1
00:00:08,240 --> 00:00:05,059
morning everyone if you'd kindly take a

2
00:00:10,640 --> 00:00:08,250
seat please welcome to solar system

3
00:00:12,140 --> 00:00:10,650
exploration 250 a symposium co-sponsored

4
00:00:13,940 --> 00:00:12,150
by the space history Division of the

5
00:00:14,990 --> 00:00:13,950
National Air and Space Museum the

6
00:00:17,689 --> 00:00:15,000
science Mission Directorate at NASA

7
00:00:19,910 --> 00:00:17,699
headquarters Jet Propulsion Laboratory

8
00:00:21,859 --> 00:00:19,920
and the NASA history program I'm

9
00:00:23,630 --> 00:00:21,869
bilberry the NASA chief historian and

10
00:00:25,460 --> 00:00:23,640
before I introduce our first speaker I'd

11
00:00:26,390 --> 00:00:25,470
like for formal welcoming remarks there

12
00:00:27,830 --> 00:00:26,400
are a couple of administrative

13
00:00:29,810 --> 00:00:27,840

announcements that need to be made so

14
00:00:32,150 --> 00:00:29,820
let's start with that first of all let's

15
00:00:35,840 --> 00:00:32,160
start with safety if for some reason we

16
00:00:38,420 --> 00:00:35,850
need to exit the room follow doors to

17
00:00:41,119 --> 00:00:38,430
your left there and exit out follow the

18
00:00:43,400 --> 00:00:41,129
directions of the staff in case we need

19
00:00:45,500 --> 00:00:43,410
that for some reason secondly courtesy

20
00:00:49,040 --> 00:00:45,510
of those you have cell phones and mobile

21
00:00:53,270 --> 00:00:49,050
devices if you go to either quiet moan

22
00:00:54,889 --> 00:00:53,280
or vibrate mode would that be great I'll

23
00:00:56,630 --> 00:00:54,899
also like to express our thanks to

24
00:00:58,459 --> 00:00:56,640
everybody who applied the participate in

25
00:01:00,290 --> 00:00:58,469
this and the program and the panels and

26
00:01:04,160 --> 00:01:00,300
we had three times more papers than we

27
00:01:05,840 --> 00:01:04,170
have room for on the on the panels so

28
00:01:07,520 --> 00:01:05,850
that's really impressive for a two-day

29
00:01:08,660 --> 00:01:07,530
symposium the organizing committee I

30
00:01:11,390 --> 00:01:08,670
think was able to select the pretty

31
00:01:12,890 --> 00:01:11,400
diverse and interesting group of papers

32
00:01:15,100 --> 00:01:12,900
and we think you'll really enjoy the

33
00:01:19,219 --> 00:01:15,110
program we have set up for you today on

34
00:01:20,810 --> 00:01:19,229
lunch those you preorder lunches they'll

35
00:01:23,030 --> 00:01:20,820
be available back where you found the

36
00:01:24,920 --> 00:01:23,040
coffee this morning at lunch time would

37
00:01:26,210 --> 00:01:24,930
ask you to file out pick up your lunch

38
00:01:28,130 --> 00:01:26,220

and come back in here for our keynote

39
00:01:29,690 --> 00:01:28,140
lunch speaker there's a little fold up

40
00:01:33,050 --> 00:01:29,700
table there on your charioteer so you

41
00:01:34,850 --> 00:01:33,060
can just enjoy your lunch there you'll

42
00:01:36,260 --> 00:01:34,860
have a little sticker on your security

43
00:01:37,370 --> 00:01:36,270
badge to the various colored if you

44
00:01:38,780 --> 00:01:37,380
ordered your lunch if you didn't order

45
00:01:40,219 --> 00:01:38,790
launch three places just outside the

46
00:01:43,069 --> 00:01:40,229
doors you can grab something quick if

47
00:01:45,260 --> 00:01:43,079
you'd like we're doing a live webcast

48
00:01:47,690 --> 00:01:45,270
today so please keep in mind that if

49
00:01:49,760 --> 00:01:47,700
you're not standing up here at the table

50
00:01:51,440 --> 00:01:49,770
talking people won't hear you very well

51
00:01:52,969 --> 00:01:51,450
so we have microphones and we'll have

52
00:01:54,590 --> 00:01:52,979
runners so they're in the Q&A sessions

53
00:01:56,240 --> 00:01:54,600
if you'd please make sure before you ask

54
00:01:59,300 --> 00:01:56,250
your question after you recognized by

55
00:02:02,090 --> 00:01:59,310
the panel to make sure you have a

56
00:02:04,039 --> 00:02:02,100
microphone in front of you now an event

57
00:02:05,420 --> 00:02:04,049
like this doesn't happen by itself so

58
00:02:07,399 --> 00:02:05,430
I'd like to thank the organizing

59
00:02:09,249 --> 00:02:07,409
committee members and in fact I like to

60
00:02:11,540 --> 00:02:09,259
ask the organizing committee members

61
00:02:13,270 --> 00:02:11,550
people from the history program staff

62
00:02:14,699 --> 00:02:13,280
anybody from xantech

63
00:02:16,840 --> 00:02:14,709

in here leo folks advantage the

64
00:02:19,030 --> 00:02:16,850
registration process and the website

65
00:02:20,350 --> 00:02:19,040
force and any of the staff from the

66
00:02:22,390 --> 00:02:20,360
Lockheed Martin global vision sorry

67
00:02:24,580 --> 00:02:22,400
could you please just stand for a second

68
00:02:25,630 --> 00:02:24,590
and I'd asked everybody to join me in a

69
00:02:32,140 --> 00:02:25,640
round of applause for everybody helped

70
00:02:35,080 --> 00:02:32,150
out with it thanks very much we really

71
00:02:36,760 --> 00:02:35,090
appreciate that now our hosts Lockheed

72
00:02:38,860 --> 00:02:36,770
Martin have been most generous and

73
00:02:40,510 --> 00:02:38,870
helpful in a lot of ways I'd like to

74
00:02:43,180 --> 00:02:40,520
invite you to take a tour their display

75
00:02:45,580 --> 00:02:43,190
out there the space experiences on the

76
00:02:46,780 --> 00:02:45,590
far side of the lobby over there and mr.

