
SPRAKER

1
00:00:10,870 --> 00:00:06,070
oh dear

2
00:00:16,150 --> 00:00:13,749
i wish i could go read about it

3
00:00:17,990 --> 00:00:16,160
well i'd like to get our panelists up to

4
00:00:21,029 --> 00:00:18,000
have a little bit of a round table even

5
00:00:25,830 --> 00:00:21,039
though it's a rectangular table

6
00:00:30,470 --> 00:00:27,269
so if we can

7
00:00:31,830 --> 00:00:30,480
have our panels seated we can

8
00:00:34,069 --> 00:00:31,840
try and

9
00:00:36,229 --> 00:00:34,079
shed some light on some of the

10
00:00:38,389 --> 00:00:36,239
the questions that i know

11
00:00:40,310 --> 00:00:38,399
are still unanswered

12
00:00:42,069 --> 00:00:40,320
um

13
00:00:44,229 --> 00:00:42,079

let's see

14
00:00:45,510 --> 00:00:44,239
i guess maybe we'll maybe we'll go in

15
00:00:48,150 --> 00:00:45,520
the same order

16
00:00:49,830 --> 00:00:48,160
glenn let me start with you

17
00:00:51,670 --> 00:00:49,840
um

18
00:00:53,350 --> 00:00:51,680
you know one of the constants over the

19
00:00:54,389 --> 00:00:53,360
years has been

20
00:00:56,229 --> 00:00:54,399
uh

21
00:00:58,470 --> 00:00:56,239
a kind of a battle about what the

22
00:01:00,150 --> 00:00:58,480
justification for first the science

23
00:01:01,990 --> 00:01:00,160
missions have been what the and

24
00:01:03,029 --> 00:01:02,000
planetary of course is only one subset

25
00:01:05,590 --> 00:01:03,039
of that but

26
00:01:07,590 --> 00:01:05,600
you know if you if you and you of course

27
00:01:09,670 --> 00:01:07,600
have been pointing out that we misuse

28
00:01:12,710 --> 00:01:09,680
the word precursors or we miss the

29
00:01:14,550 --> 00:01:12,720
nuances in the word precursors and so

30
00:01:17,109 --> 00:01:14,560
i'll just throw out the

31
00:01:20,550 --> 00:01:17,119
what may be a simplistic interpretation

32
00:01:22,310 --> 00:01:20,560
of of uh the past events which says that

33
00:01:24,870 --> 00:01:22,320
um the planetary

34
00:01:26,950 --> 00:01:24,880
program is sort of like the remora that

35
00:01:28,149 --> 00:01:26,960
latches on to the human space flight

36
00:01:30,630 --> 00:01:28,159
shark

37
00:01:32,469 --> 00:01:30,640
and and only makes a living as long as

38
00:01:34,950 --> 00:01:32,479

that shark is healthy

39
00:01:37,109 --> 00:01:34,960
um has your research given you a

40
00:01:38,630 --> 00:01:37,119
different perspective of how planetary

41
00:01:41,670 --> 00:01:38,640
fits into the broader picture of the

42
00:01:43,590 --> 00:01:41,680
space program

43
00:01:45,109 --> 00:01:43,600
uh wow that's a good question to start

44
00:01:46,789 --> 00:01:45,119
with um

45
00:01:49,670 --> 00:01:46,799
we don't mess around here no yeah

46
00:01:51,109 --> 00:01:49,680
seriously uh no i think um i'm you know

47
00:01:52,069 --> 00:01:51,119
historians will say that there's three

48
00:01:54,149 --> 00:01:52,079
general

49
00:01:55,429 --> 00:01:54,159
uh historical justifications for space

50
00:01:58,069 --> 00:01:55,439
flight there's the von braun

51
00:02:01,109 --> 00:01:58,079
nationalistic approach plant the flag

52
00:02:04,069 --> 00:02:01,119
uh george o'neill's space settlement

53
00:02:06,830 --> 00:02:04,079
vision and carl sagan

54
00:02:09,589 --> 00:02:06,840
belief that just understanding the solar

55
00:02:12,390 --> 00:02:09,599
system uh evokes a sense of wonder that

56
00:02:14,070 --> 00:02:12,400
that cannot be replicated anywhere and

57
00:02:16,150 --> 00:02:14,080
by studying anything else and and i

58
00:02:18,869 --> 00:02:16,160
think uh to a degree it's very possible

59
00:02:20,550 --> 00:02:18,879
to continue to pursue a planetary

60
00:02:22,630 --> 00:02:20,560
science program

61
00:02:25,110 --> 00:02:22,640
for those ah moments when uh something

62
00:02:26,630 --> 00:02:25,120
really spectacular is discovered

63
00:02:28,229 --> 00:02:26,640

that said

64
00:02:30,390 --> 00:02:28,239
it's hard to build a business case on

65
00:02:31,750 --> 00:02:30,400
that and sometimes within

66
00:02:33,589 --> 00:02:31,760
um

67
00:02:35,670 --> 00:02:33,599
planetary exploration that's required

68
00:02:37,990 --> 00:02:35,680
and um there are a lot of people who

69
00:02:39,750 --> 00:02:38,000
believe that settling the space system

70
00:02:41,750 --> 00:02:39,760
either because of what's happening here

71
00:02:43,750 --> 00:02:41,760
on earth or because ultimately humans

72
00:02:45,430 --> 00:02:43,760
just want to go out there and

73
00:02:47,830 --> 00:02:45,440
step foot on the moon

74
00:02:49,670 --> 00:02:47,840
is a worthwhile goal and

75
00:02:51,750 --> 00:02:49,680
i think planetary science and human will

76
00:02:53,350 --> 00:02:51,760
always be intertwined as long as there

77
00:02:55,589 --> 00:02:53,360
are people here on earth but um

78
00:02:57,190 --> 00:02:55,599
definitely the uh there's the human uh

79
00:02:58,390 --> 00:02:57,200
settlement of the the solar system is

80
00:03:00,470 --> 00:02:58,400
something that's very compelling and i

81
00:03:02,630 --> 00:03:00,480
think we need to recognize that as a

82
00:03:04,390 --> 00:03:02,640
factor in understanding the course of

83
00:03:06,790 --> 00:03:04,400
planetary exploration

84
00:03:08,869 --> 00:03:06,800
anybody else want to weigh in on that on

85
00:03:10,949 --> 00:03:08,879
that rather large

86
00:03:13,830 --> 00:03:10,959
chunk of

87
00:03:16,149 --> 00:03:13,840
reasoning and questioning that we've got

88
00:03:18,949 --> 00:03:16,159

on the table

89
00:03:21,030 --> 00:03:18,959
scott looks absolutely you know you look

90
00:03:23,110 --> 00:03:21,040
i can't tell if you're in a trance from

91
00:03:26,390 --> 00:03:23,120
that question or

92
00:03:28,869 --> 00:03:26,400
i i'm i'm dazzled by the last two days

93
00:03:30,309 --> 00:03:28,879
you're numbed yeah no the uh

94
00:03:32,390 --> 00:03:30,319
you know one thing that we haven't

95
00:03:34,550 --> 00:03:32,400
talked about at all with respect to the

96
00:03:37,670 --> 00:03:34,560
planetary program is that

97
00:03:38,710 --> 00:03:37,680
someone observed it was an invention of

98
00:03:41,589 --> 00:03:38,720
nasa

99
00:03:43,110 --> 00:03:41,599
every other element has other agencies

100
00:03:45,350 --> 00:03:43,120
that are involved in the earth science

101
00:03:47,830 --> 00:03:45,360
arena there are many agencies that are

102
00:03:50,070 --> 00:03:47,840
involved so

103
00:03:52,550 --> 00:03:50,080
on the one hand that makes

104
00:03:54,550 --> 00:03:52,560
planetary sort of vulnerable

105
00:03:56,309 --> 00:03:54,560
because one agency decides if it comes

106
00:03:59,110 --> 00:03:56,319
or goes

107
00:04:02,470 --> 00:03:59,120
on the other hand i would argue to

108
00:04:04,390 --> 00:04:02,480
jim's boss and boss's bosses that

109
00:04:06,710 --> 00:04:04,400
it means you have a special stewardship

110
00:04:09,910 --> 00:04:06,720
responsibility as well because the

111
00:04:12,550 --> 00:04:09,920
return on investment in term

112
00:04:15,030 --> 00:04:12,560
as inspiration to the world is just

113
00:04:18,229 --> 00:04:15,040

staggering some people have commented on

114
00:04:20,550 --> 00:04:18,239
this tangentially i know when the

115
00:04:23,430 --> 00:04:20,560
i have a good friend who's a spanish

116
00:04:26,230 --> 00:04:23,440
physicist juan perez marketers started

117
00:04:28,230 --> 00:04:26,240
the astrobiology institute in madrid

118
00:04:30,390 --> 00:04:28,240
and when mars polar lander and mars

119
00:04:32,390 --> 00:04:30,400
climate orbiter disappeared he was

120
00:04:35,990 --> 00:04:32,400
really

121
00:04:39,030 --> 00:04:36,000
he said you know when when nasa doesn't

122
00:04:41,749 --> 00:04:39,040
do well the entire world feels bad

123
00:04:43,590 --> 00:04:41,759
so i you know i think that we somehow

124
00:04:46,150 --> 00:04:43,600
through the planetary program bring the

125
00:04:48,629 --> 00:04:46,160
sense of inspiration and uplift

126
00:04:50,550 --> 00:04:48,639
to the rest of the world you know that's

127
00:04:52,390 --> 00:04:50,560
that's certainly i don't think anybody

128
00:04:54,710 --> 00:04:52,400
would argue with that and yet we've

129
00:04:57,830 --> 00:04:54,720
heard so many times over the last two

130
00:04:59,670 --> 00:04:57,840
days in particular yesterday morning's

131
00:05:02,390 --> 00:04:59,680
discussions of budget

132
00:05:04,710 --> 00:05:02,400
that when the going gets tough you know

133
00:05:07,510 --> 00:05:04,720
it becomes very clear that of the space

134
00:05:09,350 --> 00:05:07,520
science pursuits of nasa planetary is

135
00:05:11,749 --> 00:05:09,360
low man on the totem pole

136
00:05:14,310 --> 00:05:11,759
and how do we

137
00:05:15,510 --> 00:05:14,320
how do we grapple with that how do we

138
00:05:17,430 --> 00:05:15,520

um

139
00:05:19,830 --> 00:05:17,440
how do we reconcile that how do we

140
00:05:22,070 --> 00:05:19,840
change that does anybody want to

141
00:05:24,629 --> 00:05:22,080
want to weigh in on on that is it a

142
00:05:26,629 --> 00:05:24,639
matter of making the case better yeah

143
00:05:28,790 --> 00:05:26,639
amy

144
00:05:30,790 --> 00:05:28,800
yeah um i mean i think this time around

145
00:05:33,110 --> 00:05:30,800
it really wasn't so much low man on the

146
00:05:36,150 --> 00:05:33,120
totem pole for there wasn't any sort of

147
00:05:37,830 --> 00:05:36,160
prejudice associated with the you know

148
00:05:40,469 --> 00:05:37,840
being prejudiced against the planetary

149
00:05:43,029 --> 00:05:40,479
program i think it's a matter of timing

150
00:05:45,510 --> 00:05:43,039
um in this case um with respect i i

151
00:05:49,029 --> 00:05:45,520
think we're alluding to the 21 budget

152
00:05:50,870 --> 00:05:49,039
cut in the fy 13 budget um most recently

153
00:05:53,350 --> 00:05:50,880
and i think that that was mostly a

154
00:05:55,510 --> 00:05:53,360
product of the fact that

155
00:05:56,950 --> 00:05:55,520
nasa and and the white house and

156
00:05:59,350 --> 00:05:56,960
congress are have a lot of

157
00:06:01,990 --> 00:05:59,360
constituencies that they need to satisfy

158
00:06:03,270 --> 00:06:02,000
in terms of the budget and um

159
00:06:04,870 --> 00:06:03,280
you know across human space flight

160
00:06:06,870 --> 00:06:04,880
aeronautics

161
00:06:08,550 --> 00:06:06,880
space science of course and then and so

162
00:06:10,950 --> 00:06:08,560
there's sort of a general understanding

163
00:06:14,230 --> 00:06:10,960

that you've got allocations uh you know

164
00:06:15,909 --> 00:06:14,240
sort of a box if you will and uh that

165
00:06:17,670 --> 00:06:15,919
generally speaking will go to space

166
00:06:20,070 --> 00:06:17,680
science and then within space science

167
00:06:22,629 --> 00:06:20,080
you have the contention of planetary

