at the situation

1139
00:41:37,190 --> 00:41:34,960
five minutes looks at the situation and

1140
00:41:39,510 --> 00:41:37,200
says we've got to have a delay

1141
00:41:41,829 --> 00:41:39,520
in this decision now

1142
00:41:44,790 --> 00:41:41,839
mr green said a delay decision is a big

1143
00:41:47,510 --> 00:41:44,800
deal it's a big decision you don't just

1144
00:41:49,349 --> 00:41:47,520
delay a mission two years and relax

1145
00:41:52,630 --> 00:41:49,359
it's a big decision

1146
00:41:55,270 --> 00:41:52,640
stern had gone to griffin to try to get

1147
00:41:56,870 --> 00:41:55,280
a delay in the mars science laboratory

1148
00:41:58,309 --> 00:41:56,880
he was going to delay it and then put a

1149
00:42:00,870 --> 00:41:58,319
cash on it

1150
00:42:03,030 --> 00:42:00,880
to start mars sample return

1151
00:42:04,950 --> 00:42:03,040
via mars science laboratory but he

1152
00:42:06,790 --> 00:42:04,960
needed a delay to do that

1153
00:42:09,589 --> 00:42:06,800
he didn't get his delay from griffin

1154
00:42:12,790 --> 00:42:09,599
weiler gets the delay and if anyone he

1155
00:42:15,109 --> 00:42:12,800
wants a real textbook study of how to do

1156
00:42:17,109 --> 00:42:15,119
things right and how to do things wrong

1157
00:42:19,670 --> 00:42:17,119
in a decision-making process study the

1158
00:42:22,150 --> 00:42:19,680
decision-making process of stern and the

1159
00:42:24,150 --> 00:42:22,160
decision-making process of weiler and

1160
00:42:26,550 --> 00:42:24,160
how they got the boss to give them the

1161
00:42:28,550 --> 00:42:26,560
answer they wanted because wyler got the

1162
00:42:30,630 --> 00:42:28,560
answer he wanted which is the delay the

1163
00:42:33,270 --> 00:42:30,640

decision to delay the decision to delay

1164
00:42:35,910 --> 00:42:33,280
was a very important decision probably

1165
00:42:38,790 --> 00:42:35,920
the most important mars decision

1166
00:42:41,190 --> 00:42:38,800
that griffin that griffin made

1167
00:42:43,430 --> 00:42:41,200
griffin goes

1168
00:42:46,630 --> 00:42:43,440
and so we got another administrator

1169
00:42:48,550 --> 00:42:46,640
and and this is now we have bolden

1170
00:42:50,309 --> 00:42:48,560
now bolden is our present administrator

1171
00:42:51,030 --> 00:42:50,319
and the story is not finished to unfold

1172
00:42:53,990 --> 00:42:51,040
it

1173
00:42:55,990 --> 00:42:54,000
bolden is interesting because

1174
00:42:57,510 --> 00:42:56,000
uh

1175
00:42:58,390 --> 00:42:57,520
essentially he didn't really want the

1176
00:43:00,710 --> 00:42:58,400
job

1177
00:43:02,950 --> 00:43:00,720
uh he said that and he and and they

1178
00:43:06,309 --> 00:43:02,960
didn't want the job because he had had a

1179
00:43:08,390 --> 00:43:06,319
job under golden back in the early 90s

1180
00:43:11,829 --> 00:43:08,400
and had been and found that dealing with

1181
00:43:13,270 --> 00:43:11,839
the politics of the job was dreadful

1182
00:43:14,630 --> 00:43:13,280
couldn't stand it

1183
00:43:16,950 --> 00:43:14,640
and uh

1184
00:43:20,150 --> 00:43:16,960
but he's a good soldier he's a military

1185
00:43:22,790 --> 00:43:20,160
guy and so he said when when obama asked

1186
00:43:25,430 --> 00:43:22,800
him to take the job he couldn't say no

1187
00:43:27,430 --> 00:43:25,440
having taken the job now he has to run

1188
00:43:28,870 --> 00:43:27,440

nasa and he asked for the

1189
00:43:30,870 --> 00:43:28,880
commander-in-chief to give him his

1190
00:43:32,550 --> 00:43:30,880
marching orders but as you know he

1191
00:43:34,870 --> 00:43:32,560
didn't get any marching orders for a

1192
00:43:37,349 --> 00:43:34,880
long while it wasn't until the next year

1193
00:43:39,349 --> 00:43:37,359
2010 that a budget came out and the

1194
00:43:40,790 --> 00:43:39,359