77
00:02:48,400 --> 00:02:46,790
david brandt who's standing in the back

78
00:02:49,330 --> 00:02:48,410
back there be happy to help organize a

79
00:02:50,470 --> 00:02:49,340
tour for if you want to take a look

80
00:02:53,410 --> 00:02:50,480
through there any time during the day if

81
00:02:54,820 --> 00:02:53,420
you'd want to walk out and do that it's

82
00:02:56,680 --> 00:02:54,830
a great display and if you haven't seen

83
00:03:00,460 --> 00:02:56,690
it before is well worth of look and if

84
00:03:01,420 --> 00:03:00,470
you have other questions about symposium

85
00:03:02,920 --> 00:03:01,430
or other things are going to feel free

86
00:03:05,170 --> 00:03:02,930
to define one of us who have one is

87
00:03:09,490 --> 00:03:05,180
yellow staff tags on and ask us the

88
00:03:11,080 --> 00:03:09,500

questions were happy to help you out now

89
00:03:13,479 --> 00:03:11,090
i have the honor of introducing our

90
00:03:15,009 --> 00:03:13,489
opening speaker mr. jim cracker is the

91
00:03:16,720 --> 00:03:15,019
vice president and general manager for

92
00:03:18,880 --> 00:03:16,730
civil space at the Lockheed Martin space

93
00:03:20,350 --> 00:03:18,890
systems company mr. Crocker's

94
00:03:21,670 --> 00:03:20,360
responsible for his company's business

95
00:03:23,620 --> 00:03:21,680
that focuses on something near and dear

96
00:03:25,090 --> 00:03:23,630
to all of us space science of planetary

97
00:03:26,970 --> 00:03:25,100
exploration but also there are human

98
00:03:28,509 --> 00:03:26,980
spaceflight programs now mirroring the

99
00:03:30,850 --> 00:03:28,519
integration that's happening at NASA

100
00:03:32,110 --> 00:03:30,860
headquarters as well he has a long and

101
00:03:33,550 --> 00:03:32,120
distinguished career in the space

102
00:03:35,170 --> 00:03:33,560
business and I'd like to touch very

103
00:03:37,180 --> 00:03:35,180
briefly on three interesting points I

104
00:03:38,380 --> 00:03:37,190
think from his career at start of his

105
00:03:39,789 --> 00:03:38,390
career of course he graduate from

106
00:03:42,250 --> 00:03:39,799
Georgia Tech with a double e degree

107
00:03:43,720 --> 00:03:42,260
which is impressive enough as it is he

108
00:03:46,420 --> 00:03:43,730
designed electronics for scientific

109
00:03:47,620 --> 00:03:46,430
experiments and Skylab you later led the

110
00:03:49,300 --> 00:03:47,630
team that developed the co-star

111
00:03:51,370 --> 00:03:49,310
instrument which you can now see sitting

112
00:03:52,960 --> 00:03:51,380
in the air space museum and that ban DC

113
00:03:54,430 --> 00:03:52,970

there that's the instrument that was

114
00:03:56,800 --> 00:03:54,440
used to correct the flawed optics on the

115
00:03:58,180 --> 00:03:56,810
Hubble Space Telescope and just prior to

116
00:03:59,770 --> 00:03:58,190
joining Lockheed Martin you serve this

117
00:04:04,539 --> 00:03:59,780
program director for the next generation

118
00:04:05,650 --> 00:04:04,549
space telescope at ball aerospace he's

119
00:04:09,660 --> 00:04:05,660
clearly a person knows a thing or two

120
00:04:13,199 --> 00:04:09,670
about solar system exploration in fact

121
00:04:15,460 --> 00:04:13,209
Lockheed Martin's currently involved in

122
00:04:17,199 --> 00:04:15,470
the next three planetary missions that

123
00:04:18,219 --> 00:04:17,209
are going to fly maven osiris-rex and

124
00:04:19,420 --> 00:04:18,229
insight Lockheed Martin's to the

125
00:04:23,050 --> 00:04:19,430
contract on ahead they're flying

126
00:04:27,190 --> 00:04:23,060
formation juno grail amuro and odyssey

127
00:04:29,020 --> 00:04:27,200
and without any further ado let me

128
00:04:37,690 --> 00:04:29,030
introduce mr. Jim Crocker to talk to us

129
00:04:40,330 --> 00:04:37,700
about thanks for that great introduction

130
00:04:42,430 --> 00:04:40,340
bill well good morning welcome to

131
00:04:44,170 --> 00:04:42,440
Lockheed Martin's Global Vision Center

132
00:04:45,940 --> 00:04:44,180
we're really honored to have all of you

133
00:04:50,110 --> 00:04:45,950
here today it's such a privilege for us

134
00:04:53,350 --> 00:04:50,120
to host this 50th anniversary

135
00:04:57,719 --> 00:04:53,360
celebration symposium on 50 years of

136
00:05:01,150 --> 00:04:57,729
planetary exploration in space 50 years

137
00:05:03,520 --> 00:05:01,160
50 years half a century you know there's

138
00:05:05,230 --> 00:05:03,530

a lot of celebrations going on if you

139
00:05:07,659 --> 00:05:05,240
walk around today and you see people

140
00:05:09,610 --> 00:05:07,669
with these little blue pins on they're

141
00:05:11,140 --> 00:05:09,620
probably people who work for lockheed

142
00:05:14,920 --> 00:05:11,150
martin because this year we're

143
00:05:20,500 --> 00:05:14,930
celebrating our 100th anniversary July

144
00:05:25,540 --> 00:05:20,510
and August sixteenth of 1912 1912 in los

145
00:05:29,590 --> 00:05:25,550
angeles california in a small church

146
00:05:33,190 --> 00:05:29,600
building glenelg martin assembled his

147
00:05:35,440 --> 00:05:33,200
very first aircraft now he did that at

148
00:05:38,620 --> 00:05:35,450
the encouragement of no less than

149
00:05:43,900 --> 00:05:38,630
orrible right he said you have a very

150
00:05:45,640 --> 00:05:43,910
interesting innovative may be risky new

151
00:05:47,830 --> 00:05:45,650
design but you really ought to go try

152
00:05:50,440 --> 00:05:47,840
this he ran into church he did that he

153
00:05:52,420 --> 00:05:50,450
created something that to this day is

154
00:05:55,629 --> 00:05:52,430
not only an aircraft but a great

155
00:05:58,750 --> 00:05:55,639
corporation and four months later 400

156
00:06:01,320 --> 00:05:58,760
miles away the two Lockheed brothers who

157
00:06:04,000 --> 00:06:01,330
were great machinist had in a garage

158
00:06:06,310 --> 00:06:04,010
started to assemble sea planes which

159
00:06:09,879 --> 00:06:06,320
would start to set records for speed and

160
00:06:11,890 --> 00:06:09,889
distance so a church in a garage many of

161
00:06:14,879 --> 00:06:11,900
the things that many of the startups now

162
00:06:17,680 --> 00:06:14,889
start in that we see in Silicon Valley

163
00:06:20,260 --> 00:06:17,690

just a couple of years ago however we

164
00:06:22,690 --> 00:06:20,270
had a 50th anniversary celebration of

165
00:06:24,760 --> 00:06:22,700
our own in space systems company because

166
00:06:26,680 --> 00:06:24,770
that's when both the Sunnyvale facility

167
00:06:28,810 --> 00:06:26,690
and the Denver facility were both

168
00:06:32,200 --> 00:06:28,820
brought online just a little over 50

169
00:06:35,020 --> 00:06:32,210
years ago and some people say that at

170
00:06:36,590 --> 00:06:35,030
least in Silicon Valley it was the

171
00:06:39,020 --> 00:06:36,600
Lockheed Stanford

172
00:06:41,090 --> 00:06:39,030
one time we had 30,000 scientists and

173
00:06:43,520 --> 00:06:41,100
engineers working in sunnyvale that were

174
00:06:45,380 --> 00:06:43,530
really the underpinnings of silicon

175
00:06:48,260 --> 00:06:45,390
valley and and some of the great

176
00:06:51,050 --> 00:06:48,270
innovation that has come out in that

177
00:06:52,910 --> 00:06:51,060
area can historians tell us can be

178
00:06:56,270 --> 00:06:52,920
traced directly back to some of those

179
00:06:57,500 --> 00:06:56,280
investments and things that we made you

180
00:07:00,260 --> 00:06:57,510
know I was going to talk this morning

181
00:07:02,420 --> 00:07:00,270
and spend the 10 or 15 minutes that I

182
00:07:04,520 --> 00:07:02,430
have with you telling you about all of

183
00:07:06,220 --> 00:07:04,530
the great missions that Lockheed Martin

184
00:07:09,110 --> 00:07:06,230
has done over the last 50 years

185
00:07:12,380 --> 00:07:09,120
basically the places we've been and the

186
00:07:16,370 --> 00:07:12,390
places we go or are pretty amazing you

187
00:07:18,080 --> 00:07:16,380
know sometimes I I talk to k through 12

188
00:07:20,300 --> 00:07:18,090

children I'm on the board of the Denver

189
00:07:21,740 --> 00:07:20,310
Museum nature and science and I can tell

190
00:07:23,720 --> 00:07:21,750
you there's two things that these kids

191
00:07:27,080 --> 00:07:23,730
get excited about is dinosaurs and space

192
00:07:28,970 --> 00:07:27,090
exploration dinosaurs and Rovers I tell

193
00:07:31,490 --> 00:07:28,980
you those are those are two really easy

194
00:07:33,440 --> 00:07:31,500
things to get kids excited about so it's

195
00:07:35,510 --> 00:07:33,450
going to tell you about the 20 missions

196
00:07:37,250 --> 00:07:35,520
that we've done matter of fact this this

197
00:07:40,310 --> 00:07:37,260
is already out of date because we just

198
00:07:42,020 --> 00:07:40,320
recently were selected to with JPL do

199
00:07:44,390 --> 00:07:42,030
the insight mission so I don't even have

200
00:07:46,790 --> 00:07:44,400
this talk updated for our latest mission

201
00:07:49,520 --> 00:07:46,800
we've done 20 missions or either done or

202
00:07:51,620 --> 00:07:49,530
on contract we have three missions in

203
00:07:53,960 --> 00:07:51,630
the queue we have about 20 missions and

204
00:07:58,760 --> 00:07:53,970
total that we've done but in addition to

205
00:08:01,580 --> 00:07:58,770
that we have been honored to go with all

206
00:08:05,090 --> 00:08:01,590
of you with the scientists with NASA to

207
00:08:07,520 --> 00:08:05,100
every planet in the solar system now we

208
00:08:09,650 --> 00:08:07,530
can argue about Pluto but that's another

209
00:08:12,080 --> 00:08:09,660
story we talked about that a little last

210
00:08:14,360 --> 00:08:12,090
night but so we're going to the first

211
00:08:16,700 --> 00:08:14,370
Quaker belt object having provided the

212
00:08:18,620 --> 00:08:16,710
Atlas that that launched that that

213
00:08:21,590 --> 00:08:18,630

spacecraft and also providing the

214
00:08:23,060 --> 00:08:21,600
radioisotope system so we have a list

215
00:08:24,500 --> 00:08:23,070
here of the missions that we've been

216
00:08:26,060 --> 00:08:24,510
involved in and that's sort of playing

217
00:08:31,130 --> 00:08:26,070
in the background it talks about our

218
00:08:33,469 --> 00:08:31,140
role and also about the exciting science

219
00:08:34,730 --> 00:08:33,479
that's been done for each of those but

220
00:08:36,409 --> 00:08:34,740
I'm not going to talk about this this

221
00:08:39,589 --> 00:08:36,419
morning because last night I was

222
00:08:41,180 --> 00:08:39,599
motivated from the question that was

223
00:08:44,060 --> 00:08:41,190
asked in the audience over at the

224
00:08:47,050 --> 00:08:44,070
national Geographics reception that we

225
00:08:50,080 --> 00:08:47,060
had a question about why do we

226
00:08:52,420 --> 00:08:50,090
you do this I just said okay I'm going

227
00:08:54,130 --> 00:08:52,430
to throw this away because I think that

228
00:08:56,380 --> 00:08:54,140
this is more important and it's a matter

229
00:08:58,510 --> 00:08:56,390
of fact these missions that they sell

230
00:09:00,370 --> 00:08:58,520