168
00:06:23,350 --> 00:06:22,639
science astrophysics heliophysics and

169
00:06:27,590 --> 00:06:23,360
and

170
00:06:29,029 --> 00:06:27,600
um

171
00:06:31,909 --> 00:06:29,039
you know i think this time around what

172
00:06:34,390 --> 00:06:31,919
it was was there is one massive space

173
00:06:36,230 --> 00:06:34,400
science mission um not faster better

174
00:06:39,749 --> 00:06:36,240
cheaper um the james webb space

175
00:06:42,950 --> 00:06:39,759
telescope which um is is is consuming a

176
00:06:44,710 --> 00:06:42,960
lot of um a lot of budget certainly and

177
00:06:47,510 --> 00:06:44,720
i think that that kind of mission is

178
00:06:49,270 --> 00:06:47,520
generally kind of scary um to to folks

179
00:06:52,390 --> 00:06:49,280
at you know in the white house and in

180
00:06:56,710 --> 00:06:52,400
omb i can speak um from that experience

181
00:06:58,870 --> 00:06:56,720
and are you know and and fear to have a

182
00:07:00,710 --> 00:06:58,880
to put to in place a mission like that

183
00:07:04,550 --> 00:07:00,720
you get

184
00:07:07,670 --> 00:07:04,560
know kind of passing like you know

185
00:07:09,749 --> 00:07:07,680
running into the overruns and such uh

186
00:07:12,309 --> 00:07:09,759
and also there's generally a concern

187
00:07:14,950 --> 00:07:12,319
about leaving um kind of what you what

188
00:07:17,510 --> 00:07:14,960

you leave for future administrations um

189
00:07:19,909 --> 00:07:17,520
whether you buy or into that

190
00:07:22,070 --> 00:07:19,919
logic or not is another matter or agree

191
00:07:25,270 --> 00:07:22,080
with that rationale but that that kind

192
00:07:27,189 --> 00:07:25,280
of sense sometimes exists let me let me

193
00:07:29,430 --> 00:07:27,199
stay with you for a second here because

194
00:07:31,909 --> 00:07:29,440
um one of the things that

195
00:07:33,830 --> 00:07:31,919
that i remember that one of my favorite

196
00:07:35,270 --> 00:07:33,840
anecdotes from the faster better cheaper

197
00:07:37,909 --> 00:07:35,280
era

198
00:07:41,029 --> 00:07:37,919
came from tony spear who was the project

199
00:07:43,589 --> 00:07:41,039
manager on the mars pathfinder lander

200
00:07:44,390 --> 00:07:43,599
and you know they had this uh small you

201
00:07:47,909 --> 00:07:44,400
know

202
00:07:50,070 --> 00:07:47,919
young eager skunk works type team at jpl

203
00:07:52,550 --> 00:07:50,080
that could really get in and reinvent

204
00:07:54,469 --> 00:07:52,560
how you land on mars and it was all very

205
00:07:55,909 --> 00:07:54,479
exciting and of course we know how it

206
00:07:58,629 --> 00:07:55,919
turned out it was

207
00:08:01,749 --> 00:07:58,639
wonderfully successful but you know tony

208
00:08:04,869 --> 00:08:01,759
uh told me uh he on the one hand you had

209
00:08:06,629 --> 00:08:04,879
dan golden out in public you know

210
00:08:09,350 --> 00:08:06,639
boasting that he was

211
00:08:11,670 --> 00:08:09,360
telling his people to take risks and and

212
00:08:14,629 --> 00:08:11,680
that was a good thing and in private he

213
00:08:17,749 --> 00:08:14,639

was telling tony spear don't you dare

214
00:08:19,189 --> 00:08:17,759
fail or i'll shoot you on the jpl mall

215
00:08:20,950 --> 00:08:19,199
now

216
00:08:23,189 --> 00:08:20,960
my question is

217
00:08:25,029 --> 00:08:23,199
out of that

218
00:08:27,749 --> 00:08:25,039
and i'm interested in your perspective

219
00:08:29,110 --> 00:08:27,759
also as a former omb

220
00:08:30,950 --> 00:08:29,120
denizen

221
00:08:34,949 --> 00:08:30,960
what is the

222
00:08:36,630 --> 00:08:34,959
tolerance

223
00:08:40,070 --> 00:08:36,640
for mistakes

224
00:08:43,430 --> 00:08:40,080
whether they are mistakes in

225
00:08:46,230 --> 00:08:43,440
costing a mission budget or

226
00:08:49,590 --> 00:08:46,240
whether they're mistakes in performance

227
00:08:53,110 --> 00:08:49,600
can you can you talk about what you saw

228
00:08:56,470 --> 00:08:53,120
from both sides of the fence

229
00:08:57,829 --> 00:08:56,480
in with respect to performance

230
00:08:59,590 --> 00:08:57,839
um

231
00:09:02,710 --> 00:08:59,600
let me think about this

232
00:09:04,470 --> 00:09:02,720
um i i think that the crowd i i mean

233
00:09:06,630 --> 00:09:04,480
there are rational people i mean i know

234
00:09:08,630 --> 00:09:06,640
the decisions don't come across as

235
00:09:10,550 --> 00:09:08,640
rational all the time and they're not

236
00:09:12,710 --> 00:09:10,560
rationally constructed seems to be a lot

237
00:09:14,389 --> 00:09:12,720
of laughter going on in the world

238
00:09:17,110 --> 00:09:14,399

but i'm not sure what to make of that

239
00:09:19,670 --> 00:09:17,120
yes exactly um but there are actually

240
00:09:21,670 --> 00:09:19,680
people there who very much care about

241
00:09:22,470 --> 00:09:21,680
the space program in fact

242
00:09:24,150 --> 00:09:22,480
i mean

243
00:09:25,829 --> 00:09:24,160
it may be a little known secret but most

244
00:09:27,990 --> 00:09:25,839
of the folks who are

245
00:09:29,670 --> 00:09:28,000
at the office of management budget and

246
00:09:32,470 --> 00:09:29,680
at the office of science and technology

247
00:09:34,790 --> 00:09:32,480
policy are actually there because they

248
00:09:36,389 --> 00:09:34,800
believe in if not have a background

249
00:09:38,230 --> 00:09:36,399
actually they pretty much all have a

250
00:09:40,389 --> 00:09:38,240
background and higher degrees in these

251
00:09:41,990 --> 00:09:40,399
in these fields so so i mean there is a

252
00:09:45,030 --> 00:09:42,000
passion there and i think there is an

253
00:09:46,710 --> 00:09:45,040
understanding um in terms of when things

254
00:09:48,870 --> 00:09:46,720
don't perform

255
00:09:51,670 --> 00:09:48,880
that these things happen

256
00:09:53,829 --> 00:09:51,680
usually though there is some sort of um

257
00:09:56,550 --> 00:09:53,839
there's some sort of response um and

258
00:09:58,389 --> 00:09:56,560
that response is um usually it's

259
00:10:00,949 --> 00:09:58,399
actually more money comes you know when

260
00:10:02,550 --> 00:10:00,959
when you have a performance issue

261
00:10:05,590 --> 00:10:02,560
um no one

262
00:10:07,990 --> 00:10:05,600
no one wants to to um create or no one

263
00:10:09,590 --> 00:10:08,000

wants to recreate the the failures of

264
00:10:13,110 --> 00:10:09,600
the past and so

265
00:10:14,389 --> 00:10:13,120
um either a mission may be reflown um as

266
00:10:15,910 --> 00:10:14,399
was talked about with the orbiting

267
00:10:18,630 --> 00:10:15,920
carbon observatory that's an earth

268
00:10:21,430 --> 00:10:18,640
science example um and that or you see

269
00:10:23,350 --> 00:10:21,440
very um you know sort of uh

270
00:10:25,269 --> 00:10:23,360
major changes with respect to colombia

271
00:10:27,430 --> 00:10:25,279
for example and inspiring the vision for

272
00:10:28,790 --> 00:10:27,440
space exploration so some kind of

273
00:10:30,630 --> 00:10:28,800
drawing experiences that aren't

274
00:10:32,710 --> 00:10:30,640
necessarily solar system exploration

275
00:10:35,030 --> 00:10:32,720
specific but giving you the landscape of

276
00:10:36,949 --> 00:10:35,040
attitude about nasa

277
00:10:39,509 --> 00:10:36,959
in terms of cost

278
00:10:41,430 --> 00:10:39,519
so if the if the missions fail in terms

279
00:10:43,030 --> 00:10:41,440
of cost

280
00:10:45,430 --> 00:10:43,040
those are looked at i think really on a

281
00:10:47,030 --> 00:10:45,440
case-by-case basis

282
00:10:50,389 --> 00:10:47,040
you know sometimes the answer i mean the

283
00:10:52,949 --> 00:10:50,399
answer with respect to james webb uh was

284
00:10:55,190 --> 00:10:52,959
was to continue to fund it i mean but a

285
00:10:57,750 --> 00:10:55,200
part of that was driven by consulting

286
00:11:00,710 --> 00:10:57,760
with the science community and also

287
00:11:03,269 --> 00:11:00,720
the the view of barbara mikulski and and

288
00:11:06,389 --> 00:11:03,279

others in the in the congress so so that

289
00:11:08,550 --> 00:11:06,399
so those decisions aren't unilaterally

290
00:11:10,150 --> 00:11:08,560
made by omb i mean the final president's

291
00:11:13,350 --> 00:11:10,160
budget goes out but

292
00:11:17,509 --> 00:11:13,360
um but they're driven by the influences

293
00:11:22,069 --> 00:11:20,230
scott and this is also a question for

294
00:11:25,269 --> 00:11:22,079
for chas because

295
00:11:27,990 --> 00:11:25,279
both of you have described enterprises

296
00:11:28,870 --> 00:11:28,000
which in some ways are a leap of faith

297
00:11:29,990 --> 00:11:28,880
right

298
00:11:32,790 --> 00:11:30,000
um

299
00:11:35,030 --> 00:11:32,800
scott the mars program

300
00:11:37,030 --> 00:11:35,040
was predicated on follow the water and

301
00:11:40,710 --> 00:11:37,040
you found the water

302
00:11:43,190 --> 00:11:40,720
but you haven't found life yet and

303
00:11:44,230 --> 00:11:43,200
there's no guarantee that even after a

304
00:11:47,030 --> 00:11:44,240
very

305
00:11:49,110 --> 00:11:47,040
uh careful program of reducing the

306
00:11:51,750 --> 00:11:49,120
technological risk of a sample return

307
00:11:53,110 --> 00:11:51,760
and choosing the best possible site you

308
00:11:55,190 --> 00:11:53,120
can

309
00:11:57,430 --> 00:11:55,200
you know there's no guarantee that

310
00:11:59,430 --> 00:11:57,440
that it'll be in that two kilograms or

311
00:12:01,110 --> 00:11:59,440
whatever it is that comes back

312
00:12:03,030 --> 00:12:01,120
and and chas you know you you've been

313
00:12:04,629 --> 00:12:03,040

talking about a very

314
00:12:05,590 --> 00:12:04,639
optimistic vision of what we might

315
00:12:08,069 --> 00:12:05,600
discover

316
00:12:11,190 --> 00:12:08,079
uh on exoplanets that would certainly

317
00:12:13,190 --> 00:12:11,200
capture the world's imagination but

318
00:12:14,310 --> 00:12:13,200
what about the risk

319
00:12:16,470 --> 00:12:14,320
of

320
00:12:17,910 --> 00:12:16,480
ex promising something that you maybe

321
00:12:19,509 --> 00:12:17,920
can't deliver

322
00:12:21,670 --> 00:12:19,519
each of you would like to weigh in on

323
00:12:23,910 --> 00:12:21,680
that with your respective uh well i

324
00:12:25,590 --> 00:12:23,920
think the biggest challenge we have with

325
00:12:29,750 --> 00:12:25,600
exoplanets

326
00:12:32,470 --> 00:12:29,760
is the exciting goal is clearly

327
00:12:36,550 --> 00:12:32,480
to find life in the atmospheres of some

328
00:12:41,430 --> 00:12:39,190
that is among the hardest technological

329
00:12:43,269 --> 00:12:41,440
things i can conceive of

330
00:12:45,030 --> 00:12:43,279
we've laid out you need an eight meter

331
00:12:47,030 --> 00:12:45,040
telescope well maybe it's a six meter

332
00:12:48,790 --> 00:12:47,040