budget said we're going to cancel

1195
00:43:43,910 --> 00:43:40,800
constellation

1196
00:43:45,349 --> 00:43:43,920
now bolden had had very little influence

1197
00:43:47,829 --> 00:43:45,359
in that decision

1198
00:43:50,470 --> 00:43:47,839
and the critical question to be you want

1199
00:43:52,829 --> 00:43:50,480
to ask about a leader is does he have

1200
00:43:55,990 --> 00:43:52,839
influence and does he use it on behalf

1201
00:43:58,630 --> 00:43:56,000
of mars

1202
00:43:59,910 --> 00:43:58,640
that decision that roll out decision was

1203
00:44:02,630 --> 00:43:59,920
dreadful

1204
00:44:04,470 --> 00:44:02,640
uh bolton calls it a disaster it was it

1205
00:44:07,109 --> 00:44:04,480
was a disaster for nasa it was a

1206
00:44:09,510 --> 00:44:07,119
disaster for him personally because he

1207
00:44:11,109 --> 00:44:09,520
hadn't had that much control over it and

1208
00:44:13,109 --> 00:44:11,119
the congress says why should we talk to

1209
00:44:14,870 --> 00:44:13,119
you we should be talking to the omb or

1210
00:44:16,630 --> 00:44:14,880
somebody like that who make really makes

1211
00:44:18,710 --> 00:44:16,640
decisions around here and the

1212
00:44:21,589 --> 00:44:18,720
consequences have hurt his influence

1213
00:44:24,309 --> 00:44:21,599

and so bolden becomes

1214
00:44:26,550 --> 00:44:24,319
caught between this toxic thing that he

1215
00:44:29,109 --> 00:44:26,560
desperately didn't want to be part of

1216
00:44:30,710 --> 00:44:29,119
of washington which is the congress and

1217
00:44:33,190 --> 00:44:30,720
the president fighting

1218
00:44:35,030 --> 00:44:33,200
over a program called constellation

1219
00:44:36,550 --> 00:44:35,040
which has been killed

1220
00:44:38,150 --> 00:44:36,560
uh and then and what are we going to

1221
00:44:40,150 --> 00:44:38,160
replace it with

1222
00:44:41,829 --> 00:44:40,160
and in the end of the day

1223
00:44:44,950 --> 00:44:41,839
finally after months and months and

1224
00:44:47,109 --> 00:44:44,960
months congress makes a decision which

1225
00:44:48,950 --> 00:44:47,119
fortune forces on the president which

1226
00:44:51,589 --> 00:44:48,960
we're going to have a major manned space

1227
00:44:53,510 --> 00:44:51,599
program which the space

1228
00:44:54,710 --> 00:44:53,520
this is called the space

1229
00:44:57,510 --> 00:44:54,720
whatever it is

1230
00:44:59,109 --> 00:44:57,520
it's the rockets big rockets heavy lift

1231
00:45:00,309 --> 00:44:59,119
and we're going to have orion two

1232
00:45:02,390 --> 00:45:00,319
minutes to go

1233
00:45:03,750 --> 00:45:02,400
and uh but they're not going to give you

1234
00:45:04,630 --> 00:45:03,760
more money

1235
00:45:05,910 --> 00:45:04,640
so

1236
00:45:07,430 --> 00:45:05,920
all of a sudden

1237
00:45:09,430 --> 00:45:07,440
you've got a situation of being an

1238
00:45:12,150 --> 00:45:09,440

administrator in which you've got this

1239
00:45:13,349 --> 00:45:12,160
massive new man program

1240
00:45:15,349 --> 00:45:13,359
you've got

1241
00:45:17,030 --> 00:45:15,359
the mars program which you are very

1242
00:45:18,950 --> 00:45:17,040
supportive of and i'll get back to in a

1243
00:45:20,630 --> 00:45:18,960
minute because essentially while all

1244
00:45:23,430 --> 00:45:20,640
this is going on

1245
00:45:25,190 --> 00:45:23,440
this big politics stuff is going on

1246
00:45:27,750 --> 00:45:25,200
what is going on at the

1247
00:45:30,309 --> 00:45:27,760
science level wilder level

1248
00:45:32,790 --> 00:45:30,319
is a negotiation between wyler and his

1249
00:45:34,710 --> 00:45:32,800
counterpart in england to have

1250
00:45:38,069 --> 00:45:34,720
mars sample return

1251
00:45:40,550 --> 00:45:38,079
via this exomars effort with europe so

1252
00:45:42,870 --> 00:45:40,560
this is going on at that level but this