themselves I mean why do I need to tell

231
00:09:02,230 --> 00:09:00,380
you about this all of us here will be

232
00:09:03,760 --> 00:09:02,240
extremely excited about all of these

233
00:09:05,710 --> 00:09:03,770
missions so you can you can read the

234
00:09:07,720 --> 00:09:05,720
text in the background because I think

235
00:09:11,680 --> 00:09:07,730
this is more important I think we're at

236
00:09:14,740 --> 00:09:11,690
a time when re-energizing why we do this

237
00:09:18,010 --> 00:09:14,750
is so important and I think all of us

238
00:09:20,470 --> 00:09:18,020

need to be thinking about as the young

239
00:09:22,240 --> 00:09:20,480
science teacher last night ask the

240
00:09:23,769 --> 00:09:22,250
question i'll repeat the story matter of

241
00:09:25,570 --> 00:09:23,779
fact i tried to catch him last night

242
00:09:27,010 --> 00:09:25,580
before he got away but in the crowd I

243
00:09:29,680 --> 00:09:27,020
lost him so if you're out there

244
00:09:32,260 --> 00:09:29,690
somewhere please email me at james h

245
00:09:34,600 --> 00:09:32,270
crocker @ gmail.com because i'd like to

246
00:09:36,400 --> 00:09:34,610
hook up with you he said that he's a

247
00:09:39,790 --> 00:09:36,410
science teacher he got motivated to go

248
00:09:42,670 --> 00:09:39,800
into science because of all of the cool

249
00:09:45,130 --> 00:09:42,680
things that you do all of us together do

250
00:09:47,230 --> 00:09:45,140
in planetary and space exploration and

251
00:09:48,940 --> 00:09:47,240
so you're striving along and his wife

252
00:09:51,280 --> 00:09:48,950
said to him he was telling her about

253
00:09:53,740 --> 00:09:51,290
Pluto and and how cool it was with the

254
00:09:55,960 --> 00:09:53,750
New Horizons mission she said well why

255
00:09:59,170 --> 00:09:55,970
are we exploring space and he said I

256
00:10:01,030 --> 00:09:59,180
stopped the car and said get out I want

257
00:10:08,470 --> 00:10:01,040
to find out if he's still married or not

258
00:10:12,040 --> 00:10:08,480
so I'd like to find out but he's I don't

259
00:10:13,840 --> 00:10:12,050
go there so so he said he was joking

260
00:10:15,730 --> 00:10:13,850
about not telling his wife to get a car

261
00:10:18,970 --> 00:10:15,740
but seriously he said what would be the

262
00:10:22,150 --> 00:10:18,980
32nd speech that we would give to a

263
00:10:24,130 --> 00:10:22,160

politician to explain why we do this and

264
00:10:27,730 --> 00:10:24,140
I ask you what would not only be the

265
00:10:29,650 --> 00:10:27,740
32nd speech that you would give but what

266
00:10:32,110 --> 00:10:29,660
would be the longer conversation that

267
00:10:36,730 --> 00:10:32,120
you would have with a friend or with a

268
00:10:38,860 --> 00:10:36,740
student about why we do this what would

269
00:10:41,440 --> 00:10:38,870
be that conversation now more than ever

270
00:10:44,800 --> 00:10:41,450
is extremely important that we

271
00:10:47,500 --> 00:10:44,810
understand why we do this well I can

272
00:10:49,720 --> 00:10:47,510
tell you why I do this and it comes down

273
00:10:51,670 --> 00:10:49,730
to a couple of things one thing was up

274
00:10:54,730 --> 00:10:51,680
when I was in the third grade my father

275
00:10:58,510 --> 00:10:54,740
bundle is up in a car and he drove us to

276
00:11:00,879 --> 00:10:58,520
a museum and in the museum was a hella

277
00:11:02,769 --> 00:11:00,889
crafters I would learn later

278
00:11:05,859 --> 00:11:02,779
I got in the ham radio shortwave radio

279
00:11:09,729 --> 00:11:05,869
there was a man named Billy McFadden who

280
00:11:11,109 --> 00:11:09,739
was retired a Navy radio operator who

281
00:11:14,889 --> 00:11:11,119
told us we were going to hear something

282
00:11:17,619 --> 00:11:14,899
amazing wow what is this is warm tubes

283
00:11:18,999 --> 00:11:17,629
glowing on the helicopters radio and he

284
00:11:20,650 --> 00:11:19,009
I was kind of the youngest person there

285
00:11:22,869 --> 00:11:20,660
I think so he called me over and he put

286
00:11:24,999 --> 00:11:22,879
these big earphones on you thought he

287
00:11:28,030 --> 00:11:25,009
said it's coming just a minute listen

288
00:11:33,189 --> 00:11:28,040

for it and I heard the sounds of Sputnik

289
00:11:34,869 --> 00:11:33,199
and it was spaced calling to me I didn't

290
00:11:36,340 --> 00:11:34,879
know what a satellite was I didn't

291
00:11:39,669 --> 00:11:36,350
understand it at the time but I was

292
00:11:41,979 --> 00:11:39,679
hearing things from outer space and it

293
00:11:45,220 --> 00:11:41,989
changed it changed me I wanted to learn

294
00:11:47,079 --> 00:11:45,230
about this this stuff I wanted to a new

295
00:11:48,909 --> 00:11:47,089
math had something to do with it I new

296
00:11:51,400 --> 00:11:48,919
science had something to do with it so I

297
00:11:54,609 --> 00:11:51,410
started very learning about it was a few

298
00:11:57,369 --> 00:11:54,619
years later that in a backyard that my

299
00:12:00,039 --> 00:11:57,379
father drugged me to one late one night

300
00:12:03,099 --> 00:12:00,049
that I climbed up on a ladder and I

301
00:12:05,439 --> 00:12:03,109
looked through a 12 inch telescope that

302
00:12:08,470 --> 00:12:05,449
someone in our small town had had built

303
00:12:10,929 --> 00:12:08,480
and I saw the moon and I saw the moons

304
00:12:14,109 --> 00:12:10,939
of Jupiter and that was alike I mean it

305
00:12:15,489 --> 00:12:14,119
just it just motivated me to go on and

306
00:12:18,759 --> 00:12:15,499
go into science and go into engineering

307
00:12:21,069 --> 00:12:18,769
I can tell you that the that the young k

308
00:12:22,720 --> 00:12:21,079
through 12 people I talked to and at the

309
00:12:25,239 --> 00:12:22,730
museum at the Denver Museum and it

310
00:12:30,460 --> 00:12:25,249
colleges and high schools and everything

311
00:12:32,919 --> 00:12:30,470
I go into they don't go in to taking the

312
00:12:36,129 --> 00:12:32,929
hard science the hard math classes

313
00:12:39,069 --> 00:12:36,139

because they want to design a bridge

314
00:12:41,259 --> 00:12:39,079
that's ten percent lighter are a car

315
00:12:43,840 --> 00:12:41,269
that can get two miles more to the

316
00:12:46,150 --> 00:12:43,850
gallon or a jet that can fly a little

317
00:12:47,949 --> 00:12:46,160
further they go into these very hard

318
00:12:53,019 --> 00:12:47,959
things because someone is stealing them

319
00:12:55,720 --> 00:12:53,029
the passion for what we do instill in

320
00:12:58,150 --> 00:12:55,730
someone the passion for what we do

321
00:13:00,369 --> 00:12:58,160
become a missionary for what we do

322
00:13:02,769 --> 00:13:00,379
because I tell you it can change this

323
00:13:04,929 --> 00:13:02,779
country if you go back and you look at

324
00:13:06,660 --> 00:13:04,939
not people who are in the space program

325
00:13:10,170 --> 00:13:06,670
but I

326
00:13:11,730 --> 00:13:10,180
men I'm in several alumni organizations

327
00:13:13,460 --> 00:13:11,740
Johns Hopkins and Georgia Tech

328
00:13:17,730 --> 00:13:13,470
University of Alabama in Huntsville and

329
00:13:21,480 --> 00:13:17,740
when these kids come to come to

330
00:13:23,970 --> 00:13:21,490
different venues that I'm in very few of

331
00:13:27,380 --> 00:13:23,980
them are in space maybe one or two or

332
00:13:29,430 --> 00:13:27,390
two percent but many of them design

333
00:13:34,260 --> 00:13:29,440
telecommunications electronics they

334
00:13:36,780 --> 00:13:34,270
design computers they design cat-scans

335
00:13:40,320 --> 00:13:36,790
they design medical electronics they

336
00:13:42,330 --> 00:13:40,330
design teleoperated surgical equipment

337
00:13:44,430 --> 00:13:42,340
but when you ask them why did you go

338
00:13:46,380 --> 00:13:44,440

into science and engineering more often

339
00:13:49,500 --> 00:13:46,390
than not they will tell you it's because

340
00:13:52,230 --> 00:13:49,510
I saw Neil Armstrong step onto the moon

341
00:13:55,890 --> 00:13:52,240
I saw the pictures from Voyager come

342
00:13:57,120 --> 00:13:55,900
back I saw fill in the blank something

343
00:13:59,880 --> 00:13:57,130
that had to do with space exploration

344
00:14:03,150 --> 00:13:59,890
that challenge them to do the very hard

345
00:14:08,370 --> 00:14:03,160
things that they had to do to go into

346
00:14:10,170 --> 00:14:08,380
these exciting tough hard feels more

347
00:14:12,840 --> 00:14:10,180
often than not it was motivated for

348
00:14:14,520 --> 00:14:12,850
science that was motivated to go into

349
00:14:17,130 --> 00:14:14,530
science and engineering because of what

350
00:14:20,160 --> 00:14:17,140
you have done what all of us had done

351
00:14:23,270 --> 00:14:20,170
together in planetary exploration you

352
00:14:26,100 --> 00:14:23,280
know I had the privilege two years ago

353
00:14:28,530 --> 00:14:26,110
actually one year ago of going to China

354
00:14:31,110 --> 00:14:28,540
with the u.s. space Federation and

355
00:14:34,200 --> 00:14:31,120
seeing their space exploration program

356
00:14:36,780 --> 00:14:34,210
it was really really for me and I opener

357
00:14:41,340 --> 00:14:36,790
what was going on over there they don't

358
00:14:43,440 --> 00:14:41,350
let me a lot especially in in some some

359
00:14:45,300 --> 00:14:43,450
countries but this was a really great

360
00:14:47,310 --> 00:14:45,310
opportunity for me to go and see

361
00:14:50,550 --> 00:14:47,320
firsthand what the Chinese space program

362
00:14:52,950 --> 00:14:50,560
was doing we got to go to both Beijing

363
00:14:55,290 --> 00:14:52,960

to the human spaceflight Operations

364
00:14:57,260 --> 00:14:55,300
Center they have there and also to to

365
00:14:59,640 --> 00:14:57,270
Shanghai where they build most of their

366
00:15:02,130 --> 00:14:59,650
weather satellites and they actually had

367
00:15:05,040 --> 00:15:02,140
the Mars mission that would launch later

368
00:15:07,350 --> 00:15:05,050
on phobos-grunt unsuccessfully because

369
00:15:08,700 --> 00:15:07,360
of a problem with the rocket but they

370
00:15:12,300 --> 00:15:08,710
were really excited about going to Mars

371
00:15:14,670 --> 00:15:12,310
I can tell you as part of this trip we

372
00:15:16,680 --> 00:15:14,680
went over to their equivalent the air

373
00:15:18,940 --> 00:15:16,690
and space museum and it's starting to

374
00:15:21,460 --> 00:15:18,950
grow they had their fur

375
00:15:25,570 --> 00:15:21,470
capsule that they had longed there

376
00:15:28,420 --> 00:15:25,580
talkonaut sin they had a model of their

377
00:15:32,410 --> 00:15:28,430
space station that they had launched

378
00:15:34,540 --> 00:15:32,420
just a year or so earlier but I saw over

379
00:15:36,300 --> 00:15:34,550
in the corner a statue and I thought one

380
00:15:39,820 --> 00:15:36,310
is kind of strange it kind of looks like

381
00:15:41,920 --> 00:15:39,830
like something really old the only what

382
00:15:44,320 --> 00:15:41,930
that was I walked over there and as I

383