telescope maybe it's an occult or maybe

333
00:12:51,750 --> 00:12:48,800
it's this maybe it's that

334
00:12:54,310 --> 00:12:51,760
it will whatever it is it will be

335
00:12:55,509 --> 00:12:54,320
you know a web class mission

336
00:12:58,310 --> 00:12:55,519
to do that

337
00:12:59,829 --> 00:12:58,320
and it is a hugely demanding physics

338
00:13:01,430 --> 00:12:59,839

experiment

339
00:13:03,110 --> 00:13:01,440
first of all i think we made good

340
00:13:05,750 --> 00:13:03,120
progress on showing we can do the

341
00:13:07,910 --> 00:13:05,760
physics of it but it will be a very

342
00:13:09,670 --> 00:13:07,920
complicated

343
00:13:11,350 --> 00:13:09,680
space system

344
00:13:12,870 --> 00:13:11,360
that has to do that

345
00:13:19,670 --> 00:13:12,880
and

346
00:13:21,030 --> 00:13:19,680
it's going to be a very tough experiment

347
00:13:23,509 --> 00:13:21,040
and if the

348
00:13:25,350 --> 00:13:23,519
nearest earth when we finally find this

349
00:13:27,269 --> 00:13:25,360
parameter that i called adus of earth

350
00:13:29,350 --> 00:13:27,279
the fraction of

351
00:13:32,069 --> 00:13:29,360
stars that have an earth-like planet in

352
00:13:36,310 --> 00:13:32,079
the habitable zone is too small so we

353
00:13:38,710 --> 00:13:36,320
have to look further away than alpha sen

354
00:13:40,389 --> 00:13:38,720
b for example if we have to look to 25

355
00:13:42,550 --> 00:13:40,399
parsecs

356
00:13:44,710 --> 00:13:42,560
75 light years and not two or three

357
00:13:47,030 --> 00:13:44,720
light years we may not be able to

358
00:13:49,350 --> 00:13:47,040
accomplish that goal

359
00:13:51,509 --> 00:13:49,360
it looks as though the adus of earth the

360
00:13:53,590 --> 00:13:51,519
fraction of stars with

361
00:13:54,470 --> 00:13:53,600
habitable zone planets may be as large

362
00:13:56,389 --> 00:13:54,480
as

363
00:13:58,790 --> 00:13:56,399

5 10 15

364
00:14:01,030 --> 00:13:58,800
we get the statistics from kepler

365
00:14:03,350 --> 00:14:01,040
some of the radial velocity work and so

366
00:14:05,750 --> 00:14:03,360
on if they're if they're close enough we

367
00:14:08,150 --> 00:14:05,760
can do it if not it may simply be

368
00:14:10,150 --> 00:14:08,160
unattainable

369
00:14:12,230 --> 00:14:10,160
and we'll just have to wait for

370
00:14:14,629 --> 00:14:12,240
jill tarter's daughter to hook up to the

371
00:14:17,269 --> 00:14:14,639
internet

372
00:14:19,829 --> 00:14:17,279
uh yeah scientific risk

373
00:14:21,990 --> 00:14:19,839
uh and technological risk are the two

374
00:14:24,790 --> 00:14:22,000
things that you have to mitigate to

375
00:14:27,509 --> 00:14:24,800
understand and mitigate before you

376
00:14:30,470 --> 00:14:27,519
embark on an enterprise that is a

377
00:14:32,389 --> 00:14:30,480
decade-long series of missions for

378
00:14:35,350 --> 00:14:32,399
example with the mars program and the

379
00:14:37,030 --> 00:14:35,360
next decade that that we hope comes so

380
00:14:39,269 --> 00:14:37,040
let me talk a little bit about two

381
00:14:41,910 --> 00:14:39,279
pieces of scientific risk

382
00:14:44,870 --> 00:14:41,920
one was the viking effect

383
00:14:47,269 --> 00:14:44,880
where there was an instrument that

384
00:14:50,389 --> 00:14:47,279
everyone believed if you

385
00:14:52,629 --> 00:14:50,399
took it there reached out because

386
00:14:54,949 --> 00:14:52,639
organic material was ubiquitous you

387
00:14:57,350 --> 00:14:54,959
grabbed up the soil you put it in the

388
00:14:59,750 --> 00:14:57,360

chemistry set you added water and voila

389
00:15:01,350 --> 00:14:59,760
you would see the isotopes of carbon and

390
00:15:03,670 --> 00:15:01,360
you would have the fingerprints of life

391
00:15:06,230 --> 00:15:03,680
and of course that didn't happen

392
00:15:09,509 --> 00:15:06,240
so in the wake of that what turned out

393
00:15:11,189 --> 00:15:09,519
to be a huge scientific risk not not if

394
00:15:12,790 --> 00:15:11,199
i could just throw in for people that

395
00:15:15,430 --> 00:15:12,800
aren't familiar with the history not

396
00:15:17,189 --> 00:15:15,440
only did they not find organics the only

397
00:15:19,750 --> 00:15:17,199
way they could interpret the biology

398
00:15:22,310 --> 00:15:19,760
results was through the presence of

399
00:15:23,750 --> 00:15:22,320
highly reactive compounds like peroxides

400
00:15:26,790 --> 00:15:23,760
that would mean that the soil was

401
00:15:28,310 --> 00:15:26,800
actually hostile to organics yes correct

402
00:15:30,389 --> 00:15:28,320
and so

403
00:15:32,389 --> 00:15:30,399
in the wake of this taking this

404
00:15:34,389 --> 00:15:32,399
scientific risk although they probably

405
00:15:35,509 --> 00:15:34,399
didn't realize it at the time

406
00:15:36,389 --> 00:15:35,519
uh

407
00:15:44,710 --> 00:15:36,399
the

408
00:15:46,870 --> 00:15:44,720
disciplines move from that

409
00:15:48,870 --> 00:15:46,880
hit the home run and discover life in

410
00:15:50,710 --> 00:15:48,880
one fell swoop to understand the

411
00:15:53,030 --> 00:15:50,720
habitable environment

412
00:15:54,550 --> 00:15:53,040
understand the range of habitability for

413
00:15:56,550 --> 00:15:54,560

living systems and of course in

414
00:15:57,710 --> 00:15:56,560
astrobiology that gave rise to

415
00:16:00,389 --> 00:15:57,720
understanding

416
00:16:03,509 --> 00:16:00,399
extremophiles and a range of living

417
00:16:04,550 --> 00:16:03,519
systems that nobody expected 15 or 20

418
00:16:06,949 --> 00:16:04,560
years ago

419
00:16:09,350 --> 00:16:06,959
so that was one step in mitigating the

420
00:16:11,110 --> 00:16:09,360
scientific risk toward finding life on

421
00:16:13,990 --> 00:16:11,120
mars is looking for habitable

422
00:16:15,910 --> 00:16:14,000
environments either past or present

423
00:16:18,710 --> 00:16:15,920
rather than that thing that is so

424
00:16:20,230 --> 00:16:18,720
difficult to do which is to define life

425
00:16:23,350 --> 00:16:20,240
and create an instrument that will go

426
00:16:26,790 --> 00:16:23,360
and actually detect it second piece

427
00:16:31,350 --> 00:16:28,870
was

428
00:16:34,310 --> 00:16:31,360
in large part why i canceled the

429
00:16:36,949 --> 00:16:34,320
existing mars sample return program in

430
00:16:38,710 --> 00:16:36,959
2000 you know there were plenty of cost

431
00:16:41,749 --> 00:16:38,720
reasons it was going to be done for

432
00:16:43,990 --> 00:16:41,759
about 98 and you know leaps of faith on

433
00:16:46,470 --> 00:16:44,000
the technologies that i showed you and

434
00:16:48,710 --> 00:16:46,480
so forth but the main reason i canceled

435
00:16:52,550 --> 00:16:48,720
it was the scientific risk was simply

436
00:16:55,509 --> 00:16:52,560
too high we had a room uh this size with

437
00:16:58,069 --> 00:16:55,519
about 80 or 90 of the best scientists

438
00:17:01,430 --> 00:16:58,079

engineers executives in the planetary

439
00:17:02,790 --> 00:17:01,440
program fine and i said who can tell me

440
00:17:05,270 --> 00:17:02,800
where to go

441
00:17:08,069 --> 00:17:05,280
to get a sample that is worth i think

442
00:17:10,150 --> 00:17:08,079
the cost was then three billion dollars

443
00:17:12,710 --> 00:17:10,160
and there was no crisp answer and the

444
00:17:14,710 --> 00:17:12,720
best that you got was well a grab sample

445
00:17:15,669 --> 00:17:14,720
and you'd find the salt well that's not

446
00:17:18,309 --> 00:17:15,679
worth it

447
00:17:21,510 --> 00:17:18,319
so as a result of what clearly was a

448
00:17:23,590 --> 00:17:21,520
major scientific risk that was set aside

449
00:17:25,350 --> 00:17:23,600
and the decade of understanding mars as

450
00:17:28,390 --> 00:17:25,360
a system and looking for habitable

451
00:17:31,110 --> 00:17:28,400
environments came in its place i think

452
00:17:33,830 --> 00:17:31,120
now we have as a result of that effort

453
00:17:36,789 --> 00:17:33,840
retired a significant amount of

454
00:17:38,789 --> 00:17:36,799
scientific risk we have retired i would

455
00:17:41,590 --> 00:17:38,799
say three of the four technological

456
00:17:43,750 --> 00:17:41,600
risks and as a consequence i would argue

457
00:17:46,789 --> 00:17:43,760
to our friends at omb we are ready to do

458
00:17:48,470 --> 00:17:46,799
this and it is an attainable goal

459
00:17:49,830 --> 00:17:48,480
what do you think amy is he got his

460
00:17:52,710 --> 00:17:49,840
elevator pitch

461
00:17:54,950 --> 00:17:52,720
down to a point where omb will go for it

462
00:17:56,870 --> 00:17:54,960
what if it's attainable for the price i

463
00:18:01,270 --> 00:17:56,880

guess it is

464
00:18:05,430 --> 00:18:03,510
all right well at this juncture since

465
00:18:07,750 --> 00:18:05,440
we've solved the problems of the world

466
00:18:09,990 --> 00:18:07,760
uh why don't we open it up to questions

467
00:18:12,230 --> 00:18:10,000
and um we have the

468
00:18:15,350 --> 00:18:12,240
the traveling microphone and and uh

469
00:18:17,270 --> 00:18:15,360
mikhail please

470
00:18:19,669 --> 00:18:17,280
well thank you actually i have two

471
00:18:21,590 --> 00:18:19,679
questions one to scott want to

472
00:18:23,830 --> 00:18:21,600
cheers

473
00:18:24,950 --> 00:18:23,840
scott

474
00:18:26,710 --> 00:18:24,960
just

475
00:18:29,430 --> 00:18:26,720
according to the follow the water

476
00:18:31,110 --> 00:18:29,440
strategy you described

477
00:18:33,270 --> 00:18:31,120
very wise

478
00:18:35,909 --> 00:18:33,280
but it seems to me

479
00:18:37,430 --> 00:18:35,919
it's not completely well

480
00:18:39,990 --> 00:18:37,440
just embrace

481
00:18:41,590 --> 00:18:40,000
the all possibilities

482
00:18:44,549 --> 00:18:41,600
we are trying

483
00:18:48,710 --> 00:18:44,559
to look for signs of life

484
00:18:51,430 --> 00:18:48,720
both you know extend or extinct life

485
00:18:53,190 --> 00:18:51,440
just on the surface

486
00:18:56,230 --> 00:18:53,200
but surface is so

487
00:18:58,630 --> 00:18:56,240
oxidizing environment on mars and

488
00:19:01,029 --> 00:18:58,640

possibly oxidizing gold

489
00:19:01,909 --> 00:19:01,039
quite deep

490
00:19:04,070 --> 00:19:01,919
so

491
00:19:06,870 --> 00:19:04,080
there are concepts

492
00:19:09,190 --> 00:19:06,880
similar to what we have on the earth

493
00:19:13,029 --> 00:19:09,200
deep-seated biosphere

494
00:19:15,110 --> 00:19:13,039
deep-seated it's just was discovered on

495
00:19:18,789 --> 00:19:15,120
the planet earth

496
00:19:20,390 --> 00:19:18,799
only at the end of last century

497
00:19:23,190 --> 00:19:20,400
and possibly it's even better

498
00:19:25,110 --> 00:19:23,200
environment for the microbes for the

499
00:19:26,710 --> 00:19:25,120
primitive life

500
00:19:28,630 --> 00:19:26,720
on mars

501