1253
00:45:45,829 --> 00:45:42,880
other stuff is going on at another level

1254
00:45:48,230 --> 00:45:45,839
which is all about manned space and all

1255
00:45:49,270 --> 00:45:48,240
about money and finally they come

1256
00:45:51,510 --> 00:45:49,280
together

1257
00:45:52,710 --> 00:45:51,520
when you're dealing with the budget

1258
00:45:54,870 --> 00:45:52,720
last

1259
00:45:56,230 --> 00:45:54,880
between thanksgiving and christmas of

1260
00:45:57,510 --> 00:45:56,240
last year

1261
00:46:00,069 --> 00:45:57,520
when you're dealing with the final

1262
00:46:03,750 --> 00:46:00,079
budget decisions nasa has people in

1263
00:46:04,710 --> 00:46:03,760

paris negotiating with europe over exo

1264
00:46:06,630 --> 00:46:04,720
mars

1265
00:46:09,030 --> 00:46:06,640
bolden is talking to dordane his

1266
00:46:10,470 --> 00:46:09,040
counterpart over there about

1267
00:46:12,230 --> 00:46:10,480
whether or not we can really go ahead

1268
00:46:14,470 --> 00:46:12,240
with this this is three years of

1269
00:46:16,069 --> 00:46:14,480
negotiation that's been going on at the

1270
00:46:17,990 --> 00:46:16,079
same time he's talking to the budget

1271
00:46:20,870 --> 00:46:18,000
bureau the office of management budget

1272
00:46:23,030 --> 00:46:20,880
and the baffling budget says look look

1273
00:46:25,349 --> 00:46:23,040
you've got no money

1274
00:46:27,430 --> 00:46:25,359
for james webb space telescope it's gone

1275
00:46:29,510 --> 00:46:27,440
up to 8.7 billion dollars where are you

1276
00:46:31,990 --> 00:46:29,520
going to get the money for that he says

1277
00:46:32,950 --> 00:46:32,000
they say to him make a decision

1278
00:46:35,349 --> 00:46:32,960
web

1279
00:46:37,589 --> 00:46:35,359
versus mars what do you want you can't

1280
00:46:39,430 --> 00:46:37,599
have two huge

1281
00:46:41,190 --> 00:46:39,440
flagship programs

1282
00:46:43,349 --> 00:46:41,200
it's not the decision

1283
00:46:45,349 --> 00:46:43,359
and so bolden says

1284
00:46:47,430 --> 00:46:45,359
well truth of the matter is bolden makes

1285
00:46:50,230 --> 00:46:47,440
a decision but it's not his decision

1286
00:46:51,910 --> 00:46:50,240
it's forced on him by the omb and is

1287
00:46:53,750 --> 00:46:51,920
forced on the omb

1288
00:46:56,069 --> 00:46:53,760

by the political people who have already

1289
00:46:57,349 --> 00:46:56,079
decided that james webb will survive one

1290
00:46:58,870 --> 00:46:57,359
way or another

1291
00:46:59,750 --> 00:46:58,880
and we'll take the money from somewhere

1292
00:47:00,630 --> 00:46:59,760
else

1293
00:47:02,069 --> 00:47:00,640
so

1294
00:47:04,230 --> 00:47:02,079
what's the

1295
00:47:07,270 --> 00:47:04,240
what is the moral of the story

1296
00:47:08,870 --> 00:47:07,280
the moral of the story is that all that

1297
00:47:11,510 --> 00:47:08,880
if you're asking the question do nasa

1298
00:47:13,670 --> 00:47:11,520
administrators matter yeah they matter

1299
00:47:15,510 --> 00:47:13,680
do they have influence not all of them

1300
00:47:36,950 --> 00:47:15,520
that and if they have influence they use

1301
00:47:40,069 --> 00:47:38,710
goes from nasa ames excuse me my

1302
00:47:42,150 --> 00:47:40,079
question is whether um a nasa

1303
00:47:43,829 --> 00:47:42,160
administrator will ever be able to

1304
00:47:46,390 --> 00:47:43,839
uh set a rational

1305
00:47:47,910 --> 00:47:46,400
um strategic direction uh for the agency

1306
00:47:49,349 --> 00:47:47,920
um should we be looking at another type

1307
00:47:50,870 --> 00:47:49,359
of organization to do that like a

1308
00:47:52,390 --> 00:47:50,880
committee and i've been thinking about

1309
00:47:54,630 --> 00:47:52,400
that since this morning when duane day

1310
00:47:56,230 --> 00:47:54,640