00:15:47,020 --> 00:15:44,330
got closer it dawned on me who the

384
00:15:48,400 --> 00:15:47,030
statue was up if I tell you a little bit

385
00:15:50,260 --> 00:15:48,410
about it I think a number of you in the

386
00:15:53,340 --> 00:15:50,270
audience will get it it was a it was a

387
00:15:55,840 --> 00:15:53,350
Chinese dignitary dressed in robes

388
00:15:59,110 --> 00:15:55,850

basically setting on a what looked like

389
00:16:01,630 --> 00:15:59,120
a chair he was holding two kites in his

390
00:16:03,490 --> 00:16:01,640
hand but on the and I got it right away

391
00:16:06,460 --> 00:16:03,500
when I saw in the back there were there

392
00:16:10,330 --> 00:16:06,470
were clay models of hundreds and

393
00:16:14,370 --> 00:16:10,340
hundreds of skyrockets well if you don't

394
00:16:19,510 --> 00:16:14,380
know who it is is one who and he was a

395
00:16:23,050 --> 00:16:19,520
minor diplomat in the in the 14th

396
00:16:25,240 --> 00:16:23,060
century who decided go the moon and so

397
00:16:27,100 --> 00:16:25,250
he figured long yes rockets had been

398
00:16:29,200 --> 00:16:27,110
invented so you just put enough of them

399
00:16:31,960 --> 00:16:29,210
on the back of a chariot and he did and

400
00:16:34,420 --> 00:16:31,970
he got his up he got his servants to run

401
00:16:36,040 --> 00:16:34,430
up and and light the fuses they let all

402
00:16:38,110 --> 00:16:36,050
the fuses and they ran back away and

403
00:16:41,530 --> 00:16:38,120
there was this big explosion cloud of

404
00:16:45,220 --> 00:16:41,540
dust and he was gone and they believed

405
00:16:47,080 --> 00:16:45,230
he got to the moon now before you laugh

406
00:16:49,150 --> 00:16:47,090
too loudly two things one there's a

407
00:16:52,740 --> 00:16:49,160
crater on the moon who's named in his

408
00:16:57,720 --> 00:16:52,750
honor and half an hour later the Chinese

409
00:17:02,530 --> 00:16:57,730
across the street doc their spacecraft

410
00:17:08,350 --> 00:17:02,540
with their space station which they will

411
00:17:16,880 --> 00:17:13,300
the other thing I saw there was the step

412
00:17:19,400 --> 00:17:16,890
the spring in the step and the speed

413
00:17:21,680 --> 00:17:19,410

that the young engineers in China were

414
00:17:24,500 --> 00:17:21,690
moving now most of them speak english

415
00:17:26,630 --> 00:17:24,510
and so i had a conversation with a

416
00:17:28,160 --> 00:17:26,640
number of them and i could tell you that

417
00:17:29,600 --> 00:17:28,170
there are some uncomfortable people

418
00:17:32,090 --> 00:17:29,610
while i was having these English

419
00:17:34,310 --> 00:17:32,100
conversations going on but we were

420
00:17:36,350 --> 00:17:34,320
talking about why did you go into

421
00:17:37,940 --> 00:17:36,360
science and engineering and I can tell

422
00:17:41,120 --> 00:17:37,950
you that they went into science

423
00:17:44,810 --> 00:17:41,130
engineering because of what we did they

424
00:17:47,600 --> 00:17:44,820
were incredibly jazzed about going to

425
00:17:50,720 --> 00:17:47,610
the moon they were incredibly jazzed

426
00:17:52,250 --> 00:17:50,730
about going to Mars they went in and did

427
00:17:54,620 --> 00:17:52,260
the hard science and engineering because

428
00:17:58,280 --> 00:17:54,630
they wanted to be part of expects

429
00:18:00,590 --> 00:17:58,290
pleurae shin of the universe that's why

430
00:18:03,920 --> 00:18:00,600
we do this when I was in the seventh

431
00:18:07,760 --> 00:18:03,930
grade I had a teacher inspired me I came

432
00:18:10,700 --> 00:18:07,770
from a small town only 20 22 23 thousand

433
00:18:12,710 --> 00:18:10,710
people at the time and so mrs. Johnson

434
00:18:15,860 --> 00:18:12,720
my seventh-grade teacher was trying to

435
00:18:17,900 --> 00:18:15,870
put some culture in a kind of small town

436
00:18:21,560 --> 00:18:17,910
country boys and she she taught us up

437
00:18:23,780 --> 00:18:21,570
and girls she taught us to enjoy some

438
00:18:25,700 --> 00:18:23,790

classical music some Beethoven Chopin

439
00:18:27,320 --> 00:18:25,710
and I thought that was kind of cool and

440
00:18:30,050 --> 00:18:27,330
I've enjoyed that the rest of my life

441
00:18:31,610 --> 00:18:30,060
but she showed us some art to art from

442
00:18:32,960 --> 00:18:31,620
different periods and some of it I have

443
00:18:35,030 --> 00:18:32,970
to tell you I didn't care for but there

444
00:18:37,880 --> 00:18:35,040
was one particularly that stuck in my

445
00:18:41,870 --> 00:18:37,890
mind there's a Hubble Space Telescope

446
00:18:44,780 --> 00:18:41,880
image that kind of makes art come to

447
00:18:47,000 --> 00:18:44,790
life and it's called starry nights if

448
00:18:48,770 --> 00:18:47,010
you've ever seen the original by Vincent

449
00:18:50,600 --> 00:18:48,780
van Gogh and you've also seen the Hubble

450
00:18:53,420 --> 00:18:50,610
image they kind of merged together in my

451
00:18:55,820 --> 00:18:53,430
mind but more importantly more

452
00:18:59,420 --> 00:18:55,830
importantly is a quote from Vincent van

453
00:19:01,790 --> 00:18:59,430
Gogh that says as for me I don't know

454
00:19:05,300 --> 00:19:01,800
much but when I look at the stars I

455
00:19:07,640 --> 00:19:05,310
dream so there's for dreaming today I

456
00:19:08,930 --> 00:19:07,650
hope you enjoy this conversation that

457
00:19:11,420 --> 00:19:08,940
we're going to have today but I hope

458
00:19:13,670 --> 00:19:11,430
you'll carry this conversation out care

459
00:19:15,440 --> 00:19:13,680
it to the hill carried in schools care

460
00:19:17,600 --> 00:19:15,450
it to your neighbors keratin people in

461
00:19:19,910 --> 00:19:17,610
this nation is important what we do and

462
00:19:21,049 --> 00:19:19,920
it's important that we share the

463
00:19:22,999 --> 00:19:21,059

excitement and

464
00:19:26,239 --> 00:19:23,009
come with us on this voyage this is the

465
00:19:28,039 --> 00:19:26,249
this is our voyage of discovery this

466
00:19:30,259 --> 00:19:28,049
will be written about in the textbooks

467
00:19:32,060 --> 00:19:30,269
it's what Magellan did is what

468
00:19:34,310 --> 00:19:32,070
Shackleton did is what all great

469
00:20:03,210 --> 00:19:34,320
explorers do we're living in this time

470
00:20:07,289 --> 00:20:05,279
well good morning everybody I'm Roger la

471
00:20:08,940 --> 00:20:07,299
Gnaeus i'm a senior curator at the

472
00:20:11,190 --> 00:20:08,950
National Air and Space Museum and I've

473
00:20:13,770 --> 00:20:11,200
been engaged in space history for more

474
00:20:15,390 --> 00:20:13,780
than 20 years now some of that time at

475
00:20:17,789 --> 00:20:15,400
NASA headquarters is the chief of story

476
00:20:21,480 --> 00:20:17,799
it's pleasure to see all of you here

477
00:20:23,580 --> 00:20:21,490
it's a pleasure to renew acquaintances

478
00:20:26,789 --> 00:20:23,590
with old friends and meet meet new folks

479
00:20:29,070 --> 00:20:26,799
that will become friends I hope and I

480
00:20:32,250 --> 00:20:29,080
can't think of a better way to start our

481
00:20:35,100 --> 00:20:32,260
formal presentations today than by

482
00:20:38,220 --> 00:20:35,110
inviting Peter westwick up to come and

483
00:20:42,120 --> 00:20:38,230
give our opening keynote Peters at the

484
00:20:45,840 --> 00:20:42,130
university of southern california USC he

485
00:20:48,570 --> 00:20:45,850
is a rising star in the history of

486
00:20:51,090 --> 00:20:48,580
science and technology he's done three

487
00:20:53,549 --> 00:20:51,100
major books thus far and I suspect we'll

488
00:20:55,919 --> 00:20:53,559

see more coming down the pike in the

489
00:21:00,090 --> 00:20:55,929
not-too-distant future and he's over

490
00:21:02,250 --> 00:21:00,100
there going well maybe but initially he

491
00:21:05,520 --> 00:21:02,260
he did a very fine book on the National

492
00:21:08,580 --> 00:21:05,530
Labs he followed that with a an even

493
00:21:10,049 --> 00:21:08,590
better book from my perspective on JPL

494
00:21:12,390 --> 00:21:10,059
the history of that since about nineteen

495
00:21:15,419 --> 00:21:12,400
eighty and then finally he has just

496
00:21:20,220 --> 00:21:15,429
published within the last year a book

497
00:21:23,880 --> 00:21:20,230
called what is the title again blue sky

498
00:21:25,880 --> 00:21:23,890
metropolis I don't know why I had a had

499
00:21:29,029 --> 00:21:25,890
a problem with that but it deals with

500
00:21:32,010 --> 00:21:29,039
California and the aerospace community

501
00:21:35,430 --> 00:21:32,020
without further ado let me invite Peter

502
00:21:42,780 --> 00:21:35,440
to come up and to open our presentations

503
00:21:50,290 --> 00:21:46,480
okay thank you roger for the overly

504
00:21:52,240 --> 00:21:50,300
generous introduction i would like to

505
00:21:54,790 --> 00:21:52,250
thank i think all of us would like to

506
00:21:57,760 --> 00:21:54,800
thank the organizers of this great

507
00:22:00,850 --> 00:21:57,770
conference very interesting program

508
00:22:03,490 --> 00:22:00,860
coming up bill and roger course the NASA

509
00:22:06,670 --> 00:22:03,500
history and science programs Aaron space

510
00:22:08,080 --> 00:22:06,680
museum space history folks JPL also like

511
00:22:10,390 --> 00:22:08,090
to thank Lockheed Martin for hosting us

512
00:22:11,890 --> 00:22:10,400
here over the past several months I've

513
00:22:15,250 --> 00:22:11,900

been seeing these full-page ads in The

514
00:22:16,630 --> 00:22:15,260
Washington Post showing some of the

515
00:22:18,670 --> 00:22:16,640
fruits from Lockheed Martin's Legacy

516
00:22:19,990 --> 00:22:18,680
Project showing the history of the

517
00:22:22,600 --> 00:22:20,000
company of last hundred years it's good

518
00:22:24,970 --> 00:22:22,610
to see an aerospace firm recognizing the

519
00:22:26,620 --> 00:22:24,980
importance of history I lost like thank

520
00:22:29,470 --> 00:22:26,630
Jim for the nice lead and actually the

521
00:22:31,060 --> 00:22:29,480
question he asked why do we do it as you

522
00:22:34,270 --> 00:22:31,070
can tell from my title is one of the

523
00:22:36,940 --> 00:22:34,280
concerns of my talk with hopefully a

524
00:22:40,120 --> 00:22:36,950
little bit of historical perspective on

525
00:22:42,060 --> 00:22:40,130
why we have done it so this past August

526
00:22:44,500 --> 00:22:42,070
many of us were captivated by curiosity

527
00:22:46,330 --> 00:22:44,510
landing on Mars and I mean the

528
00:22:47,770 --> 00:22:46,340
spacecraft not the human spirit of

529
00:22:50,620 --> 00:22:47,780
inquiry although that was certainly

530
00:22:53,110 --> 00:22:50,630
present too as all of you know a lot was

531
00:22:54,880 --> 00:22:53,120
riding on the lander on the landing two

532
00:22:57,070 --> 00:22:54,890
billion dollar Rover for starters but

533
00:23:00,580 --> 00:22:57,080
also perhaps the national appetite for

534
00:23:02,350 --> 00:23:00,590
planetary exploration itself curiosity

535
00:23:04,240 --> 00:23:02,360
success may have ensured that the u.s.