00:19:31,830 --> 00:19:28,640
and it seems to me

502
00:19:34,710 --> 00:19:31,840
just it should be in the program one

503
00:19:36,830 --> 00:19:34,720
specific segment we specifically

504
00:19:39,590 --> 00:19:36,840
targeted to this

505
00:19:41,029 --> 00:19:39,600
idea scott can you summarize your

506
00:19:42,630 --> 00:19:41,039
understanding of the question before you

507
00:19:45,750 --> 00:19:42,640
answer it yes

508
00:19:47,350 --> 00:19:45,760
so this is a very good question uh which

509
00:19:49,350 --> 00:19:47,360
is the

510
00:19:51,830 --> 00:19:49,360
follow the water the last decade of mars

511
00:19:53,750 --> 00:19:51,840
missions which are characterized by this

512
00:19:56,390 --> 00:19:53,760
very simple phrase

513
00:19:59,190 --> 00:19:56,400

have been looking for habitats that

514
00:20:00,789 --> 00:19:59,200
might preserve the biosignatures of

515
00:20:02,470 --> 00:20:00,799
extinct life

516
00:20:04,950 --> 00:20:02,480
it really has not been geared toward

517
00:20:07,029 --> 00:20:04,960
extant life at all the

518
00:20:09,909 --> 00:20:07,039
uh so the question is

519
00:20:12,789 --> 00:20:09,919
if you go down that path aren't isn't

520
00:20:15,190 --> 00:20:12,799
there a whole extra path where you might

521
00:20:17,430 --> 00:20:15,200
go under the surface particularly at

522
00:20:19,990 --> 00:20:17,440
least two meters down under where things

523
00:20:22,710 --> 00:20:20,000
have been gardened and irradiated and

524
00:20:28,710 --> 00:20:26,230
could be a few kilometers and so this

525
00:20:31,590 --> 00:20:28,720
this is a very tantalizing possibility

526
00:20:33,909 --> 00:20:31,600
we may have evidence that periodically

527
00:20:36,310 --> 00:20:33,919
plugs of ice are melted and we get brine

528
00:20:37,590 --> 00:20:36,320
flows it could be water is very near the

529
00:20:39,990 --> 00:20:37,600
surface

530
00:20:41,510 --> 00:20:40,000
but drilling kilometers

531
00:20:43,350 --> 00:20:41,520
autonomously

532
00:20:45,430 --> 00:20:43,360
is a technological challenge we don't

533
00:20:47,590 --> 00:20:45,440
have a good answer for right now and in

534
00:20:49,510 --> 00:20:47,600
fact it's been used as a justification

535
00:20:50,549 --> 00:20:49,520
for sending humans

536
00:20:53,029 --> 00:20:50,559
that kind of

537
00:20:55,270 --> 00:20:53,039
on to my last chart yes it was the

538
00:20:56,870 --> 00:20:55,280

colonists who went down

539
00:20:57,750 --> 00:20:56,880
you know bruce willis and the drilling

540
00:20:58,950 --> 00:20:57,760
guys

541
00:21:01,029 --> 00:20:58,960
were there

542
00:21:03,029 --> 00:21:01,039
going down because maybe that's what it

543
00:21:07,350 --> 00:21:03,039
takes to either that or you have to go

544
00:21:12,390 --> 00:21:10,070
from now to find something similar

545
00:21:15,669 --> 00:21:12,400
but but i think the the

546
00:21:18,789 --> 00:21:15,679
argument for extinct life if you find

547
00:21:20,149 --> 00:21:18,799
the right types of sedimentary layers

548
00:21:22,630 --> 00:21:20,159
and minerals

549
00:21:24,230 --> 00:21:22,640
that is the most likely strata to have

550
00:21:26,470 --> 00:21:24,240
preserved the

551
00:21:28,390 --> 00:21:26,480
extinct fingerprints of life and that's

552
00:21:30,390 --> 00:21:28,400
what this whole last decade has been

553
00:21:33,190 --> 00:21:30,400
about yeah we really should

554
00:21:34,950 --> 00:21:33,200
make it clear that there are really two

555
00:21:36,310 --> 00:21:34,960
potential presents under the christmas

556
00:21:39,510 --> 00:21:36,320
tree and one

557
00:21:41,190 --> 00:21:39,520
is extinct life which i think people

558
00:21:43,270 --> 00:21:41,200
may have hopes of and then there's the

559
00:21:45,430 --> 00:21:43,280
question of existing life which is a

560
00:21:48,390 --> 00:21:45,440
whole other level of

561
00:21:51,669 --> 00:21:48,400
of investigation and and

562
00:21:53,750 --> 00:21:51,679
let's wait for the methane results yeah

563
00:21:54,789 --> 00:21:53,760

if possible the second one

564
00:21:56,390 --> 00:21:54,799
chess

565
00:21:59,430 --> 00:21:56,400
um

566
00:22:01,190 --> 00:21:59,440
you know again the strategy

567
00:22:03,430 --> 00:22:01,200
to find the

568
00:22:05,430 --> 00:22:03,440
as much as possible earth-like planets

569
00:22:06,950 --> 00:22:05,440
and the signs for life

570
00:22:09,190 --> 00:22:06,960
obvious things

571
00:22:11,510 --> 00:22:09,200
and different instruments and the

572
00:22:13,669 --> 00:22:11,520
different facilities are developed you

573
00:22:16,870 --> 00:22:13,679
mentioned about that

574
00:22:19,830 --> 00:22:16,880
but what is kind of rational

575
00:22:22,710 --> 00:22:19,840
you would propose being just in charge

576
00:22:26,230 --> 00:22:22,720
completely of the overall program i mean

577
00:22:28,310 --> 00:22:26,240
ground-based facilities space segment

578
00:22:30,230 --> 00:22:28,320
certainly you would say both but it's

579
00:22:33,190 --> 00:22:30,240
impossible to impress everything you

580
00:22:37,830 --> 00:22:33,200
know but we have for example you know

581
00:22:41,190 --> 00:22:37,840
already a square kilometer array

582
00:22:43,750 --> 00:22:41,200
to be deployed very soon it's a powerful

583
00:22:47,669 --> 00:22:43,760
radio astronomy instruments in the south

584
00:22:51,990 --> 00:22:47,679
hemisphere australia south or africa

585
00:22:55,590 --> 00:22:52,000
okay and uh not saying about so powerful

586
00:22:57,830 --> 00:22:55,600
optical telescopes under development

587
00:23:01,830 --> 00:22:57,840
right now and also we have james webb

588
00:23:02,870 --> 00:23:01,840

telescope we have darwin and many others

589
00:23:05,110 --> 00:23:02,880
so

590
00:23:07,669 --> 00:23:05,120
what do you think what kind of rationale

591
00:23:11,350 --> 00:23:07,679
what kind of the strategy because it

592
00:23:13,590 --> 00:23:11,360
will be very much you know just

593
00:23:14,630 --> 00:23:13,600
money taking

594
00:23:17,750 --> 00:23:14,640
process

595
00:23:19,990 --> 00:23:17,760
and i do not think that everyone in the

596
00:23:22,950 --> 00:23:20,000
community both in planetary and

597
00:23:24,710 --> 00:23:22,960
astrophysical community will enjoy

598
00:23:26,710 --> 00:23:24,720
about that

599
00:23:27,830 --> 00:23:26,720
well i think one of the things

600
00:23:31,029 --> 00:23:27,840
we learned

601
00:23:32,870 --> 00:23:31,039
painfully over the last decade

602
00:23:35,270 --> 00:23:32,880
is that

603
00:23:36,789 --> 00:23:35,280
whatever facilities we develop

604
00:23:38,230 --> 00:23:36,799
do have to be

605
00:23:40,950 --> 00:23:38,240
multi-purpose

606
00:23:42,470 --> 00:23:40,960
so for example i think if we originally

607
00:23:44,230 --> 00:23:42,480
proposed to do an infrared

608
00:23:47,269 --> 00:23:44,240
interferometer that might have been the

609
00:23:48,830 --> 00:23:47,279
simplest thing to go and find

610
00:23:51,750 --> 00:23:48,840
the infrared emission

611
00:23:53,669 --> 00:23:51,760
from a uh

612
00:23:56,070 --> 00:23:53,679
you know from an earth you know sitting

613
00:23:58,630 --> 00:23:56,080

a few an astronomical unit away from his

614
00:24:00,230 --> 00:23:58,640
host star that was a relatively little

615
00:24:02,230 --> 00:24:00,240
interest to the rest of the

616
00:24:04,710 --> 00:24:02,240
astrophysical community

617
00:24:06,470 --> 00:24:04,720
so i think right now the astrophysics

618
00:24:08,549 --> 00:24:06,480
community would be very interested in a

619
00:24:12,310 --> 00:24:08,559
large

620
00:24:14,789 --> 00:24:12,320
visible light telescope that would be

621
00:24:17,669 --> 00:24:14,799
the next big step beyond james webb

622
00:24:19,510 --> 00:24:17,679
which of course is an infrared telescope

623
00:24:22,630 --> 00:24:19,520
and that large

624
00:24:25,750 --> 00:24:22,640
optical telescope optical uv

625
00:24:28,230 --> 00:24:25,760
would have instruments on it capable of

626
00:24:30,870 --> 00:24:28,240
getting down to the 10 to the -10

627
00:24:32,710 --> 00:24:30,880
contrast level that you would need

628
00:24:36,230 --> 00:24:32,720
for some observing modes but then would

629
00:24:38,789 --> 00:24:36,240
also do spectra of z of whatever

630
00:24:41,909 --> 00:24:38,799
you know galaxies were also obtainable

631
00:24:43,909 --> 00:24:41,919
so you get a convergence of desire by a

632
00:24:45,750 --> 00:24:43,919
fairly broad set of people in the

633
00:24:48,149 --> 00:24:45,760
astronomy community

634
00:24:50,470 --> 00:24:48,159
you would also have interest from the

635
00:24:52,470 --> 00:24:50,480
exoplanet community presumably the

636
00:24:53,510 --> 00:24:52,480
planetary community would be interested

637
00:24:55,430 --> 00:24:53,520
in getting

638
00:24:57,269 --> 00:24:55,440

spectra of giant planets even

639
00:24:59,830 --> 00:24:57,279
potentially down to

640
00:25:01,830 --> 00:24:59,840
earth-like planets so i think that's the

641
00:25:04,789 --> 00:25:01,840
challenge is to come up with

642
00:25:08,549 --> 00:25:04,799
a mission that could do that

643
00:25:10,549 --> 00:25:08,559
i haven't heard a convincing argument

644
00:25:12,789 --> 00:25:10,559
that lets you do

645
00:25:14,630 --> 00:25:12,799
the spectroscopy

646
00:25:16,230 --> 00:25:14,640
of a habitable planet through the

647
00:25:18,710 --> 00:25:16,240
earth's atmosphere

648
00:25:20,310 --> 00:25:18,720
in the 30 and 40 meter telescopes that

649
00:25:21,269 --> 00:25:20,320
will probably be

650
00:25:24,310 --> 00:25:21,279
built

651
00:25:27,110 --> 00:25:24,320
you know either in the us or in europe

652
00:25:28,710 --> 00:25:27,120
over the next 10 to 15 years

653
00:25:31,269 --> 00:25:28,720
the challenge of working through the

654
00:25:33,510 --> 00:25:31,279
earth's atmosphere is simply too great

655
00:25:35,830 --> 00:25:33,520
to get you to these extreme contrast

656
00:25:37,990 --> 00:25:35,840
ratios that you need

657
00:25:38,950 --> 00:25:38,000
and that probably requires being in

658
00:25:40,630 --> 00:25:38,960
space

659
00:25:42,950 --> 00:25:40,640
the proponents for those telescopes

660
00:25:45,269 --> 00:25:42,960
argue they might be able to do it

661
00:25:46,789 --> 00:25:45,279
pretty skeptical of course they'll say

662
00:25:48,789 --> 00:25:46,799
gee we're pretty skeptical that you can

663
00:25:50,630 --> 00:25:48,799

do it in space either and

664
00:25:52,789 --> 00:25:50,640
it's a tough problem i think space

665
00:25:54,549 --> 00:25:52,799
simply gives you an advantage

666
00:25:58,310 --> 00:25:54,559
of getting above the atmosphere that's

667
00:26:00,070 --> 00:25:58,320
very hard to to negate so i think that's

668
00:26:03,350 --> 00:26:00,080
where we're going to go and it may take