was talking about the ssb um and how

1311
00:47:58,470 --> 00:47:56,240
that absorbs some of the functions of

1312
00:47:59,990 --> 00:47:58,480
the naca jim green is saying that the

1313
00:48:01,990 --> 00:48:00,000

decadal surveys work very well in

1314
00:48:03,430 --> 00:48:02,000
setting a strategic direction and giving

1315
00:48:05,829 --> 00:48:03,440
everything that an administrator has to

1316
00:48:07,109 --> 00:48:05,839
balance uh should strategic direction be

1317
00:48:08,790 --> 00:48:07,119
coming from a different area that he

1318
00:48:10,069 --> 00:48:08,800
could then implement

1319
00:48:14,710 --> 00:48:10,079
i think the

1320
00:48:18,790 --> 00:48:17,430
the problem any any administrator has

1321
00:48:21,349 --> 00:48:18,800
dealing with his

1322
00:48:23,589 --> 00:48:21,359
the issue of a rational program

1323
00:48:25,430 --> 00:48:23,599
is that any administrator

1324
00:48:26,230 --> 00:48:25,440
isn't around that long

1325
00:48:28,790 --> 00:48:26,240
uh

1326
00:48:30,790 --> 00:48:28,800
note the typical administrators around

1327
00:48:32,950 --> 00:48:30,800
four years maybe five years golden was

1328
00:48:34,390 --> 00:48:32,960
the exception being nine and a half

1329
00:48:35,190 --> 00:48:34,400
that's rare

1330
00:48:35,990 --> 00:48:35,200
uh

1331
00:48:36,710 --> 00:48:36,000
so

1332
00:48:37,510 --> 00:48:36,720
the

1333
00:48:39,990 --> 00:48:37,520
what

1334
00:48:42,630 --> 00:48:40,000
the best you can do

1335
00:48:45,349 --> 00:48:42,640
is is to have the community

1336
00:48:46,790 --> 00:48:45,359
come up with a rational program have the

1337
00:48:50,309 --> 00:48:46,800
program office

1338
00:48:53,430 --> 00:48:50,319

the people who are career civil servants

1339
00:48:55,829 --> 00:48:53,440
buy in to that rational program

1340
00:48:59,829 --> 00:48:55,839
and then you try to you try to make sure

1341
00:49:02,069 --> 00:48:59,839
the administrator is on your side

1342
00:49:03,910 --> 00:49:02,079
and that he's good enough to sell it to

1343
00:49:04,950 --> 00:49:03,920
the political community

1344
00:49:07,190 --> 00:49:04,960
the

1345
00:49:08,870 --> 00:49:07,200
essentially mars exploration is like a

1346
00:49:12,069 --> 00:49:08,880
marathon race

1347
00:49:14,710 --> 00:49:12,079
it's going on over a year decades really

1348
00:49:17,270 --> 00:49:14,720
and so and the administrator comes in

1349
00:49:19,510 --> 00:49:17,280
and vectors into that off and on

1350
00:49:22,230 --> 00:49:19,520
so the more you can have a you won't get

1351
00:49:26,150 --> 00:49:22,240
ever you'll never get rationality

1352
00:49:27,750 --> 00:49:26,160
you get what is called muddling through

1353
00:49:28,950 --> 00:49:27,760
muddling through and that's the best

1354
00:49:30,069 --> 00:49:28,960
you're going to do

1355
00:49:40,230 --> 00:49:30,079
bundling through is the best you're

1356
00:49:40,240 --> 00:49:55,030
take about five minutes

1357
00:49:58,309 --> 00:49:56,630
thanks we've had a variety of fantastic

1358
00:50:03,190 --> 00:49:58,319
perspectives of mars exploration let's

1359
00:50:07,910 --> 00:50:05,190
hi i'm hiding behind the column here

1360
00:50:11,510 --> 00:50:07,920
richard burke i'm jim burke's son

1361
00:50:17,030 --> 00:50:14,630
several speakers have alluded to

1362
00:50:19,270 --> 00:50:17,040
water liquid water being the gold

1363
00:50:21,910 --> 00:50:19,280

standard for habitability

1364
00:50:24,710 --> 00:50:21,920
wondering about organisms in antarctica

1365
00:50:25,510 --> 00:50:24,720
that have no liquid water and if there's

1366
00:50:27,589 --> 00:50:25,520
any

1367
00:50:32,230 --> 00:50:27,599
addition to this discussion

1368
00:50:36,790 --> 00:50:35,510
well uh it's a great question um

1369
00:50:38,470 --> 00:50:36,800
one of the things

1370