536
00:23:06,460 --> 00:23:04,250
at least will continue to explore the

537
00:23:08,500 --> 00:23:06,470
solar system so that the history we are

538
00:23:10,780 --> 00:23:08,510

we are called here to consider will

539
00:23:14,350 --> 00:23:10,790
continue now so we historians also thank

540
00:23:16,150 --> 00:23:14,360
JPL for some job security about 50 years

541
00:23:19,270 --> 00:23:16,160
earlier the Mariner two spacecrafts

542
00:23:21,580 --> 00:23:19,280
skimmed 20,000 miles over Venus Mariner

543
00:23:23,860 --> 00:23:21,590
and curiosity a book and the 50 years

544
00:23:26,380 --> 00:23:23,870
that define this conference in between

545
00:23:29,020 --> 00:23:26,390
space explorers have met triumphant

546
00:23:31,330 --> 00:23:29,030
success and epic failure they have seen

547
00:23:34,350 --> 00:23:31,340
ring spokes and blueberries but also

548
00:23:36,700 --> 00:23:34,360
faces on Mars and great galactic ghouls

549
00:23:38,890 --> 00:23:36,710
these 50 years of planetary exploration

550
00:23:41,830 --> 00:23:38,900
have taught us remarkable things about

551
00:23:45,520 --> 00:23:41,840
the solar system they've also taught us

552
00:23:46,930 --> 00:23:45,530
a great deal about ourselves we are

553
00:23:49,780 --> 00:23:46,940
gathered here to look outward to the

554
00:23:51,910 --> 00:23:49,790
other planets and to contemplate all we

555
00:23:54,730 --> 00:23:51,920
have learned about them but we will also

556
00:23:55,590 --> 00:23:54,740
drop our gaze back to earth and consider

557
00:23:58,230 --> 00:23:55,600
what deep space

558
00:24:02,279 --> 00:23:58,240
exploration tells us about our own human

559
00:24:04,560 --> 00:24:02,289
history over the last 50 years so our

560
00:24:07,140 --> 00:24:04,570
first question is who has done it who

561
00:24:09,510 --> 00:24:07,150
are the explorers by this I mean not the

562
00:24:12,360 --> 00:24:09,520
robots but the people institutions and

563
00:24:15,120 --> 00:24:12,370

nations who built them let's start with

564
00:24:16,680 --> 00:24:15,130
the people who are these people and what

565
00:24:19,169 --> 00:24:16,690
do they do all day how have they changed

566
00:24:22,380 --> 00:24:19,179
over 50 years and how has the work

567
00:24:23,730 --> 00:24:22,390
changed what are their backgrounds what

568
00:24:27,029 --> 00:24:23,740
do they do when they're not working and

569
00:24:29,370 --> 00:24:27,039
how does that affect their work as Glenn

570
00:24:31,320 --> 00:24:29,380
Asner pointed out a few years ago after

571
00:24:33,450 --> 00:24:31,330
50 years we still need more social

572
00:24:34,740 --> 00:24:33,460
history of space exploration to

573
00:24:37,169 --> 00:24:34,750
understand what all these people were

574
00:24:41,120 --> 00:24:37,179
doing we know a bit about the type of

575
00:24:43,230 --> 00:24:41,130
people involved for starters mostly men

576
00:24:45,630 --> 00:24:43,240
engineering and systems management was

577
00:24:47,490 --> 00:24:45,640
an overwhelmingly male preserve for most

578
00:24:49,380 --> 00:24:47,500
of the boat least the first half of this

579
00:24:51,779 --> 00:24:49,390
period now women in the space program

580
00:24:53,520 --> 00:24:51,789
have been studied more in relation to

581
00:24:56,460 --> 00:24:53,530
the astronaut corps much remains to be

582
00:24:58,440 --> 00:24:56,470
done for planetary exploration the

583
00:25:00,720 --> 00:24:58,450
number of women present in JPL's Mission

584
00:25:03,470 --> 00:25:00,730
Control for curiosity was a market

585
00:25:05,700 --> 00:25:03,480
contrast to all the men running Mariner

586
00:25:10,070 --> 00:25:05,710
still though the engineers on curiosity

587
00:25:12,899 --> 00:25:10,080
are mostly male and also mostly white

588
00:25:14,490 --> 00:25:12,909

nASA has not had a sterling record of

589
00:25:17,340 --> 00:25:14,500
majority representation although that

590
00:25:19,890 --> 00:25:17,350
too is changing recently and as with

591
00:25:21,510 --> 00:25:19,900
gender this ethnic representation is in

592
00:25:23,039 --> 00:25:21,520
part a reflection of the engineering

593
00:25:25,350 --> 00:25:23,049
profession at large in the United States

594
00:25:28,649 --> 00:25:25,360
which has been changing over the last 50

595
00:25:31,470 --> 00:25:28,659
years also but nevertheless even into

596
00:25:34,560 --> 00:25:31,480
the 1990s this group of the planetary

597
00:25:39,590 --> 00:25:34,570
explorers themselves whereas Dan Goldin

598
00:25:43,770 --> 00:25:39,600
so pungently put it Pale Male and stale

599
00:25:46,440 --> 00:25:43,780
as only Dan Goldin could put it one

600
00:25:47,640 --> 00:25:46,450
might also think about social classes we

601
00:25:49,529 --> 00:25:47,650
mostly think about white-collar

602
00:25:51,450 --> 00:25:49,539
engineers and managers and neglect the

603
00:25:53,700 --> 00:25:51,460
many other people involved in the

604
00:25:55,799 --> 00:25:53,710
enterprise machinists security guards

605
00:25:57,510 --> 00:25:55,809
secretaries some of whom share the

606
00:26:00,779 --> 00:25:57,520
excitement of space exploration but

607
00:26:02,580 --> 00:26:00,789
others of whom may not I recall the JPL

608
00:26:04,110 --> 00:26:02,590
janitor he said the most exciting thing

609
00:26:06,210 --> 00:26:04,120
about the Viking landing was the large

610
00:26:08,960 --> 00:26:06,220
rat who ran across the floor and jumped

611
00:26:10,940 --> 00:26:08,970
into a trashcan the

612
00:26:12,980 --> 00:26:10,950
is also age demographics the younger

613
00:26:15,440 --> 00:26:12,990

cohort that is filled in as the original

614
00:26:17,659 --> 00:26:15,450
space race generation retires has

615
00:26:19,640 --> 00:26:17,669
evidently brought a new sensibility to

616
00:26:22,039 --> 00:26:19,650
planetary missions at least to judge by

617
00:26:24,110 --> 00:26:22,049
the Mohawks in Mission Control not to

618
00:26:26,299 --> 00:26:24,120
mention the NASA and we know it video

619
00:26:29,210 --> 00:26:26,309
you can all look up on youtube I

620
00:26:30,950 --> 00:26:29,220
recommend it if you haven't stale they

621
00:26:32,630 --> 00:26:30,960
are not although neither we should

622
00:26:37,039 --> 00:26:32,640
remember was the original generation

623
00:26:39,649 --> 00:26:37,049
back in the day next what institutions

624
00:26:41,810 --> 00:26:39,659
explore the planets looking just at the

625
00:26:43,970 --> 00:26:41,820
US we have universities government labs

626
00:26:46,220 --> 00:26:43,980
industrial corporations for starters

627
00:26:49,250 --> 00:26:46,230
each type has different goals and

628
00:26:51,740 --> 00:26:49,260
cultures and sometimes those things are

629
00:26:54,919 --> 00:26:51,750
those include things besides planetary

630
00:26:58,159 --> 00:26:54,929
exploration how do University scientists

631
00:26:59,990 --> 00:26:58,169
interact with industry engineers how

632
00:27:02,090 --> 00:27:00,000
does academic culture intersect the

633
00:27:04,149 --> 00:27:02,100
profit motive of contractors and the

634
00:27:06,950 --> 00:27:04,159
government demand for accountability

635
00:27:10,850 --> 00:27:06,960
consider JPL to take an example at

636
00:27:12,770 --> 00:27:10,860
random JPL started as an army rocket lab

637
00:27:15,470 --> 00:27:12,780
and even after embracing planetary

638
00:27:18,230 --> 00:27:15,480

spacecraft as its main mission JPL

639
00:27:21,289 --> 00:27:18,240
continued to work on military programs

640
00:27:23,600 --> 00:27:21,299
at times substantial ones these programs

641
00:27:26,360 --> 00:27:23,610
affected how JPL built planetary

642
00:27:28,580 --> 00:27:26,370
spacecraft dating back to Ranger all the

643
00:27:30,230 --> 00:27:28,590
way forward to faster better cheaper and

644
00:27:32,779 --> 00:27:30,240
the relation between civil and military

645
00:27:36,740 --> 00:27:32,789
space was by no means static nor

646
00:27:38,570 --> 00:27:36,750
confined to JPL there's also much talk

647
00:27:40,070 --> 00:27:38,580
now about private industry and space

648
00:27:43,130 --> 00:27:40,080
exploration the so-called alternative

649
00:27:46,010 --> 00:27:43,140
space movement alt space new space space

650
00:27:47,779 --> 00:27:46,020
2.0 whatever you want to call it and

651
00:27:49,100 --> 00:27:47,789
most public attention here is focused on

652
00:27:51,710 --> 00:27:49,110
the human spaceflight program a

653
00:27:54,649 --> 00:27:51,720
potential space tourism out in the

654
00:27:56,840 --> 00:27:54,659
Mojave SpaceX ferrying supplies to the

655
00:27:58,610 --> 00:27:56,850
space station but some private groups

656
00:28:01,279 --> 00:27:58,620
have tried to get into the planetary

657
00:28:03,980 --> 00:28:01,289
program thinking back to am SAT

658
00:28:05,690 --> 00:28:03,990
Planetary Society in the 80s forward to

659
00:28:07,549 --> 00:28:05,700
Astrobotic sand some of the other teams

660
00:28:11,990 --> 00:28:07,559
now competing for the google lunar

661
00:28:14,690 --> 00:28:12,000
xprize if these institutions are just

662
00:28:16,460 --> 00:28:14,700
examples from the US now that raises the

663
00:28:19,820 --> 00:28:16,470

question about which countries have done

664
00:28:21,409 --> 00:28:19,830
planetary exploration and Hawaii for

665
00:28:22,640 --> 00:28:21,419
much of the last 50 years it was mostly

666
00:28:25,070 --> 00:28:22,650
the US and

667
00:28:27,170 --> 00:28:25,080
Union although more recently they've

668
00:28:29,630 --> 00:28:27,180
been joined by Europe Japan China and

669
00:28:32,420 --> 00:28:29,640
India will return to some of these

670
00:28:33,920 --> 00:28:32,430
countries in a moment let us first note

671
00:28:36,470 --> 00:28:33,930
though that our social and institutional

672
00:28:39,050 --> 00:28:36,480
history will provide a different picture

673
00:28:40,970 --> 00:28:39,060
in these different context and that

674
00:28:43,580 --> 00:28:40,980
cross national comparisons of say the

675
00:28:46,370 --> 00:28:43,590
type of people building spacecraft their

676
00:28:48,110 --> 00:28:46,380
gender ethnicity social class might be

677
00:28:50,630 --> 00:28:48,120
illuminating in some of these other

678
00:28:52,340 --> 00:28:50,640
places for institutions consider the

679
00:28:54,380 --> 00:28:52,350
bureaucratic politics of the Soviet

680
00:28:56,870 --> 00:28:54,390
Union the Ministry of general machine

681
00:28:58,340 --> 00:28:56,880