669
00:26:05,590 --> 00:26:03,360
you know 20 25 years to get there you

670
00:26:08,549 --> 00:26:05,600
know i put it in 2040 maybe i was being

671
00:26:10,710 --> 00:26:08,559
pessimistic maybe i was being optimistic

672
00:26:12,870 --> 00:26:10,720
um we'll have to see but it will be

673
00:26:15,269 --> 00:26:12,880
challenging technologically and that's

674
00:26:17,190 --> 00:26:15,279
because the physics dictates

675
00:26:18,149 --> 00:26:17,200
you know what you have to do if alpha

676
00:26:19,909 --> 00:26:18,159
send b

677
00:26:21,830 --> 00:26:19,919
planet c d and e are in the habitable

678
00:26:22,950 --> 00:26:21,840
zone that helps enormously then you're

679
00:26:24,390 --> 00:26:22,960
talking

680
00:26:26,950 --> 00:26:24,400
nearly an order of magnitude

681
00:26:29,750 --> 00:26:26,960
simplification in the problem is because

682
00:26:31,830 --> 00:26:29,760
the planet is that much further away

683
00:26:34,310 --> 00:26:31,840
from its host star and that's what

684
00:26:36,470 --> 00:26:34,320
drives the difficulty

685
00:26:38,710 --> 00:26:36,480
okay

686
00:26:41,190 --> 00:26:38,720
this question is probably for amy but uh

687
00:26:45,110 --> 00:26:41,200
i'm i'm sure scott and chaz and others

688
00:26:46,710 --> 00:26:45,120

will have uh an opinion on it as well

689
00:26:49,029 --> 00:26:46,720
we've talked a lot over the last few

690
00:26:52,710 --> 00:26:49,039
days about ebb and flow of budget

691
00:26:56,630 --> 00:26:52,720
ebb and flow of the pace of missions

692
00:26:57,990 --> 00:26:56,640
and uh and ebb and flow of success

693
00:27:00,070 --> 00:26:58,000
but we haven't talked about one of the

694
00:27:02,549 --> 00:27:00,080
factors that could be a contributor and

695
00:27:04,630 --> 00:27:02,559
that is recognized in some other areas

696
00:27:05,430 --> 00:27:04,640
as a as a contributing factor and that

697
00:27:06,549 --> 00:27:05,440
is

698
00:27:07,669 --> 00:27:06,559
the

699
00:27:09,990 --> 00:27:07,679
um

700
00:27:11,190 --> 00:27:10,000
the training of the

701
00:27:12,390 --> 00:27:11,200
the continuity and training of the

702
00:27:15,590 --> 00:27:12,400
workforce

703
00:27:18,470 --> 00:27:15,600
uh in in the lost decade we had many

704
00:27:20,950 --> 00:27:18,480
less engineers working on

705
00:27:22,230 --> 00:27:20,960
planetary spacecraft and and developing

706
00:27:25,590 --> 00:27:22,240
the systems

707
00:27:27,269 --> 00:27:25,600
and did that contribute to what we

708
00:27:28,789 --> 00:27:27,279
did achieve and didn't achieve in the

709
00:27:31,029 --> 00:27:28,799
1990s

710
00:27:33,430 --> 00:27:31,039
and in fact is the

711
00:27:35,990 --> 00:27:33,440
is the last the success the remarkable

712
00:27:38,789 --> 00:27:36,000
success of the last decade impart

713
00:27:42,389 --> 00:27:38,799

traceable to the success

714
00:27:45,110 --> 00:27:42,399
of being able to consistently hand off

715
00:27:46,830 --> 00:27:45,120
the responsibilities for

716
00:27:48,710 --> 00:27:46,840
development engineering and

717
00:27:51,430 --> 00:27:48,720
operations uh from

718
00:27:53,190 --> 00:27:51,440
from one uh well-trained group to the

719
00:27:54,549 --> 00:27:53,200
next well-trained group

720
00:27:56,389 --> 00:27:54,559
uh

721
00:27:57,750 --> 00:27:56,399
your thought it's a it's a topic we

722
00:28:00,149 --> 00:27:57,760
haven't talked about at all in the last

723
00:28:04,230 --> 00:28:00,159
two days talked about and

724
00:28:05,350 --> 00:28:04,240
i i don't have i have no idea um

725
00:28:10,549 --> 00:28:05,360
in terms of

726
00:28:13,190 --> 00:28:10,559
the particular strains that that you're

727
00:28:15,269 --> 00:28:13,200
talking about in the relations um

728
00:28:18,070 --> 00:28:15,279
okay but chas and chas and scott both

729
00:28:21,750 --> 00:28:20,389
so let me give you one real clear-cut

730
00:28:22,950 --> 00:28:21,760
example

731
00:28:26,710 --> 00:28:22,960
when

732
00:28:29,350 --> 00:28:26,720
i was in pasadena before we gathered at

733
00:28:31,510 --> 00:28:29,360
jpl for the curiosity landing i was down

734
00:28:33,750 --> 00:28:31,520
at the planet fest event i ran into rob

735
00:28:36,310 --> 00:28:33,760
manning of course the chief engineer for

736
00:28:38,909 --> 00:28:36,320
our science lab curiosity and and i've

737
00:28:41,110 --> 00:28:38,919
known rob for since

738
00:28:42,789 --> 00:28:41,120

1993 or so

739
00:28:45,190 --> 00:28:42,799
and i said so

740
00:28:47,909 --> 00:28:45,200
rob how's it going he's

741
00:28:51,430 --> 00:28:47,919
enjoy the show it's gonna work

742
00:28:53,110 --> 00:28:51,440
now i i i realized that you know he was

743
00:28:54,950 --> 00:28:53,120
uh pumped up by

744
00:28:58,230 --> 00:28:54,960
about the whole thing but i said so you

745
00:29:01,750 --> 00:28:58,240
know why look we have tested this thing

746
00:29:04,630 --> 00:29:01,760
we have years and years of testing

747
00:29:06,710 --> 00:29:04,640
we've tested overlapping things

748
00:29:08,950 --> 00:29:06,720
in the case that we can't get the exact

749
00:29:11,750 --> 00:29:08,960
environmental condition we've you know

750
00:29:13,830 --> 00:29:11,760
we've done every conceivable failure

751
00:29:16,310 --> 00:29:13,840
mode and and so forth and he said we're

752
00:29:18,870 --> 00:29:16,320
highly confident this will work to that

753
00:29:21,750 --> 00:29:18,880
explanation i will add that

754
00:29:23,669 --> 00:29:21,760
rob manning and and cookie and the

755
00:29:27,029 --> 00:29:23,679
others started with tony spear on

756
00:29:28,789 --> 00:29:27,039
pathfinder in 1993

757
00:29:31,909 --> 00:29:28,799
they went through pathfinder they went

758
00:29:35,029 --> 00:29:31,919
through spirit opportunity phoenix this

759
00:29:37,269 --> 00:29:35,039
was their fifth landing on mars and you

760
00:29:39,269 --> 00:29:37,279
have a cadre of people who have learned

761
00:29:41,590 --> 00:29:39,279
all those tools and techniques

762
00:29:43,669 --> 00:29:41,600
and the numbers i showed you to do the

763
00:29:46,230 --> 00:29:43,679

caching rover that one of the reasons

764
00:29:48,230 --> 00:29:46,240
that you can say that's a good number

765
00:29:50,549 --> 00:29:48,240
and is so low is because you're counting

766
00:29:51,510 --> 00:29:50,559
on those people being there if you delay

767
00:29:56,070 --> 00:29:51,520
this

768
00:29:58,710 --> 00:29:56,080
people they don't believe it but if you

769
00:30:00,230 --> 00:29:58,720
delay this by five to ten years these

770
00:30:01,750 --> 00:30:00,240
folks have to make a living they'll go

771
00:30:03,750 --> 00:30:01,760
somewhere else you won't have this

772
00:30:05,669 --> 00:30:03,760
expertise it's something that we

773
00:30:07,029 --> 00:30:05,679
understand in human space flight and

774
00:30:08,549 --> 00:30:07,039
it's been talked about a lot it's been

775
00:30:10,710 --> 00:30:08,559
talked about about a lot in the launch

776
00:30:13,669 --> 00:30:10,720
vehicle development community where that

777
00:30:15,990 --> 00:30:13,679
was lost and is now being rebuilt and uh

778
00:30:18,389 --> 00:30:16,000
and it bears here as well on on planet

779
00:30:19,269 --> 00:30:18,399
true and astrophysics it's true

780
00:30:22,470 --> 00:30:19,279
you know

781
00:30:26,789 --> 00:30:22,480
as

782
00:30:29,269 --> 00:30:26,799
oxygen you lose people

783
00:30:31,750 --> 00:30:29,279
um in other parts of the program

784
00:30:33,750 --> 00:30:31,760
and it's very discouraging to have you

785
00:30:35,430 --> 00:30:33,760
have somebody land on curiosity and say

786
00:30:38,470 --> 00:30:35,440
oh gee i need a charge number starting

787
00:30:40,310 --> 00:30:38,480
next week because i just finished edl i

788
00:30:41,669 --> 00:30:40,320

wonder where else i can go

789
00:30:43,750 --> 00:30:41,679
and they'll go somewhere and you lose

790
00:30:45,830 --> 00:30:43,760
the best people first well in fact it

791
00:30:47,430 --> 00:30:45,840
was part of the justification for the

792
00:30:49,190 --> 00:30:47,440
national lunar science institute was

793
00:30:50,389 --> 00:30:49,200
that we had not done any lunar science

794
00:30:52,389 --> 00:30:50,399
in quite

795
00:30:54,389 --> 00:30:52,399
some time and we needed to train a whole

796
00:30:56,149 --> 00:30:54,399
new cadre of lunar scientists

797
00:30:57,909 --> 00:30:56,159
that seems to be working very well and

798
00:31:00,470 --> 00:30:57,919
you know i think one thing that came

799
00:31:01,990 --> 00:31:00,480
very clear in this conference is

800
00:31:03,190 --> 00:31:02,000
the enormous perspective that some of

801
00:31:05,269 --> 00:31:03,200
the people who have been in the space

802
00:31:07,669 --> 00:31:05,279
science community for so long bring to

803
00:31:09,590 --> 00:31:07,679
it i mean they're not just building uh

804
00:31:10,950 --> 00:31:09,600
spacecraft they're building instruments

805
00:31:12,549 --> 00:31:10,960
they're fighting

806
00:31:14,310 --> 00:31:12,559
budget battles they're

807
00:31:17,269 --> 00:31:14,320
developing planetary models they're

808
00:31:19,430 --> 00:31:17,279
archiving the data they're training

809
00:31:21,110 --> 00:31:19,440
people to follow after them and uh it's

810
00:31:22,789 --> 00:31:21,120
just been remarkable to hear from some

811
00:31:24,710 --> 00:31:22,799
of the people who have been involved for

812
00:31:26,470 --> 00:31:24,720
so long about what sort of experience

813
00:31:29,430 --> 00:31:26,480

they have gained

814
00:31:30,950 --> 00:31:29,440
okay greg this dialogue is a perfect uh

815
00:31:33,190 --> 00:31:30,960
intro to the question that i wanted to

816
00:31:35,110 --> 00:31:33,200
put to amy which is why i stood up and

817
00:31:37,190 --> 00:31:35,120
it's not to put you on the spot

818
00:31:40,149 --> 00:31:37,200
but you did comment that the that the

819
00:31:41,830 --> 00:31:40,159
folks at omb and upper reaches of nasa

820
00:31:44,389 --> 00:31:41,840
who made this decision concerning the

821
00:31:46,230 --> 00:31:44,399
fiscal 13 budget are smart people

822
00:31:48,789 --> 00:31:46,240
intelligent well educated and of course

823
00:31:51,350 --> 00:31:48,799
we know that uh that to be the case

824
00:31:53,190 --> 00:31:51,360
because we know we know them ourselves

825
00:31:54,389 --> 00:31:53,200
the question that i have for you has two

826
00:31:55,669 --> 00:31:54,399
parts

827
00:31:58,630 --> 00:31:55,679
do they

828
00:32:01,350 --> 00:31:58,640
understand the implications of standing

829
00:32:02,950 --> 00:32:01,360
down for five or six years and the loss

830
00:32:04,230 --> 00:32:02,960
of this workforce

831
00:32:05,990 --> 00:32:04,240
and if so

832
00:32:07,269 --> 00:32:06,000
what does that tell us about their true