00:50:39,990 --> 00:50:38,480
that the

1371
00:50:42,150 --> 00:50:40,000
extremophile

1372
00:50:42,870 --> 00:50:42,160
revolution if we can call it that or the

1373
00:50:48,470 --> 00:50:42,880
the

1374
00:50:51,430 --> 00:50:48,480
of discoveries of of ever

1375
00:50:52,630 --> 00:50:51,440
increasing extreme conditions that

1376
00:50:55,750 --> 00:50:52,640
that uh

1377
00:50:58,790 --> 00:50:55,760
that life can inhabit on earth

1378
00:51:01,750 --> 00:50:58,800
what they all do have in common is

1379
00:51:04,710 --> 00:51:01,760
their utilization of liquid water but

1380
00:51:06,630 --> 00:51:04,720
what's remarkable and you've alluded to

1381
00:51:11,510 --> 00:51:06,640
this uh in in the situation of

1382
00:51:14,950 --> 00:51:12,950
they

1383
00:51:17,030 --> 00:51:14,960
life has the ability to really push that

1384
00:51:20,230 --> 00:51:17,040
boundary so

1385
00:51:21,430 --> 00:51:20,240
so even in situations where

1386
00:51:23,349 --> 00:51:21,440
where it's

1387
00:51:26,309 --> 00:51:23,359
it's only sort of true there's liquid

1388
00:51:28,069 --> 00:51:26,319

water and uh you know the these uh

1389
00:51:30,630 --> 00:51:28,079
crypto endolythic organisms that are

1390
00:51:34,150 --> 00:51:30,640
living inside of frozen rocks in

1391
00:51:36,150 --> 00:51:34,160
antarctica but somehow using um sunlight

1392
00:51:39,349 --> 00:51:36,160
in the top layers of those rocks to

1393
00:51:41,190 --> 00:51:39,359
slightly warm themselves above the um

1394
00:51:43,670 --> 00:51:41,200
the uh

1395
00:51:44,790 --> 00:51:43,680
freezing point or places where they're

1396
00:51:47,990 --> 00:51:44,800
using

1397
00:51:51,589 --> 00:51:48,000
the salinity to push down below what

1398
00:51:53,910 --> 00:51:51,599
would seem to be the uh the

1399
00:51:56,230 --> 00:51:53,920
cold limit but they're using various

1400
00:51:57,910 --> 00:51:56,240
natural antifreezes so i don't think

1401
00:51:59,589 --> 00:51:57,920
it's literally true

1402
00:52:01,829 --> 00:51:59,599
that we've found

1403
00:52:05,270 --> 00:52:01,839
life that does not use liquid water but

1404
00:52:06,230 --> 00:52:05,280
it is remarkable the extent to which um

1405
00:52:07,990 --> 00:52:06,240
you know

1406
00:52:10,549 --> 00:52:08,000
the the literal interpretation of what

1407
00:52:15,349 --> 00:52:10,559
we need what we mean by liquid both on

1408
00:52:17,589 --> 00:52:15,359
the cold and hot and saline and acidic

1409
00:52:19,750 --> 00:52:17,599
boundaries have been pushed by life and

1410
00:52:21,430 --> 00:52:19,760
it really shows us as as i said before

1411
00:52:23,349 --> 00:52:21,440
that life seems to be not just necessary

1412
00:52:25,910 --> 00:52:23,359
but almost the water seems to be not

1413
00:52:28,470 --> 00:52:25,920

just necessary but almost sufficient for

1414
00:52:30,549 --> 00:52:28,480
uh for life so those those examples kind

1415
00:52:32,950 --> 00:52:30,559
of contribute to that sense that at

1416
00:52:35,270 --> 00:52:32,960
least for our kind of life that liquid

1417
00:52:37,589 --> 00:52:35,280
water in you know in in all its

1418
00:52:39,990 --> 00:52:37,599
manifestations even if it's just you

1419
00:52:41,910 --> 00:52:40,000
know the on the grains between minerals

1420
00:52:44,549 --> 00:52:41,920
and otherwise pretty dry and pretty

1421
00:52:46,790 --> 00:52:44,559
frozen rock is really the the key

1422
00:52:48,630 --> 00:52:46,800
criterion thank you

1423
00:52:52,549 --> 00:52:48,640
any further questions oh sorry answers

1424
00:52:56,710 --> 00:52:54,870
i think so this really matters for mars

1425
00:52:59,510 --> 00:52:56,720
because of the temperature environment

1426
00:53:01,109 --> 00:52:59,520
of the planet that just how close and

1427
00:53:03,270 --> 00:53:01,119