building or mom the e key Institute of

682
00:29:01,190 --> 00:28:58,350
space research the various design

683
00:29:04,220 --> 00:29:01,200
bureaus and NPOs and how these dynamics

684
00:29:05,570 --> 00:29:04,230
shaped the Soviet program these

685
00:29:08,510 --> 00:29:05,580
differences include the relation between

686
00:29:10,430 --> 00:29:08,520
civil and military space china for

687
00:29:12,020 --> 00:29:10,440
example may have had less distinction

688
00:29:14,030 --> 00:29:12,030

between civil and military space

689
00:29:15,800 --> 00:29:14,040
institutions in part because they

690
00:29:17,930 --> 00:29:15,810
followed American suggestions back in

691
00:29:21,800 --> 00:29:17,940
the 70s to embrace the American model

692
00:29:23,810 --> 00:29:21,810
and integrate the two realms nations of

693
00:29:25,790 --> 00:29:23,820
course collaborated as well as competed

694
00:29:27,830 --> 00:29:25,800
in space and space exploration has

695
00:29:29,270 --> 00:29:27,840
provided fertile ground for diplomatic

696
00:29:31,450 --> 00:29:29,280
or international history looking at

697
00:29:33,440 --> 00:29:31,460
these international collaborations

698
00:29:35,150 --> 00:29:33,450
looking abroad has also raised

699
00:29:37,580 --> 00:29:35,160
interesting issues about colonialism

700
00:29:40,550 --> 00:29:37,590
colonialism that is colonialism here on

701
00:29:42,410 --> 00:29:40,560
earth not space colonization for example

702
00:29:44,900 --> 00:29:42,420
the Soviets launching spacecraft out of

703
00:29:46,870 --> 00:29:44,910
what is now Kazakhstan or the French

704
00:29:49,250 --> 00:29:46,880
launching rockets out of french guiana I

705
00:29:51,290 --> 00:29:49,260
consider also the far-flung tracking

706
00:29:53,450 --> 00:29:51,300
stations of the Deep Space Network which

707
00:29:55,910 --> 00:29:53,460
confronted departed at the South Africa

708
00:30:00,590 --> 00:29:55,920
stations how did such interactions

709
00:30:03,680 --> 00:30:00,600
affect the work okay our second question

710
00:30:07,250 --> 00:30:03,690
moving along fairly swiftly here is how

711
00:30:08,540 --> 00:30:07,260
is it done planetary exploration despite

712
00:30:11,210 --> 00:30:08,550
the title of this conference is of

713
00:30:12,530 --> 00:30:11,220

course not just 50 years old astronomers

714
00:30:14,890 --> 00:30:12,540
and natural philosophers have been

715
00:30:17,090 --> 00:30:14,900
studying the planets for millennium and

716
00:30:19,430 --> 00:30:17,100
planetary science is still done today by

717
00:30:21,980 --> 00:30:19,440
telescope from the ground but I think

718
00:30:23,870 --> 00:30:21,990
when we talk about exploration we're

719
00:30:26,900 --> 00:30:23,880
talking about going to the planets not

720
00:30:29,510 --> 00:30:26,910
studying them from a distance and that

721
00:30:31,850 --> 00:30:29,520
explains our focus here on the last 50

722
00:30:34,310 --> 00:30:31,860
years what's special about this period

723
00:30:35,790 --> 00:30:34,320
is the technology of rockets which got

724
00:30:37,560 --> 00:30:35,800
humans and machines in

725
00:30:39,320 --> 00:30:37,570
outer space now of course there's the

726
00:30:42,240 --> 00:30:39,330
long-running debate about humans versus

727
00:30:44,520 --> 00:30:42,250
machines in the u.s. space program for

728
00:30:46,770 --> 00:30:44,530
this period except for the moon only

729
00:30:50,430 --> 00:30:46,780
robotic travelers have reached other

730
00:30:54,150 --> 00:30:50,440
planets now how do we define exploration

731
00:30:56,070 --> 00:30:54,160
what does exploring involve consider

732
00:30:58,140 --> 00:30:56,080
Herodotus whom we call the father of

733
00:31:00,210 --> 00:30:58,150
history and his tales of what he saw or

734
00:31:01,980 --> 00:31:00,220
heard on his travel including such

735
00:31:05,130 --> 00:31:01,990
marvelous creatures as giant camel

736
00:31:07,410 --> 00:31:05,140
eating ants and flying snakes as

737
00:31:09,930 --> 00:31:07,420
Herodotus knew it is not enough just to

738
00:31:12,450 --> 00:31:09,940

go somewhere new we want to hear about

739
00:31:16,230 --> 00:31:12,460
what's there you went to a new place

740
00:31:18,240 --> 00:31:16,240
what did you see so what is the record

741
00:31:21,240 --> 00:31:18,250
we expect to get back from other planets

742
00:31:24,990 --> 00:31:21,250
it can't be a traveler's tale so what is

743
00:31:27,870 --> 00:31:25,000
it numbers that is do we just go there

744
00:31:30,150 --> 00:31:27,880
and count things pictures physical

745
00:31:32,010 --> 00:31:30,160
samples the answer to these questions

746
00:31:34,800 --> 00:31:32,020
helps determine the technologies

747
00:31:37,020 --> 00:31:34,810
deployed such as cameras vs. counters as

748
00:31:40,650 --> 00:31:37,030
well as who is doing it for instance

749
00:31:42,360 --> 00:31:40,660
geologist or physicists this affected

750
00:31:44,430 --> 00:31:42,370
spacecraft design such as the showdown

751
00:31:46,980 --> 00:31:44,440
between spin stabilized and 3-axis

752
00:31:49,800 --> 00:31:46,990
stabilized pitting fields and particles

753
00:31:54,240 --> 00:31:49,810
against imaging physicist vs. geologist

754
00:31:55,560 --> 00:31:54,250
and aims versus JPL several talks here

755
00:31:57,780 --> 00:31:55,570
will touch on this evolution of

756
00:32:01,140 --> 00:31:57,790
spacecraft technology from orbiters to

757
00:32:03,270 --> 00:32:01,150
landers rovers bitte cons to see cds

758
00:32:06,480 --> 00:32:03,280
retro rocket landings two airbags and

759
00:32:09,480 --> 00:32:06,490
sky cranes from flagship missions to

760
00:32:11,160 --> 00:32:09,490
faster better cheaper one prime

761
00:32:13,910 --> 00:32:11,170
development of the last 50 years has

762
00:32:16,080 --> 00:32:13,920
been digital electronic computers

763
00:32:18,510 --> 00:32:16,090

spacecraft computers drove feedback

764
00:32:21,030 --> 00:32:18,520
loops of capability and complexity and

765
00:32:22,560 --> 00:32:21,040
also by the way highlighted differences

766
00:32:25,290 --> 00:32:22,570
for instance between American and Soviet

767
00:32:27,600 --> 00:32:25,300
spacecraft so American designers could

768
00:32:29,280 --> 00:32:27,610
change their software mid-flight which

769
00:32:31,440 --> 00:32:29,290
allowed Mariner 9 for example to wait

770
00:32:34,020 --> 00:32:31,450
out a dust storm on Mars meanwhile it's

771
00:32:36,930 --> 00:32:34,030
hardwired Soviet counterpart plunge

772
00:32:38,580 --> 00:32:36,940
fatally into the Maelstrom later

773
00:32:40,680 --> 00:32:38,590
spacecraft pushed this flexibility

774
00:32:42,540 --> 00:32:40,690
toward the ideal of autonomy though they

775
00:32:45,330 --> 00:32:42,550
have not taken the additional biomorphic

776
00:32:48,150 --> 00:32:45,340
step of replication urged by Freeman

777
00:32:49,440 --> 00:32:48,160
Dyson in the 80s so we are still alas

778
00:32:53,370 --> 00:32:49,450
awaiting the problem

779
00:32:55,320 --> 00:32:53,380
profusion of Astro chickens but computer

780
00:32:57,889 --> 00:32:55,330
miniaturization did raise hopes about a

781
00:33:00,240 --> 00:32:57,899
proliferation of tiny spacecraft

782
00:33:03,000 --> 00:33:00,250
proposals from microscope spacecraft

783
00:33:05,460 --> 00:33:03,010
dated to the late 1970s Jim Burke who

784
00:33:11,129 --> 00:33:05,470
was there is here I think supposed to be

785
00:33:12,750 --> 00:33:11,139
here his name is on I think the first

786
00:33:15,269 --> 00:33:12,760
proposed least that I've seen for micro

787
00:33:17,820 --> 00:33:15,279
scraft the motivation as I understand it

788
00:33:19,259 --> 00:33:17,830

was partly nostalgic an attempt to

789
00:33:20,970 --> 00:33:19,269
return to the scale of the initial

790
00:33:24,659 --> 00:33:20,980
explorers that's explorers with a

791
00:33:27,450 --> 00:33:24,669
capital e subsequent advances and

792
00:33:30,210 --> 00:33:27,460
nanotechnology spirit fantastic plans

793
00:33:33,029 --> 00:33:30,220
for you know shoebox-sized spacecraft

794
00:33:35,700 --> 00:33:33,039
with not only micro circuits but also

795
00:33:37,769 --> 00:33:35,710
mike Roisin parts these little micro

796
00:33:40,320 --> 00:33:37,779
rocket nozzles reaction wheels and the

797
00:33:43,080 --> 00:33:40,330
rest of it these plans have not gotten

798
00:33:44,879 --> 00:33:43,090
off the ground if anything size seems to

799
00:33:47,610 --> 00:33:44,889
be going in the other direction to judge

800
00:33:50,490 --> 00:33:47,620
from the Mars rovers this seems an

801
00:33:52,110 --> 00:33:50,500
interesting path not taken why after 30

802
00:33:55,680 --> 00:33:52,120
years are we still launching spacecraft

803
00:33:57,840 --> 00:33:55,690
the size of SUVs this U is partly

804
00:33:59,970 --> 00:33:57,850
technological the problem of aperture

805
00:34:02,129 --> 00:33:59,980
being one constraint but it is also

806
00:34:06,299 --> 00:34:02,139
programmatic that is to say political

807
00:34:08,309 --> 00:34:06,309
and cultural part of the appeal of micro

808
00:34:10,559 --> 00:34:08,319
spacecraft was the democratization of

809
00:34:12,450 --> 00:34:10,569
technology now you wouldn't need massive

810
00:34:15,389 --> 00:34:12,460
launch vehicles or massive budgets or

811
00:34:17,970 --> 00:34:15,399
big centralized projects and yet

812
00:34:21,059 --> 00:34:17,980
planetary exploration remains so far a

813
00:34:25,010 --> 00:34:21,069

monopoly of nation states in other words

814
00:34:27,089 --> 00:34:25,020
how we do it reflects who does it

815
00:34:29,550 --> 00:34:27,099
computers of course we're not just on

816
00:34:32,399 --> 00:34:29,560
spacecraft they also had a role sitting

817
00:34:33,720 --> 00:34:32,409
on desktops here on earth now this

818
00:34:35,669 --> 00:34:33,730
includes not just computers in

819
00:34:37,710 --> 00:34:35,679
spacecraft design that is the front end

820
00:34:40,319 --> 00:34:37,720
of missions but also on the back end

821
00:34:43,169 --> 00:34:40,329
that is on dated distribution and

822
00:34:45,869 --> 00:34:43,179
analysis as computers drove data rates

823
00:34:48,240 --> 00:34:45,879
from 10 kilobits per second on Mariner

824
00:34:50,760 --> 00:34:48,250
to a hundred kilobits on Voyager 2 100

825
00:34:53,309 --> 00:34:50,770
kilobytes on Galileo and ever upward

826
00:34:56,790 --> 00:34:53,319
data management became as much a part of

827
00:34:59,099 --> 00:34:56,800