833
00:32:09,669 --> 00:32:07,279
intentions

834
00:32:11,509 --> 00:32:09,679
if they don't understand

835
00:32:14,789 --> 00:32:11,519
the implications of standing down for

836
00:32:15,830 --> 00:32:14,799
five or six years why not and what can

837
00:32:18,710 --> 00:32:15,840
we do

838
00:32:20,630 --> 00:32:18,720

to help them understand this

839
00:32:22,230 --> 00:32:20,640
and again i would not not put you on the

840
00:32:25,669 --> 00:32:22,240
spot because you weren't there and you

841
00:32:28,630 --> 00:32:25,679
didn't do it no pressure at all

842
00:32:30,470 --> 00:32:28,640
um yes i mean so so to answer the yes no

843
00:32:33,350 --> 00:32:30,480
part of it yes they do understand the

844
00:32:35,990 --> 00:32:33,360
implications of standing down and and

845
00:32:37,430 --> 00:32:36,000
it's a real problem i mean uh

846
00:32:39,029 --> 00:32:37,440
and

847
00:32:41,750 --> 00:32:39,039
you know i think everybody there would

848
00:32:43,830 --> 00:32:41,760
like to see you know all

849
00:32:45,430 --> 00:32:43,840
everybody you know i don't want to be oh

850
00:32:46,470 --> 00:32:45,440
i shouldn't say everybody

851
00:32:48,389 --> 00:32:46,480
um but

852
00:32:50,870 --> 00:32:48,399
no no no no i just i hate to general you

853
00:32:52,470 --> 00:32:50,880
know but i on the whole i mean again

854
00:32:56,470 --> 00:32:52,480
the folks there who are reviewing the

855
00:32:59,190 --> 00:32:56,480
nasa budgets um are supporters and and

856
00:33:01,830 --> 00:32:59,200
um you know want to see nasa succeed and

857
00:33:02,950 --> 00:33:01,840
do great things as do so many people

858
00:33:04,710 --> 00:33:02,960
um

859
00:33:06,630 --> 00:33:04,720
that you know the challenge is faced

860
00:33:09,350 --> 00:33:06,640
though that there's there is so much

861
00:33:10,630 --> 00:33:09,360
content there and and and choices have

862
00:33:11,669 --> 00:33:10,640
to be made

863
00:33:13,750 --> 00:33:11,679

um

864
00:33:15,590 --> 00:33:13,760
there's a lot of instances where you

865
00:33:17,669 --> 00:33:15,600
know there's issues of these standing

866
00:33:20,149 --> 00:33:17,679
down and if we stand down that we're not

867
00:33:22,149 --> 00:33:20,159
going to be able to do x and y

868
00:33:24,070 --> 00:33:22,159
and at a certain point you can be

869
00:33:25,990 --> 00:33:24,080
propping up armies if you will and i

870
00:33:28,470 --> 00:33:26,000
don't mean to say i mean i it doesn't

871
00:33:31,590 --> 00:33:28,480
sound you know totally diplomatic to say

872
00:33:33,909 --> 00:33:31,600
that but just um and keeping keeping

873
00:33:35,590 --> 00:33:33,919
folks going for the sake of preserving a

874
00:33:37,750 --> 00:33:35,600
capability that you're going to use in

875
00:33:39,909 --> 00:33:37,760
10 years i mean we could say that across

876
00:33:41,830 --> 00:33:39,919
you know various disciplines and if

877
00:33:43,509 --> 00:33:41,840
we're constantly doing that

878
00:33:46,310 --> 00:33:43,519
you know the question is where where's

879
00:33:48,070 --> 00:33:46,320
the budget for for the content um i

880
00:33:50,310 --> 00:33:48,080
don't have an easy solution obviously

881
00:33:53,509 --> 00:33:50,320
the people there don't either

882
00:33:55,269 --> 00:33:53,519
and i mean i would love to to uh you

883
00:33:57,830 --> 00:33:55,279
know have more dialogue you know with

884
00:34:00,230 --> 00:33:57,840
the community about um you know what

885
00:34:02,230 --> 00:34:00,240
solutions um

886
00:34:03,830 --> 00:34:02,240
might be possible to mitigate this is

887
00:34:05,750 --> 00:34:03,840
there a way to cross train people and i

888
00:34:06,470 --> 00:34:05,760

mean and some of this goes back to you

889
00:34:08,069 --> 00:34:06,480
know

890
00:34:10,470 --> 00:34:08,079
prior to people enrolling in the

891
00:34:13,430 --> 00:34:10,480
workforce but is there a way i mean as

892
00:34:15,829 --> 00:34:13,440
you're um you know in school and you're

893
00:34:17,149 --> 00:34:15,839
you're in an engineering field and you

894
00:34:18,790 --> 00:34:17,159
know that you you become

895
00:34:20,950 --> 00:34:18,800
cross-disciplinary and that you're kind

896
00:34:23,109 --> 00:34:20,960
of prepared for these sorts of shifts

897
00:34:24,710 --> 00:34:23,119
and changes to have to occur and then

898
00:34:26,470 --> 00:34:24,720
there's the question of how you preserve

899
00:34:29,030 --> 00:34:26,480
the institutional knowledge i mean that

900
00:34:29,990 --> 00:34:29,040
is that is a big one um

901
00:34:31,829 --> 00:34:30,000
uh

902
00:34:33,990 --> 00:34:31,839
but i mean these are two things i think

903
00:34:35,990 --> 00:34:34,000
we have to conquer and and not just see

904
00:34:38,310 --> 00:34:36,000
budget and carrying of people as the

905
00:34:40,230 --> 00:34:38,320
solution but as i mean that there are

906
00:34:41,909 --> 00:34:40,240
other things we might do to preserve

907
00:34:43,990 --> 00:34:41,919
those well it kind of comes down to

908
00:34:45,349 --> 00:34:44,000
basic economics the people who made it

909
00:34:47,990 --> 00:34:45,359
possible to

910
00:34:49,909 --> 00:34:48,000
uh to make the make the progress that

911
00:34:52,389 --> 00:34:49,919
scott showed on one of his charts he

912
00:34:54,149 --> 00:34:52,399
picked one example of the air landing

913
00:34:55,430 --> 00:34:54,159

aerolips and how that has shrunk over

914
00:34:58,390 --> 00:34:55,440
generations

915
00:35:00,950 --> 00:34:58,400
has taken a constant effort on the part

916
00:35:03,109 --> 00:35:00,960
of now two generations and none of these

917
00:35:05,270 --> 00:35:03,119
people studied how to do that in school

918
00:35:06,870 --> 00:35:05,280
there's no field for that and it's such

919
00:35:08,710 --> 00:35:06,880
a niche

920
00:35:10,950 --> 00:35:08,720
niche area that there never will be a

921
00:35:13,829 --> 00:35:10,960
feel for that unless there's a job out

922
00:35:16,150 --> 00:35:13,839
there for them to go to it's so special

923
00:35:18,710 --> 00:35:16,160
it is so specialized and yet it is

924
00:35:20,790 --> 00:35:18,720
absolutely enabling just like the deep

925
00:35:23,030 --> 00:35:20,800
space navigators who navigate the

926
00:35:24,950 --> 00:35:23,040
cassini spacecraft every single day they

927
00:35:27,109 --> 00:35:24,960
are changing the trajectory in order to

928
00:35:29,030 --> 00:35:27,119
be able to do those flybys that's the

929
00:35:31,270 --> 00:35:29,040
only market for what they do

930
00:35:33,349 --> 00:35:31,280
so if indeed the folks over at omb do

931
00:35:34,870 --> 00:35:33,359
understand that this means losing that

932
00:35:36,950 --> 00:35:34,880
that's tantamount to saying that they

933
00:35:39,030 --> 00:35:36,960
have decided that it's okay to seed this

934
00:35:41,670 --> 00:35:39,040
this area okay i'm not sure we're going

935
00:35:44,630 --> 00:35:41,680
to solve this one

936
00:35:46,710 --> 00:35:44,640
but it is i mean it's a zero-sum game so

937
00:35:48,390 --> 00:35:46,720
it's it's a choice it's a choice

938
00:35:49,990 --> 00:35:48,400

everybody's choice yeah

939
00:35:51,670 --> 00:35:50,000
janet

940
00:35:53,190 --> 00:35:51,680
thanks thanks so much for a great panel

941
00:35:54,950 --> 00:35:53,200
um one of the things that struck me that

942
00:35:56,790 --> 00:35:54,960
cuts across all the talks is a

943
00:35:59,349 --> 00:35:56,800
particular a particular thing that is

944
00:36:01,670 --> 00:35:59,359
very powerful and more powerful i think

945
00:36:02,870 --> 00:36:01,680
than rtgs and more powerful perhaps an

946
00:36:05,910 --> 00:36:02,880
omb

947
00:36:07,829 --> 00:36:05,920
and and that's the power of talk or

948
00:36:09,750 --> 00:36:07,839
specifically what academics would call

949
00:36:11,910 --> 00:36:09,760
discourse and that is particular kinds

950
00:36:12,870 --> 00:36:11,920
of ways of talking that are shared by

951
00:36:14,710 --> 00:36:12,880
different members of different

952
00:36:15,670 --> 00:36:14,720
communities and i'm thinking of several

953
00:36:17,270 --> 00:36:15,680
of these because they're important

954
00:36:18,390 --> 00:36:17,280
especially in amy's paper which is

955
00:36:19,750 --> 00:36:18,400
brilliant

956
00:36:21,589 --> 00:36:19,760
articulates

957
00:36:24,230 --> 00:36:21,599
exactly how that talk works in a network

958
00:36:25,670 --> 00:36:24,240
so things like faster better cheaper or

959
00:36:27,750 --> 00:36:25,680
follow the water these are things that

960
00:36:29,910 --> 00:36:27,760
we all know they're they're common ways

961
00:36:31,430 --> 00:36:29,920
of talking their discourse right but

962
00:36:33,270 --> 00:36:31,440
they're really powerful and important

963
00:36:35,430 --> 00:36:33,280

because they pull together actors in

964
00:36:37,349 --> 00:36:35,440
that network in a particular kind of way

965
00:36:39,270 --> 00:36:37,359
and they justify activity and in that

966
00:36:41,030 --> 00:36:39,280
network they're also important because

967
00:36:43,109 --> 00:36:41,040
you can have anticipatory talk you can

968
00:36:45,030 --> 00:36:43,119
have future discourse right whether it's

969
00:36:46,950 --> 00:36:45,040
the discourse of the precursor mission

970
00:36:48,950 --> 00:36:46,960
or as i would argue the discourse of

971
00:36:50,470 --> 00:36:48,960
mars sample return right these are

972
00:36:52,470 --> 00:36:50,480
particular things that haven't happened

973
00:36:54,069 --> 00:36:52,480
yet but we're talking about them in a

974
00:36:56,069 --> 00:36:54,079
particular kind of way to pull those

975
00:36:57,510 --> 00:36:56,079
people into some kind of alignment and

976
00:36:59,109 --> 00:36:57,520
thirdly i think it's important to pick

977
00:37:01,109 --> 00:36:59,119
up on something that glenn mentioned at

978
00:37:03,349 --> 00:37:01,119
the beginning of his his paper

979
00:37:05,349 --> 00:37:03,359
which is that the ways and who gets to

980
00:37:07,750 --> 00:37:05,359
tell the stories actually betrays a

981
00:37:10,069 --> 00:37:07,760
particular kind of politics right that

982
00:37:11,990 --> 00:37:10,079
you know that that jpl is such a strong

983
00:37:14,069 --> 00:37:12,000
actor and not necessarily ames or johns

984
00:37:15,910 --> 00:37:14,079
hopkins et cetera right and that's

985
00:37:17,990 --> 00:37:15,920
that's the result of the kinds of ways

986
00:37:19,430 --> 00:37:18,000
of talking in the network and i want to

987
00:37:21,670 --> 00:37:19,440
take advantage of the fact that we have

988
00:37:23,349 --> 00:37:21,680

both historians and practitioners in

989
00:37:25,270 --> 00:37:23,359
this room to actually have a

990
00:37:27,270 --> 00:37:25,280
conversation about what it means to talk

991