where you might be in terms of getting

1428
00:53:05,430 --> 00:53:03,280
liquid and if you get it

1429
00:53:07,990 --> 00:53:05,440
liquid by making it a brine then you

1430
00:53:10,309 --> 00:53:08,000
have other issues with biology the water

1431
00:53:12,150 --> 00:53:10,319
activity is really what counts

1432
00:53:14,390 --> 00:53:12,160
so it's an important point

1433
00:53:16,790 --> 00:53:14,400
i'd like to take just a moment to

1434
00:53:18,950 --> 00:53:16,800
further answer a question that was asked

1435
00:53:20,870 --> 00:53:18,960
about why aren't the meteorites

1436
00:53:23,109 --> 00:53:20,880
the samples of choice

1437
00:53:25,670 --> 00:53:23,119
one reason is is because

1438
00:53:27,109 --> 00:53:25,680

you won't get a sample of a sedimentary

1439
00:53:29,589 --> 00:53:27,119
rock back

1440
00:53:31,589 --> 00:53:29,599
via a meteorite it's just not going to

1441
00:53:33,510 --> 00:53:31,599
happen and yet those are the very kinds

1442
00:53:36,950 --> 00:53:33,520
of materials that could really preserve

1443
00:53:38,309 --> 00:53:36,960
biosignatures of that past line so it's

1444
00:53:40,069 --> 00:53:38,319
not just a matter of we don't know where

1445
00:53:41,910 --> 00:53:40,079
the rocks came from it's also a matter

1446
00:53:43,510 --> 00:53:41,920
if we want the right rock and that's

1447
00:53:45,990 --> 00:53:43,520
what we've really been trying to look

1448
00:53:46,000 --> 00:53:57,990
other questions

1449
00:54:00,950 --> 00:53:58,710
so

1450
00:54:03,190 --> 00:54:00,960
one of the issues that the mars program

1451
00:54:04,710 --> 00:54:03,200
has been dealing with of late is

1452
00:54:06,150 --> 00:54:04,720
competition

1453
00:54:08,069 --> 00:54:06,160
the decadal survey

1454
00:54:10,390 --> 00:54:08,079
obviously recommended the mars sample

1455
00:54:11,349 --> 00:54:10,400
return as the primary flagship mission

1456
00:54:13,190 --> 00:54:11,359
but the

1457
00:54:14,950 --> 00:54:13,200
europa mission was certainly highly

1458
00:54:17,750 --> 00:54:14,960
considered as well and i think there was

1459
00:54:18,790 --> 00:54:17,760
a uranus mission as well um

1460
00:54:21,510 --> 00:54:18,800
what

1461
00:54:23,109 --> 00:54:21,520
do you see as the technical scientific

1462
00:54:26,630 --> 00:54:23,119
or political

1463
00:54:29,109 --> 00:54:26,640

validities of a mars mission

1464
00:54:30,630 --> 00:54:29,119
as as opposed to the other missions why

1465
00:54:36,309 --> 00:54:30,640
do you think that mars should be first

1466
00:54:42,069 --> 00:54:38,710
what you're asking to sit at mars

1467
00:54:47,190 --> 00:54:44,870
i i truly believe that the issue between

1468
00:54:48,710 --> 00:54:47,200
say mars and europa it's not really a

1469
00:54:50,950 --> 00:54:48,720
question about which of those goats the

1470
00:54:52,950 --> 00:54:50,960
decadal survey was pretty clear that you

1471
00:54:54,870 --> 00:54:52,960
know give this a try if you can't work

1472
00:54:57,589 --> 00:54:54,880
this out this is next

1473
00:55:00,710 --> 00:54:57,599
our problem right now is we can't do any

1474
00:55:02,630 --> 00:55:00,720
flagship class activity with the budgets

1475
00:55:06,390 --> 00:55:02,640
that we've got going forward

1476
00:55:08,069 --> 00:55:06,400
so i i think that's the the real issue

1477
00:55:14,789 --> 00:55:08,079
solve that one and then we can get back

1478
00:55:18,870 --> 00:55:16,870
yes thank you um john sarkis from the

1479
00:55:22,069 --> 00:55:18,880
csiro in australia

1480
00:55:26,069 --> 00:55:22,079
um just in regards to sample return

1481
00:55:28,230 --> 00:55:26,079
everyone agrees it's a desirable

1482
00:55:30,150 --> 00:55:28,240
mission and so on however as i said

1483
00:55:32,870 --> 00:55:30,160
there are potentially

1484