exploration as building spacecraft some

828
00:35:00,809 --> 00:34:59,109
planetary scientists may have little to

829
00:35:02,220 --> 00:35:00,819
do with spacecraft they just sit at

830
00:35:02,589 --> 00:35:02,230
their computer and sift through these

831
00:35:06,009 --> 00:35:02,599
mount

832
00:35:07,509 --> 00:35:06,019
downloaded data these desktop these

833
00:35:11,890 --> 00:35:07,519
desk-bound investigators may

834
00:35:13,479 --> 00:35:11,900
nevertheless also be explorers while

835
00:35:15,539 --> 00:35:13,489
we're talking about technology and the

836
00:35:18,130 --> 00:35:15,549
front end and back end of missions I

837
00:35:21,130 --> 00:35:18,140
would also urge us to recognize what we

838
00:35:22,809 --> 00:35:21,140

might call the middle specifically the

839
00:35:25,269 --> 00:35:22,819
vital link between the spacecraft and

840
00:35:28,089 --> 00:35:25,279
the downloaded data and that is the Deep

841
00:35:30,130 --> 00:35:28,099
Space Network now the DSN engineers

842
00:35:32,829 --> 00:35:30,140
aren't on TV when a spacecraft arrives

843
00:35:34,719 --> 00:35:32,839
at a distant planet but they are crucial

844
00:35:37,089 --> 00:35:34,729
to getting it there and to hearing back

845
00:35:38,739 --> 00:35:37,099
from it they have saved the bacon of

846
00:35:40,630 --> 00:35:38,749
spacecraft designers on several

847
00:35:46,150 --> 00:35:40,640
occasions and they too deserve

848
00:35:48,460 --> 00:35:46,160
recognition as explorers now how it was

849
00:35:51,370 --> 00:35:48,470
done was not just technologies it was

850
00:35:53,140 --> 00:35:51,380
also techniques we know about the

851
00:35:55,839 --> 00:35:53,150
emergence of systems engineering in the

852
00:35:58,089 --> 00:35:55,849
US which was a discipline in several

853
00:35:59,940 --> 00:35:58,099
senses of the word we also know that

854
00:36:02,410 --> 00:35:59,950
attitudes towards systems engineering

855
00:36:04,299 --> 00:36:02,420
changed over time evident in

856
00:36:07,630 --> 00:36:04,309
philosophies like faster better cheaper

857
00:36:09,579 --> 00:36:07,640
and total quality management these

858
00:36:11,859 --> 00:36:09,589
techniques and attitudes can reveal much

859
00:36:14,259 --> 00:36:11,869
about particular places and times for

860
00:36:16,900 --> 00:36:14,269
instance in attitudes towards top-down

861
00:36:19,259 --> 00:36:16,910
control versus bottom up individual

862
00:36:22,829 --> 00:36:19,269
creativity in planetary exploration and

863
00:36:25,150 --> 00:36:22,839

again who does it affect how it's done

864
00:36:26,799 --> 00:36:25,160
Donna Shirley for instance perceived

865
00:36:29,920 --> 00:36:26,809
that the increasing presence of women at

866
00:36:36,009 --> 00:36:29,930
JPL was changing the practice of systems

867
00:36:39,069 --> 00:36:36,019
engineering finally how do we do it

868
00:36:40,749 --> 00:36:39,079
suggests another basic question the

869
00:36:43,930 --> 00:36:40,759
definition of exploration often has

870
00:36:45,880 --> 00:36:43,940
connotations of novelty at what point is

871
00:36:48,309 --> 00:36:45,890
that term no longer applied to the

872
00:36:51,219 --> 00:36:48,319
planets we no longer talk much about

873
00:36:53,140 --> 00:36:51,229
explorers on earth those intrepid souls

874
00:36:56,440 --> 00:36:53,150
who ventured across deserts and oceans

875
00:36:57,789 --> 00:36:56,450
or to mountain peaks and the poles this

876
00:37:00,609 --> 00:36:57,799
does not mean there is nothing left on

877
00:37:02,859 --> 00:37:00,619
earth to explore far from it but that we

878
00:37:07,269 --> 00:37:02,869
now think of this more as science than

879
00:37:09,160 --> 00:37:07,279
exploration this is a loss the urge to

880
00:37:11,319 --> 00:37:09,170
be first to a place or at least first

881
00:37:13,660 --> 00:37:11,329
from your tribe has inspired some of

882
00:37:16,210 --> 00:37:13,670
humankind's most remarkable achievements

883
00:37:19,030 --> 00:37:16,220
are we similarly losing the romance

884
00:37:21,220 --> 00:37:19,040
to appeal of space exploration consider

885
00:37:24,010 --> 00:37:21,230
the names of deep space missions we have

886
00:37:26,680 --> 00:37:24,020
gone from Mariner Ranger Viking Voyager

887
00:37:30,280 --> 00:37:26,690
to mars polar lander mars climate

888
00:37:32,170 --> 00:37:30,290

orbiter mars science laboratory romance

889
00:37:35,410 --> 00:37:32,180
gives way to practicality in many

890
00:37:37,690 --> 00:37:35,420
long-term relationships this has

891
00:37:39,910 --> 00:37:37,700
programmatic implications do we revisit

892
00:37:41,830 --> 00:37:39,920
one planet such as Mars to extend our

893
00:37:44,050 --> 00:37:41,840
database or do we continue to seek new

894
00:37:46,330 --> 00:37:44,060
places comets or asteroids or outer

895
00:37:48,670 --> 00:37:46,340
planet satellites for broader knowledge

896
00:37:50,710 --> 00:37:48,680
and if we no longer have the romantic

897
00:37:53,349 --> 00:37:50,720
appeal of exploration how do we inspire

898
00:37:55,630 --> 00:37:53,359
the amazing dedication of the people who

899
00:37:57,820 --> 00:37:55,640
build these spacecraft will they put in

900
00:38:00,460 --> 00:37:57,830
100 hour weeks to launch yet another

901
00:38:02,740 --> 00:38:00,470
science lab to Mars and how about the

902
00:38:04,780 --> 00:38:02,750
public will they lose interest when the

903
00:38:07,480 --> 00:38:04,790
novelty and romance of deep space travel

904
00:38:10,510 --> 00:38:07,490
wears off will familiarity breeds

905
00:38:14,980 --> 00:38:10,520
contempt and that leads us to our final

906
00:38:17,980 --> 00:38:14,990
question why do it now there is of

907
00:38:20,260 --> 00:38:17,990
course curiosity and here I do me in the

908
00:38:23,440 --> 00:38:20,270
human spirit of inquiry and Jim I think

909
00:38:26,530 --> 00:38:23,450
gave a very eloquent testament to that

910
00:38:28,900 --> 00:38:26,540
spirit as a motivator I would also add

911
00:38:32,230 --> 00:38:28,910
the fun factor for the engineers

912
00:38:34,329 --> 00:38:32,240
involved take the Mars rovers here is a

913
00:38:39,099 --> 00:38:34,339

marvelous technical challenge if you are

914
00:38:42,280 --> 00:38:39,109
an engineer take this car deliver it 35

915
00:38:44,260 --> 00:38:42,290
million miles to another planet land it

916
00:38:47,560 --> 00:38:44,270
softly on the surface and then drive it

917
00:38:51,160 --> 00:38:47,570
around I mean that sounds just like

918
00:38:53,050 --> 00:38:51,170
catnip if you're an engineer okay so

919
00:38:56,140 --> 00:38:53,060
that's easy to understand but why do we

920
00:38:59,589 --> 00:38:56,150
all pay these engineers to do these

921
00:39:01,870 --> 00:38:59,599
things over the past 50 years nASA has

922
00:39:04,060 --> 00:39:01,880
spent summer around 50 billion dollars

923
00:39:05,859 --> 00:39:04,070
exploring the planets say a bill in

924
00:39:09,310 --> 00:39:05,869
billing or so a year in constant dollars

925
00:39:11,700 --> 00:39:09,320
and that number is very ballpark figure

926
00:39:15,190 --> 00:39:11,710
and depends on what you include in that

927
00:39:17,470 --> 00:39:15,200
in the budgets 50 billion dollars though

928
00:39:19,930 --> 00:39:17,480
give or take there's also the investment

929
00:39:21,970 --> 00:39:19,940
of human resources many thousands of

930
00:39:24,130 --> 00:39:21,980
highly trained and dedicated people with

931
00:39:28,089 --> 00:39:24,140
very valuable skills and the current

932
00:39:30,010 --> 00:39:28,099
economy and that is just in the US add

933
00:39:32,770 --> 00:39:30,020
to that the many thousands more

934
00:39:36,390 --> 00:39:32,780
in other countries so what did we get

935
00:39:39,430 --> 00:39:36,400
for this investment why do we do it in

936
00:39:41,350 --> 00:39:39,440
1970 a nun in Zambia and named sister

937
00:39:43,480 --> 00:39:41,360
Mary ukunda wrote to NASA's Earth

938
00:39:45,670 --> 00:39:43,490

stooling her as Roger knows the story

939
00:39:47,620 --> 00:39:45,680
wrote at NASA's Ernst drooling her

940
00:39:50,260 --> 00:39:47,630
asking how he could propose spending

941
00:39:52,680 --> 00:39:50,270
billions of dollars to explore Mars when

942
00:39:54,310 --> 00:39:52,690
children were starving here on earth

943
00:39:56,410 --> 00:39:54,320
stooling or laid out several

944
00:39:59,770 --> 00:39:56,420
justifications which have become litany

945
00:40:01,780 --> 00:39:59,780
a federal budget is broken up by agency

946
00:40:03,520 --> 00:40:01,790
and is not a zero-sum exercise so that

947
00:40:07,000 --> 00:40:03,530
the money can't just be shifted to fight

948
00:40:08,890 --> 00:40:07,010
hunger or pottery understanding other

949
00:40:11,050 --> 00:40:08,900
planets and helped us understand climate

950
00:40:14,410 --> 00:40:11,060
geology meteorology things like that

951
00:40:17,100 --> 00:40:14,420
here on earth which hubs hence helps

952
00:40:19,660 --> 00:40:17,110
improve agriculture fisheries and so on

953
00:40:21,460 --> 00:40:19,670
space exploration highlights our common

954
00:40:23,710 --> 00:40:21,470
humanity and encourages international

955
00:40:26,230 --> 00:40:23,720
cooperation and thus reduces suffering

956
00:40:28,180 --> 00:40:26,240
from international strife and if nations

957
00:40:31,900 --> 00:40:28,190
do compete better for them to do so in

958
00:40:33,340 --> 00:40:31,910
outer space than in wars then better to

959
00:40:36,520 --> 00:40:33,350
use oh and outer space then through Wars

960
00:40:38,410 --> 00:40:36,530
here on earth space exploration inspires

961
00:40:39,910 --> 00:40:38,420
young people to pursue science and

962
00:40:42,940 --> 00:40:39,920
engineering and their future discoveries

963
00:40:45,280 --> 00:40:42,950

will help humanity and finally the

964
00:40:48,400 --> 00:40:45,290
spin-off argument new technologies that

965
00:40:50,620 --> 00:40:48,410
find applications here on earth now

966
00:40:52,090 --> 00:40:50,630
plenty of ink and bytes have been

967
00:40:54,250 --> 00:40:52,100
spilled rehearsing this debate and the

968
00:40:57,070 --> 00:40:54,260
curiosity landing seems to have revived

969
00:40:59,200 --> 00:40:57,080
it you can look at this two ways on the

970
00:41:01,260 --> 00:40:59,210
one hand all those billions would pay

971
00:41:05,170 --> 00:41:01,270
for an awful lot of school textbooks or

972
00:41:06,790 --> 00:41:05,180