00:37:29,270 --> 00:37:27,280
this way because i think for historians

992
00:37:31,349 --> 00:37:29,280
it's really important for us to not take

993
00:37:33,430 --> 00:37:31,359
that discourse as the explanation but is

994
00:37:35,430 --> 00:37:33,440
the thing that needs to be explained and

995
00:37:37,589 --> 00:37:35,440
i'm very curious as to how we might do

996
00:37:39,270 --> 00:37:37,599
that i think the socio-technical network

997
00:37:40,790 --> 00:37:39,280
is a great way of getting at that but

998
00:37:42,630 --> 00:37:40,800
i'd be very curious to hear about that

999
00:37:43,990 --> 00:37:42,640
from your perspective and then for many

1000
00:37:45,750 --> 00:37:44,000
of the actors in this room have played

1001
00:37:47,589 --> 00:37:45,760
such an important role in pulling these

1002
00:37:49,910 --> 00:37:47,599
missions together and formulating

1003
00:37:51,510 --> 00:37:49,920
phrases that have been so meaningful and

1004
00:37:53,109 --> 00:37:51,520
powerful

1005
00:37:54,470 --> 00:37:53,119
what is your role do you think in

1006
00:37:56,550 --> 00:37:54,480
putting these phrases together and

1007
00:37:58,950 --> 00:37:56,560
mobilizing the network what does it take

1008
00:38:01,270 --> 00:37:58,960
to get those words to travel and not

1009
00:38:02,950 --> 00:38:01,280
just travel to washington but travel to

1010
00:38:05,270 --> 00:38:02,960
mars into saturn

1011
00:38:06,870 --> 00:38:05,280
so i'd love to just open up to the panel

1012
00:38:08,630 --> 00:38:06,880
an opportunity to talk about what it

1013
00:38:10,550 --> 00:38:08,640

what discourse means what it means to

1014
00:38:12,230 --> 00:38:10,560
talk where these different kinds of

1015
00:38:13,670 --> 00:38:12,240
phrases and expressions come from and

1016
00:38:16,550 --> 00:38:13,680
how and where they move and what gives

1017
00:38:20,390 --> 00:38:18,550
anybody want to take a shot at that

1018
00:38:22,310 --> 00:38:20,400
kurt vonnegut said

1019
00:38:25,670 --> 00:38:22,320
any physicist who can't explain what

1020
00:38:27,069 --> 00:38:25,680
he's doing to a nine-year-old is a fraud

1021
00:38:29,750 --> 00:38:27,079
so you have to be able to

1022
00:38:33,030 --> 00:38:29,760
intellectualize what you're doing

1023
00:38:34,950 --> 00:38:33,040
why are doing it and explain it to

1024
00:38:36,310 --> 00:38:34,960
a broad range of people

1025
00:38:38,230 --> 00:38:36,320
nine-year-olds

1026
00:38:40,630 --> 00:38:38,240
congress people

1027
00:38:42,310 --> 00:38:40,640
administrators

1028
00:38:44,710 --> 00:38:42,320
peer scientists

1029
00:38:46,950 --> 00:38:44,720
when you have

1030
00:38:47,990 --> 00:38:46,960
uh

1031
00:38:50,069 --> 00:38:48,000
i mean you have to be able to have a

1032
00:38:52,230 --> 00:38:50,079
discussion at a very high level

1033
00:38:53,829 --> 00:38:52,240
with a cosmologist whose mission you may

1034
00:38:55,829 --> 00:38:53,839
be saying well gee i want to delay your

1035
00:38:57,670 --> 00:38:55,839
mission by a decade so that i can do my

1036
00:38:58,470 --> 00:38:57,680
exoplanet

1037
00:39:00,150 --> 00:38:58,480
or

1038
00:39:02,150 --> 00:39:00,160

you know explain to a congressperson

1039
00:39:04,230 --> 00:39:02,160
that you there is a reason why it's

1040
00:39:05,670 --> 00:39:04,240
interesting to go find life

1041
00:39:07,750 --> 00:39:05,680
on some

1042
00:39:09,750 --> 00:39:07,760
you know planet that's uh

1043
00:39:11,109 --> 00:39:09,760
hundreds of light years away and have

1044
00:39:11,990 --> 00:39:11,119
them say yeah that's a good thing to

1045
00:39:13,589 --> 00:39:12,000
spend

1046
00:39:15,910 --> 00:39:13,599
money on even if it's not going to put a

1047
00:39:21,030 --> 00:39:15,920
bridge in my district

1048
00:39:22,870 --> 00:39:21,040
i uh i call it haiku for science

1049
00:39:24,710 --> 00:39:22,880
you need to explain what you're doing in

1050
00:39:26,470 --> 00:39:24,720
17 syllables

1051
00:39:27,829 --> 00:39:26,480
and that was the power of follow the

1052
00:39:29,910 --> 00:39:27,839
water

1053
00:39:32,069 --> 00:39:29,920
and if somebody wanted to know more you

1054
00:39:35,670 --> 00:39:32,079
could go on for hours if they were

1055
00:39:37,750 --> 00:39:35,680
satisfied with a simple explanation that

1056
00:39:39,910 --> 00:39:37,760
is literally the elevator pitch then

1057
00:39:42,630 --> 00:39:39,920
that's fine too

1058
00:39:45,510 --> 00:39:42,640
words have immense power

1059
00:39:46,310 --> 00:39:45,520
and one of the things one of my quibbles

1060
00:39:48,550 --> 00:39:46,320
with

1061
00:39:49,589 --> 00:39:48,560
uh the characterization of mars sample

1062
00:39:52,230 --> 00:39:49,599
return

1063
00:39:54,390 --> 00:39:52,240

is that that is a technique

1064
00:39:56,390 --> 00:39:54,400
the real goal is understanding

1065
00:39:59,670 --> 00:39:56,400
habitability in present

1066
00:40:02,310 --> 00:39:59,680
or past life on mars it just so happens

1067
00:40:04,390 --> 00:40:02,320
this technique is the one that the

1068
00:40:06,390 --> 00:40:04,400
community agrees is the most powerful

1069
00:40:09,670 --> 00:40:06,400
technique for making a huge step in

1070
00:40:11,109 --> 00:40:09,680
understanding and what's occurred is

1071
00:40:14,150 --> 00:40:11,119
that the technique has been

1072
00:40:17,270 --> 00:40:14,160
characterized as the end goal

1073
00:40:20,710 --> 00:40:17,280
no the end goal is understanding the

1074
00:40:23,670 --> 00:40:20,720
presence or absence of life on mars

1075
00:40:25,990 --> 00:40:23,680
okay i think we've got time for one more

1076
00:40:29,190 --> 00:40:26,000
what's the role of new up-and-coming

1077
00:40:30,710 --> 00:40:29,200
participants china maybe india brazil

1078
00:40:32,790 --> 00:40:30,720
where do they fit into everything that's

1079
00:40:34,150 --> 00:40:32,800
going on

1080
00:40:35,910 --> 00:40:34,160
well let me just start sort of in

1081
00:40:37,750 --> 00:40:35,920
response to jana's question as well

1082
00:40:40,309 --> 00:40:37,760
where they fit in in terms of

1083
00:40:41,190 --> 00:40:40,319
understanding space policy is um they're

1084
00:40:43,190 --> 00:40:41,200
a different group with different

1085
00:40:45,510 --> 00:40:43,200
motivations different motivations

1086
00:40:47,270 --> 00:40:45,520
different social technical networks like

1087
00:40:49,030 --> 00:40:47,280
amy was talking about

1088
00:40:50,950 --> 00:40:49,040

we spent a lot of time talking about

1089
00:40:53,190 --> 00:40:50,960
nasa administrators congress

1090
00:40:55,270 --> 00:40:53,200
what is involved in making them

1091
00:40:56,550 --> 00:40:55,280
understand the goals of space science

1092
00:40:58,230 --> 00:40:56,560
and in different communities there's

1093
00:40:59,910 --> 00:40:58,240
different ways of talking

1094
00:41:01,510 --> 00:40:59,920
part of the reason we do history so that

1095
00:41:03,349 --> 00:41:01,520
we can look at

1096
00:41:05,030 --> 00:41:03,359
you know stepping into the same river at

1097
00:41:07,430 --> 00:41:05,040
different times space science looked

1098
00:41:08,950 --> 00:41:07,440
different in the 1960s that it did in

1099
00:41:10,309 --> 00:41:08,960
the 1990s

1100
00:41:11,910 --> 00:41:10,319
part of the

1101
00:41:13,270 --> 00:41:11,920
role that historians play in a

1102
00:41:14,630 --> 00:41:13,280
conference like this and talking to

1103
00:41:16,710 --> 00:41:14,640
policy makers

1104
00:41:17,990 --> 00:41:16,720
there is this goal to to simplify and

1105
00:41:19,990 --> 00:41:18,000
focus on

1106
00:41:22,150 --> 00:41:20,000
turns more sample return faster better

1107
00:41:24,630 --> 00:41:22,160
cheaper precursor um exoplanet

1108
00:41:26,630 --> 00:41:24,640
exploration um but historians have an

1109
00:41:28,309 --> 00:41:26,640
obligation to sort of go back and unpack

1110
00:41:29,670 --> 00:41:28,319
what those words actually meant and how

1111
00:41:31,270 --> 00:41:29,680
they actually

1112
00:41:33,030 --> 00:41:31,280
were implemented i mean mike neufeld

1113
00:41:34,550 --> 00:41:33,040

gave a very interesting and some ways

1114
00:41:38,390 --> 00:41:34,560
very chaotic

1115
00:41:40,630 --> 00:41:38,400
paper about the explanation of

1116
00:41:42,470 --> 00:41:40,640
the invention of faster better cheaper

1117
00:41:44,230 --> 00:41:42,480
and how it really happened eric conway

1118
00:41:45,910 --> 00:41:44,240
likewise i gave a very

1119
00:41:48,390 --> 00:41:45,920
interesting paper about the image of

1120
00:41:50,550 --> 00:41:48,400
mars sample return suggesting that

1121
00:41:53,030 --> 00:41:50,560
in these periods where some people can

1122
00:41:55,270 --> 00:41:53,040
look back and

1123
00:41:57,030 --> 00:41:55,280
you know see a path from where we were

1124
00:41:58,470 --> 00:41:57,040
to the present

1125
00:41:59,270 --> 00:41:58,480
and people

1126
00:42:01,109 --> 00:41:59,280
you know

1127
00:42:03,030 --> 00:42:01,119
working in those era could have come up

1128
00:42:04,630 --> 00:42:03,040
with a very simple explanation for how

1129
00:42:06,150 --> 00:42:04,640
things happened there actually was a

1130
00:42:07,670 --> 00:42:06,160
fair amount of contest a lot of people

1131
00:42:09,750 --> 00:42:07,680
with different missions

1132
00:42:11,109 --> 00:42:09,760
trying to figure out which way to go uh

1133
00:42:13,349 --> 00:42:11,119
and i think we also need to understand

1134
00:42:14,790 --> 00:42:13,359
you know that nasa um you know i mean

1135
00:42:16,790 --> 00:42:14,800
it's not

1136
00:42:18,470 --> 00:42:16,800
we live in an age over the past 50 years

1137
00:42:21,030 --> 00:42:18,480
when nasa has been the big player there

1138
00:42:23,430 --> 00:42:21,040

are missions like exoplanet exploration

1139
00:42:25,349 --> 00:42:23,440
and mars sample return that no other

1140
00:42:27,270 --> 00:42:25,359
type of organization can do but we you

1141
00:42:29,109 --> 00:42:27,280
know nasa works within

1142
00:42:31,349 --> 00:42:29,119
a much larger context that includes the

1143
00:42:32,630 --> 00:42:31,359
international partners universities

1144
00:42:34,950 --> 00:42:32,640
commercial firms that work on

1145
00:42:36,630 --> 00:42:34,960
subcontractor commercial firms that have

1146
00:42:38,790 --> 00:42:36,640
other commercial

1147
00:42:40,710 --> 00:42:38,800
aspirations and yes figuring out how all

1148
00:42:41,990 --> 00:42:40,720
these different people can talk is one

1149
00:42:43,349 --> 00:42:42,000
thing that i found most valuable about

1150
00:42:44,950 --> 00:42:43,359
this conference

1151
00:42:46,470 --> 00:42:44,960
but that's not a direct

1152
00:42:48,150 --> 00:42:46,480
response to your question about the

1153
00:42:49,030 --> 00:42:48,160
international partners maybe there's

1154