00:55:34,710 --> 00:55:32,880
very large risks involved in that

1485
00:55:37,030 --> 00:55:34,720
so for example

1486
00:55:38,309 --> 00:55:37,040
if the sample contains some microbial

1487
00:55:40,470 --> 00:55:38,319
life or

1488
00:55:43,270 --> 00:55:40,480

or so on then returning that to the

1489
00:55:44,710 --> 00:55:43,280
earth could be potentially catastrophic

1490
00:55:46,150 --> 00:55:44,720
because there is there would be no

1491
00:55:49,109 --> 00:55:46,160
immunity to it

1492
00:55:52,069 --> 00:55:49,119
but also if we do send people to

1493
00:55:54,309 --> 00:55:52,079
to um to mars in the future then we'll

1494
00:55:56,069 --> 00:55:54,319
immediately contaminate the place

1495
00:55:59,109 --> 00:55:56,079
um and therefore

1496
00:56:01,030 --> 00:55:59,119
um you know we'll never be quite sure if

1497
00:56:03,750 --> 00:56:01,040
we do discover life subsequent

1498
00:56:05,030 --> 00:56:03,760
subsequently um is it indigenous or was

1499
00:56:06,309 --> 00:56:05,040
it introduced

1500
00:56:08,789 --> 00:56:06,319
um

1501
00:56:10,870 --> 00:56:08,799
and and so i'd like to hear your your

1502
00:56:12,789 --> 00:56:10,880
opinions on that you know about how we

1503
00:56:15,829 --> 00:56:12,799
could get around those two

1504
00:56:17,589 --> 00:56:15,839
two problems um and be confident that if

1505
00:56:19,430 --> 00:56:17,599
there is life we're safe

1506
00:56:21,990 --> 00:56:19,440
from it and also you know that we're

1507
00:56:25,510 --> 00:56:22,000
confident that it is indigenous to mars

1508
00:56:30,630 --> 00:56:28,390
well of course uh nasa has a planetary

1509
00:56:33,270 --> 00:56:30,640
protection program which

1510
00:56:34,470 --> 00:56:33,280
specifically uh is

1511
00:56:35,670 --> 00:56:34,480
exists

1512
00:56:36,630 --> 00:56:35,680
to

1513
00:56:39,349 --> 00:56:36,640

address

1514
00:56:40,789 --> 00:56:39,359
those questions

1515
00:56:42,390 --> 00:56:40,799
we don't know

1516
00:56:43,589 --> 00:56:42,400
complete we don't we don't have a

1517
00:56:45,109 --> 00:56:43,599
completely clear

1518
00:56:47,670 --> 00:56:45,119
answer to how

1519
00:56:53,270 --> 00:56:47,680
serious those those concerns are my own

1520
00:56:58,710 --> 00:56:55,589
likely to be infected by martian

1521
00:57:00,630 --> 00:56:58,720
organisms even if they do exist because

1522
00:57:01,430 --> 00:57:00,640
if you look at earth

1523
00:57:03,349 --> 00:57:01,440
the

1524
00:57:05,910 --> 00:57:03,359
evolution of

1525
00:57:10,309 --> 00:57:05,920
um of parasites and

1526
00:57:12,230 --> 00:57:10,319
of um dangerous microbes and their host

1527
00:57:13,670 --> 00:57:12,240
and target organisms very closely

1528
00:57:16,150 --> 00:57:13,680
coupled together

1529
00:57:18,789 --> 00:57:16,160
um and so it's it's

1530
00:57:21,109 --> 00:57:18,799
i think less likely that we would suffer

1531
00:57:23,190 --> 00:57:21,119
and an infestation by some kind of

1532
00:57:25,270 --> 00:57:23,200
organism that had really had a separate

1533
00:57:28,390 --> 00:57:25,280
evolution but of course we don't know

1534
00:57:30,789 --> 00:57:28,400
that and because of the existential

1535
00:57:32,549 --> 00:57:30,799
risks involved in being wrong the

1536
00:57:35,190 --> 00:57:32,559
responsible thing to do is to have a

1537
00:57:37,589 --> 00:57:35,200
planetary protection program and in my

1538
00:57:39,109 --> 00:57:37,599

view we have an adequate program to

1539
00:57:41,190 --> 00:57:39,119
guard against that but you know it's

1540
00:57:42,630 --> 00:57:41,200
it's it's worth asking and we uh we

1541
00:57:45,190 --> 00:57:42,640
continually um

1542
00:57:46,710 --> 00:57:45,200
we review that that question and we

1543
00:57:56,150 --> 00:57:46,720
ought to keep doing it as we learn more

1544
00:58:00,069 --> 00:57:57,910
i i actually wanted to offer an

1545
00:58:02,789 --> 00:58:00,079
observation which uh sparked by the

1546
00:58:04,789 --> 00:58:02,799
question of mars versus europa

1547
00:58:07,030 --> 00:58:04,799
and and it's it's a it's a personal

1548
00:58:09,829 --> 00:58:07,040
observation over the past few weeks

1549
00:58:12,390 --> 00:58:09,839
i've set in on briefings on two major

1550
00:58:14,710 --> 00:58:12,400
studies that nasa initiated in response

1551
00:58:16,470 --> 00:58:14,720
to the proposed budget cuts orlando

1552
00:58:19,190 --> 00:58:16,480
figueroa led a group called the mars

1553
00:58:21,510 --> 00:58:19,200
program planning group mppg

1554
00:58:24,069 --> 00:58:21,520
and the europa folks their science

1555
00:58:25,750 --> 00:58:24,079
definition team uh under jim green's

1556
00:58:28,230 --> 00:58:25,760
direction went back and did a major

1557
00:58:31,510 --> 00:58:28,240
study and both of those groups bit the

1558
00:58:33,430 --> 00:58:31,520
bullet and they completely rescued the

1559
00:58:35,349 --> 00:58:33,440
missions that had been part of the

1560
00:58:38,230 --> 00:58:35,359
decadal survey

1561
00:58:40,069 --> 00:58:38,240
while and and maintain a substantial

1562
00:58:42,309 --> 00:58:40,079
amount of the science that both of them

1563
00:58:44,470 --> 00:58:42,319

had in the decadal survey which makes

1564
00:58:46,710 --> 00:58:44,480
them still high priority and yet they've

1565
00:58:49,270 --> 00:58:46,720
managed to reduce the cost by a factor

1566
00:58:51,030 --> 00:58:49,280
of two or more and the cost has been

1567
00:58:53,270 --> 00:58:51,040
validated by an independent group of

1568
00:58:55,190 --> 00:58:53,280
people the same group that did the uh

1569
00:58:57,670 --> 00:58:55,200
the validation of the decadal survey

1570
00:59:01,750 --> 00:58:57,680
missions to begin with the irony to me

1571
00:59:03,349 --> 00:59:01,760
is that if the budget were still at 1.5

1572
00:59:04,710 --> 00:59:03,359
it wouldn't be either or we could do

1573
00:59:07,510 --> 00:59:04,720
them both

1574
00:59:09,750 --> 00:59:07,520
we could be standing on the you know on

1575
00:59:11,829 --> 00:59:09,760
the on the threshold of a phenomenal era

1576
00:59:13,750 --> 00:59:11,839
where we can actually explore this

1577
00:59:19,670 --> 00:59:13,760
question of habitability on two fronts

1578
00:59:24,710 --> 00:59:21,829
well we had the benefits over this last

1579
00:59:27,510 --> 00:59:24,720
decade of both a very vigorous outer

1580
00:59:28,789 --> 00:59:27,520
planets program and a very vigorous mars

1581
00:59:30,069 --> 00:59:28,799
program

1582
00:59:33,030 --> 00:59:30,079
and

1583
00:59:34,789 --> 00:59:33,040
to argue scientifically that you know we

1584
00:59:36,069 --> 00:59:34,799
should have just had one it's certainly

1585
00:59:38,230 --> 00:59:36,079
hard to do that given all the

1586
00:59:40,549 --> 00:59:38,240
discoveries in both those areas

1587
00:59:42,710 --> 00:59:40,559
but just to finish the the point about

1588
00:59:44,470 --> 00:59:42,720

sample return if you have a sample

1589
00:59:47,030 --> 00:59:44,480
return is one way of knowing what the

1590
00:59:49,190 --> 00:59:47,040
environment is before the humans step

1591
00:59:50,549 --> 00:59:49,200
down on it and whether or not there are

1592
00:59:52,549 --> 00:59:50,559
certain dangers that they might

1593
00:59:54,309 --> 00:59:52,559
encounter in that environment

1594
00:59:55,750 --> 00:59:54,319
and planetary protection is the thing

1595
00:59:56,789 --> 00:59:55,760
that's going to keep us safe in the

1596
01:00:01,670 --> 00:59:56,799
meantime

1597
01:00:04,870 --> 01:00:03,750
all right thank you very much and let's

1598
01:00:08,870 --> 01:00:04,880
take a minute to thank all of our