00:42:50,870 --> 00:42:49,040
another

1155
00:42:52,230 --> 00:42:50,880
new international partners say the

1156
00:42:53,190 --> 00:42:52,240
chinese

1157
00:42:55,829 --> 00:42:53,200
are

1158
00:42:58,470 --> 00:42:55,839
slowly being commit becoming integrated

1159
00:43:00,069 --> 00:42:58,480
into the astronomical community first in

1160
00:43:01,670 --> 00:43:00,079
the ground base they'll probably be a

1161
00:43:03,910 --> 00:43:01,680
participant in one of these large

1162
00:43:07,430 --> 00:43:03,920
ground-based telescopes

1163
00:43:09,829 --> 00:43:07,440

the tmt project is likely to have

1164
00:43:12,390 --> 00:43:09,839
chinese participation maybe also indian

1165
00:43:14,150 --> 00:43:12,400
participation i think as you build up

1166
00:43:15,990 --> 00:43:14,160
the interpersonal and scientific

1167
00:43:17,829 --> 00:43:16,000
collaborations

1168
00:43:19,750 --> 00:43:17,839
assuming the politics works out

1169
00:43:21,430 --> 00:43:19,760
favorably over the next 10 to 20 years

1170
00:43:23,510 --> 00:43:21,440
you may well have

1171
00:43:25,190 --> 00:43:23,520
you know china being as well integrated

1172
00:43:27,589 --> 00:43:25,200
into what we're doing

1173
00:43:29,430 --> 00:43:27,599
as we now have with the europeans

1174
00:43:33,109 --> 00:43:29,440
could not go that way

1175
00:43:35,190 --> 00:43:33,119
but uh certainly there's talk among

1176
00:43:37,589 --> 00:43:35,200
you know astronomers that you know gee

1177
00:43:39,270 --> 00:43:37,599
china be an obvious place to uh

1178
00:43:40,710 --> 00:43:39,280
to find support for a ground-based

1179
00:43:42,150 --> 00:43:40,720
aspirations

1180
00:43:43,670 --> 00:43:42,160
in 10 or 20 years maybe for the

1181
00:43:45,910 --> 00:43:43,680
space-based ones as well they certainly

1182
00:43:47,910 --> 00:43:45,920
have an active space program it's not

1183
00:43:51,190 --> 00:43:47,920
yet integrated into the

1184
00:43:52,790 --> 00:43:51,200
nasa or european world yet

1185
00:43:55,030 --> 00:43:52,800
anti-integrated

1186
00:43:57,349 --> 00:43:55,040
but uh that can change

1187
00:43:59,750 --> 00:43:57,359
let me uh ask scott

1188
00:44:02,710 --> 00:43:59,760

we saw in mikhail slides

1189
00:44:04,390 --> 00:44:02,720
i'm sure you noticed and it don't know

1190
00:44:06,870 --> 00:44:04,400
what your reaction was

1191
00:44:08,550 --> 00:44:06,880
then you probably knew this the russians

1192
00:44:10,870 --> 00:44:08,560
are planning a more sample return

1193
00:44:12,790 --> 00:44:10,880
mission for about the same time period

1194
00:44:15,670 --> 00:44:12,800
that we would be

1195
00:44:17,829 --> 00:44:15,680
and having grown up at a time when many

1196
00:44:18,550 --> 00:44:17,839
people were asking why are we competing

1197
00:44:20,390 --> 00:44:18,560
with

1198
00:44:22,150 --> 00:44:20,400
the russians and going to the moon why

1199
00:44:24,630 --> 00:44:22,160
aren't we cooperating and of course

1200
00:44:25,990 --> 00:44:24,640
we've seen many iterations of that at

1201
00:44:27,589 --> 00:44:26,000
this point

1202
00:44:29,750 --> 00:44:27,599
does it make sense

1203
00:44:31,589 --> 00:44:29,760
to talk about a joint

1204
00:44:34,710 --> 00:44:31,599
sample return mission you spread out the

1205
00:44:37,670 --> 00:44:34,720
risk spread out the cost

1206
00:44:40,710 --> 00:44:37,680
well the exomars

1207
00:44:43,510 --> 00:44:40,720
uh collaboration was intended to be the

1208
00:44:45,670 --> 00:44:43,520
first step toward a nasa esa

1209
00:44:48,069 --> 00:44:45,680
collaboration on sample return for

1210
00:44:51,030 --> 00:44:48,079
exactly the reasons you mentioned which

1211
00:44:53,030 --> 00:44:51,040
was to spread out the cost and diffuse

1212
00:44:54,470 --> 00:44:53,040
the risk

1213
00:44:57,109 --> 00:44:54,480

right now

1214
00:45:01,750 --> 00:44:57,119
the international collaboration in that

1215
00:45:06,550 --> 00:45:05,030
for a variety of reasons i think it will

1216
00:45:08,870 --> 00:45:06,560
come back

1217
00:45:10,309 --> 00:45:08,880
i think certainly the human exploration

1218
00:45:12,069 --> 00:45:10,319
of

1219
00:45:14,390 --> 00:45:12,079
deep space is going to be an

1220
00:45:19,430 --> 00:45:14,400
international

1221
00:45:22,069 --> 00:45:19,440
i i in direct somewhat direct response

1222
00:45:24,309 --> 00:45:22,079
to your question uh you can ask the

1223
00:45:25,670 --> 00:45:24,319
question why explore space

1224
00:45:27,990 --> 00:45:25,680
and

1225
00:45:30,470 --> 00:45:28,000
there's an hour lecture i give that has

1226
00:45:33,190 --> 00:45:30,480
the six reasons i've collected but the

1227
00:45:34,470 --> 00:45:33,200
first of those for nation states is that

1228
00:45:35,990 --> 00:45:34,480
it's a significant badge of

1229
00:45:37,670 --> 00:45:36,000
accomplishment

1230
00:45:39,349 --> 00:45:37,680
you know there's only

1231
00:45:40,150 --> 00:45:39,359
the soviet union

1232
00:45:40,950 --> 00:45:40,160
and

1233
00:45:43,270 --> 00:45:40,960
uh

1234
00:45:47,270 --> 00:45:43,280
the united states that have had the

1235
00:45:48,309 --> 00:45:47,280
independent ability to put humans

1236
00:45:50,470 --> 00:45:48,319
into

1237
00:45:52,790 --> 00:45:50,480
even low earth orbit

1238
00:45:55,750 --> 00:45:52,800

the chinese are following the mercury

1239
00:45:58,630 --> 00:45:55,760
apollo gemini apollo playbook and it is

1240
00:46:00,790 --> 00:45:58,640
for them a badge of accomplishment

1241
00:46:04,309 --> 00:46:00,800
and as far as i can tell it is for india

1242
00:46:07,510 --> 00:46:04,319
as well there are many many applications

1243
00:46:10,710 --> 00:46:07,520
of earth orbiting spacecraft for

1244
00:46:13,030 --> 00:46:10,720
a disaster relief and so forth but where

1245
00:46:16,550 --> 00:46:13,040
you ask the question of you know why put

1246
00:46:18,470 --> 00:46:16,560
people in space you cannot ignore

1247
00:46:20,390 --> 00:46:18,480
the national interest part

1248
00:46:22,069 --> 00:46:20,400
and i think that's what drives some

1249
00:46:25,030 --> 00:46:22,079
nation states to want to do that in the

1250
00:46:25,040 --> 00:46:30,309
okay torrence you want to make a point

1251
00:46:36,710 --> 00:46:32,710
i just wanted to make a very brief pitch

1252
00:46:44,069 --> 00:46:40,550
in the context of of the time that

1253
00:46:46,309 --> 00:46:44,079
all of this takes 1610 galileo

1254
00:46:48,790 --> 00:46:46,319
discovered the solar system effectively

1255
00:46:50,630 --> 00:46:48,800
by 1710 isaac newton had it figured out

1256
00:46:52,470 --> 00:46:50,640
how it worked

1257
00:46:53,270 --> 00:46:52,480
we're we're

1258
00:46:55,190 --> 00:46:53,280
still

1259
00:46:56,710 --> 00:46:55,200
ringing changes on the restricted three

1260
00:46:59,430 --> 00:46:56,720
body problems with all of these

1261
00:47:01,589 --> 00:46:59,440
trajectories we're talking about

1262
00:47:02,390 --> 00:47:01,599
we're talking about a field that's half

1263
00:47:04,790 --> 00:47:02,400

that

1264
00:47:06,870 --> 00:47:04,800
length of time long

1265
00:47:08,630 --> 00:47:06,880
and my own terms i've been working on

1266
00:47:10,390 --> 00:47:08,640
cassini one way or the other for half

1267
00:47:11,670 --> 00:47:10,400
the time since the launch of explorer

1268
00:47:14,309 --> 00:47:11,680
one

1269
00:47:15,910 --> 00:47:14,319
not me and i'm old but it also means

1270
00:47:17,829 --> 00:47:15,920
this field is young

1271
00:47:21,109 --> 00:47:17,839
and during that time we've gone from

1272
00:47:24,230 --> 00:47:21,119
zero exoplanets to over 800 and i

1273
00:47:26,390 --> 00:47:24,240
suspect that chaz's future history is

1274
00:47:28,470 --> 00:47:26,400
actually conservative

1275
00:47:31,670 --> 00:47:28,480
i can't think of a better note on which

1276
00:47:33,829 --> 00:47:31,680
to end our panel thank you torence and

1277
00:47:43,750 --> 00:47:33,839
thanks to everybody on the panel and to

1278
00:47:48,630 --> 00:47:45,510
well gentlemen and ladies

1279
00:47:50,630 --> 00:47:48,640
it's time to close our symposium

1280
00:47:53,589 --> 00:47:50,640
i would like to think that we have

1281
00:47:54,630 --> 00:47:53,599
learned a great deal during our two days

1282
00:47:56,470 --> 00:47:54,640
here

1283
00:47:58,630 --> 00:47:56,480
i will point to two things that i think

1284
00:48:01,030 --> 00:47:58,640
are very valuable for us

1285
00:48:02,790 --> 00:48:01,040
as we as we think about this particular

1286
00:48:03,910 --> 00:48:02,800
conference and as we go forward the

1287
00:48:06,150 --> 00:48:03,920
first one is

1288
00:48:09,030 --> 00:48:06,160

the interplay of historians and other

1289
00:48:11,589 --> 00:48:09,040
social scientists with engineers program

1290
00:48:14,230 --> 00:48:11,599
managers scientists i think has been a

1291
00:48:16,549 --> 00:48:14,240
very rewarding uh experience and quite

1292
00:48:19,190 --> 00:48:16,559
synergistic and so i hope that we that

1293
00:48:20,790 --> 00:48:19,200
we take that away as something to pursue

1294
00:48:23,430 --> 00:48:20,800
in the future when we think about these

1295
00:48:25,109 --> 00:48:23,440
sorts of of issues secondly

1296
00:48:27,190 --> 00:48:25,119
one of the things that we have uh

1297
00:48:29,190 --> 00:48:27,200
learned through the two days is how much

1298
00:48:31,190 --> 00:48:29,200
we don't know there has been more

1299
00:48:32,549 --> 00:48:31,200
questions raised than there have been

1300
00:48:35,349 --> 00:48:32,559
answers offered

1301
00:48:37,430 --> 00:48:35,359
uh and and that's to the good as well uh

1302
00:48:40,069 --> 00:48:37,440
the history of planetary science of

1303
00:48:41,670 --> 00:48:40,079
solar system exploration is a very rich

1304
00:48:43,430 --> 00:48:41,680
one and i hope that we will continue to

1305
00:48:45,270 --> 00:48:43,440
pursue it into the future i know the

1306
00:48:46,790 --> 00:48:45,280
historians we're going to mobilize to

1307
00:48:48,390 --> 00:48:46,800
try to do so and we're going to be

1308
00:48:50,390 --> 00:48:48,400
calling upon all of you who are

1309
00:48:51,829 --> 00:48:50,400
practitioners to help us

1310
00:48:53,670 --> 00:48:51,839
um

1311
00:48:55,670 --> 00:48:53,680
as we close the first thing i would like

1312
00:48:59,109 --> 00:48:55,680
to do is just to acknowledge our

1313
00:49:01,750 --> 00:48:59,119

sponsors nasa jpl the smithsonian

1314
00:49:03,430 --> 00:49:01,760
lockheed martin for all of your uh

1315
00:49:04,950 --> 00:49:03,440
excellent support for the activities

1316
00:49:11,589 --> 00:49:04,960
that we've done for the last two days so

1317
00:49:15,030 --> 00:49:13,030
and could we also have a round of

1318
00:49:21,910 --> 00:49:15,040
applause for all of the presenters and