food for the poor on the other curiosity

973
00:41:09,640 --> 00:41:06,800
costs less than what the Pentagon is

974
00:41:11,380 --> 00:41:09,650
spending every week in Afghanistan or

975
00:41:13,180 --> 00:41:11,390
insert your favorite favorite comparison

976
00:41:14,770 --> 00:41:13,190
here the current planetary program cost

977
00:41:17,260 --> 00:41:14,780
the equivalent of one starbucks coffee

978
00:41:19,660 --> 00:41:17,270
for each American every year americans

979
00:41:22,750 --> 00:41:19,670
spend more on dog food every year and so

980
00:41:25,600 --> 00:41:22,760
on I'm sure you have equally amusing

981
00:41:29,080 --> 00:41:25,610
examples but the fact is a billion

982
00:41:31,540 --> 00:41:29,090
dollars is a lot of money I realize it

983
00:41:34,120 --> 00:41:31,550
might be a rounding error to some budget

984
00:41:37,120 --> 00:41:34,130
ears but to the average taxpayer a

985
00:41:38,920 --> 00:41:37,130
billion dollars seems like a lot leave

986
00:41:42,010 --> 00:41:38,930
aside the many other social priorities

987
00:41:43,510 --> 00:41:42,020
what about scientific priories genomics

988
00:41:46,030 --> 00:41:43,520

particle physics

989
00:41:48,940 --> 00:41:46,040
jharana me material science they could

990
00:41:50,260 --> 00:41:48,950
all do a lot with a billion dollars or

991
00:41:53,860 --> 00:41:50,270
just think how many historians of

992
00:41:56,890 --> 00:41:53,870
science we could support with that now

993
00:41:59,920 --> 00:41:56,900
polls consistently suggest over this

994
00:42:02,260 --> 00:41:59,930
time period that perhaps only one-fourth

995
00:42:04,930 --> 00:42:02,270
of the American public is interested in

996
00:42:07,540 --> 00:42:04,940
space and even less are knowledgeable

997
00:42:08,680 --> 00:42:07,550
about it but then at planetary

998
00:42:11,350 --> 00:42:08,690
encounters you have this tremendous

999
00:42:13,900 --> 00:42:11,360
public interest recall the media

1000
00:42:16,600 --> 00:42:13,910
who descended from Viking and Voyager or

1001
00:42:19,780 --> 00:42:16,610
track the web traffic for pathfinder

1002
00:42:22,420 --> 00:42:19,790
emmy our curiosity and let us not forget

1003
00:42:24,850 --> 00:42:22,430
carl sagan whose cosmos touched perhaps

1004
00:42:26,290 --> 00:42:24,860
not billions and billions of people but

1005
00:42:28,930 --> 00:42:26,300
hundreds of millions of people around

1006
00:42:30,880 --> 00:42:28,940
the world but then why did none of the

1007
00:42:32,590 --> 00:42:30,890
major TV networks break into their

1008
00:42:36,910 --> 00:42:32,600
programming to show the curiosity

1009
00:42:40,360 --> 00:42:36,920
landing live now NASA expense a lot of

1010
00:42:42,130 --> 00:42:40,370
effort figuring out this paradox how to

1011
00:42:45,700 --> 00:42:42,140
bridge the apathy gap and sustain

1012
00:42:47,590 --> 00:42:45,710
interest in exploration I don't think

1013
00:42:49,540 --> 00:42:47,600

this is just a matter of outreach nASA

1014
00:42:51,670 --> 00:42:49,550
has always been very attentive to PR

1015
00:42:53,740 --> 00:42:51,680
from the mercury seven and Apollo

1016
00:42:57,820 --> 00:42:53,750
through curiosity and from Life magazine

1017
00:43:01,300 --> 00:42:57,830
to TV and on to today's web based social

1018
00:43:03,280 --> 00:43:01,310
media and apps recall that JPL's first

1019
00:43:04,930 --> 00:43:03,290
deep-space proposals ranked public

1020
00:43:07,540 --> 00:43:04,940
relations ahead of science or

1021
00:43:09,820 --> 00:43:07,550
engineering goals or that mariner 2

1022
00:43:11,830 --> 00:43:09,830
landed JPL director Bill Pickering on

1023
00:43:13,390 --> 00:43:11,840
the cover of Time magazine and also on

1024
00:43:16,150 --> 00:43:13,400
the roseburg actually saw one these

1025
00:43:19,240 --> 00:43:16,160
photos was the Rose Parade with Bill

1026
00:43:21,370 --> 00:43:19,250
Pickering and this Mariner float but as

1027
00:43:23,890 --> 00:43:21,380
Hans mark declared decades ago at NASA

1028
00:43:27,370 --> 00:43:23,900
space missions apparently do not change

1029
00:43:29,080 --> 00:43:27,380
how Americans vote space exploration

1030
00:43:32,230 --> 00:43:29,090
certainly resonates with deep American

1031
00:43:34,660 --> 00:43:32,240
values and not least the frontier

1032
00:43:37,240 --> 00:43:34,670
metaphor and Americans take great pride

1033
00:43:39,820 --> 00:43:37,250
in it last week a million people lined

1034
00:43:42,850 --> 00:43:39,830
the streets in LA a million people in LA

1035
00:43:44,860 --> 00:43:42,860
that bastion of civic apathy to watch a

1036
00:43:47,560 --> 00:43:44,870
space shuttle crawl by at two miles an

1037
00:43:49,720 --> 00:43:47,570
hour endeavour was only heading across

1038
00:43:52,390 --> 00:43:49,730

town and not in outer space and it was

1039
00:43:54,400 --> 00:43:52,400
still a major public happening the chief

1040
00:43:57,210 --> 00:43:54,410
of the LAPD said he had never seen a

1041
00:44:00,010 --> 00:43:57,220
crowd that was so positive and so proud

1042
00:44:02,290 --> 00:44:00,020
but when those same people step into the

1043
00:44:04,480 --> 00:44:02,300
polling booth in two weeks they won't

1044
00:44:07,780 --> 00:44:04,490
pull the lever based on a candidate's

1045
00:44:10,870 --> 00:44:07,790
space policy this morning's poll will

1046
00:44:12,700 --> 00:44:10,880
ponder the politics of space this should

1047
00:44:16,120 --> 00:44:12,710
I think includes shifting ideologies of

1048
00:44:18,040 --> 00:44:16,130
spaceflight at least in the u.s. the

1049
00:44:20,410 --> 00:44:18,050
early American space program received

1050
00:44:22,480 --> 00:44:20,420
its initial support from politicians on

1051
00:44:24,310 --> 00:44:22,490
the left who saw it as the highest

1052
00:44:27,010 --> 00:44:24,320
expression of socially directed

1053
00:44:29,170 --> 00:44:27,020
technical progress but in the late 60s

1054
00:44:31,990 --> 00:44:29,180
as liberals shifted federal attention to

1055
00:44:34,360 --> 00:44:32,000
social social problems conservatives

1056
00:44:36,070 --> 00:44:34,370
were abandoning fiscal austerity and a

1057
00:44:37,720 --> 00:44:36,080
bracing division of space as new

1058
00:44:40,510 --> 00:44:37,730
frontier as a way to rekindle that old

1059
00:44:42,070 --> 00:44:40,520
pioneer spirit so does George Will who

1060
00:44:44,740 --> 00:44:42,080
is otherwise no friend of federal

1061
00:44:48,070 --> 00:44:44,750
activity viewed Voyager as a smashingly

1062
00:44:49,930 --> 00:44:48,080
successful government program liberal

1063
00:44:52,180 --> 00:44:49,940

commentators for their part came to view

1064
00:44:54,580 --> 00:44:52,190
the frontier image as an emblem of

1065
00:44:56,230 --> 00:44:54,590
imperial conquest military adventure and

1066
00:44:58,870 --> 00:44:56,240
fire metal damage and corporate

1067
00:45:00,190 --> 00:44:58,880
profiteering hence public opinion polls

1068
00:45:02,140 --> 00:45:00,200
by the early 80s showed that

1069
00:45:04,360 --> 00:45:02,150
conservatives were more likely than

1070
00:45:09,220 --> 00:45:04,370
liberal or more likely than liberals to

1071
00:45:11,500 --> 00:45:09,230
support space exploration now some

1072
00:45:14,550 --> 00:45:11,510
people extended the frontier image at to

1073
00:45:17,080 --> 00:45:14,560
space as a new realm for commerce

1074
00:45:19,780 --> 00:45:17,090
capitalist ideology certainly animates

1075
00:45:22,000 --> 00:45:19,790
the alt space movement but the profit

1076
00:45:24,220 --> 00:45:22,010
motive seems largely absent from

1077
00:45:25,960 --> 00:45:24,230
planetary exploration which would be

1078
00:45:29,050 --> 00:45:25,970
interesting for a major American

1079
00:45:30,640 --> 00:45:29,060
Enterprise at least to a historian yes

1080
00:45:32,710 --> 00:45:30,650
there was excited talk about space

1081
00:45:35,020 --> 00:45:32,720
mining and space solar power back in the

1082
00:45:38,440 --> 00:45:35,030
70s and more recently there's the google

1083
00:45:40,870 --> 00:45:38,450
lunar xprize but as a ploy to spur

1084
00:45:44,110 --> 00:45:40,880
private investment the XPrize seems an

1085
00:45:47,320 --> 00:45:44,120
implicit admission that no marketplace

1086
00:45:49,270 --> 00:45:47,330
exists for planetary exploration so

1087
00:45:51,340 --> 00:45:49,280
while many institutions have made money

1088
00:45:53,740 --> 00:45:51,350

building spacecraft some others may have

1089
00:45:56,380 --> 00:45:53,750
lost it the justification for those

1090
00:45:58,770 --> 00:45:56,390
missions was not commercial we have not

1091
00:46:03,010 --> 00:45:58,780
launched the spacecraft to make money or

1092
00:46:05,530 --> 00:46:03,020
so it seems but in an age when as

1093
00:46:07,450 --> 00:46:05,540
historian Eric Hobsbawm declared the

1094
00:46:10,960 --> 00:46:07,460
consumer has taken the place of the

1095
00:46:13,210 --> 00:46:10,970
citizen can one so easily detach planet

1096
00:46:15,490 --> 00:46:13,220
Terry exploration from the context of

1097
00:46:19,690 --> 00:46:15,500
consumer capitalism or late capitalism

1098
00:46:22,810 --> 00:46:19,700
some commentators have called it in this

1099
00:46:25,570 --> 00:46:22,820
context I look at will IM of the Black

1100
00:46:27,400 --> 00:46:25,580
Eyed Peas this lead singer of The Black

1101
00:46:30,220 --> 00:46:27,410
Eyed Peas who broadcast his latest

1102
00:46:31,720 --> 00:46:30,230
single from Mars via curiosity and I

1103
00:46:35,620 --> 00:46:31,730
wonder whether this is a sign of the

1104
00:46:37,270 --> 00:46:35,630
times okay this last point suggest that

1105
00:46:39,790 --> 00:46:37,280
to answer the question of why we do it

1106
00:46:41,860 --> 00:46:39,800
we have to look at the broader context

1107
00:46:45,220 --> 00:46:41,870
at what else was happening over the last

1108
00:46:48,910 --> 00:46:45,230
50 years for more than half that period

1109
00:46:50,440 --> 00:46:48,920
that was of course the Cold War one

1110
00:46:52,600 --> 00:46:50,450
reason the us-supported planetary

1111
00:46:55,030 --> 00:46:52,610
exploration for many years was to beat

1112
00:46:57,310 --> 00:46:55,040
the Russians in this case in the battle

1113
00:47:00,010 --> 00:46:57,320

for hearts and minds for international

1114
00:47:01,480 --> 00:47:00,020
status and prestige this reason often

1115
00:47:03,820 --> 00:47:01,490
rose and fell with the temperature of

1116
00:47:06,250 --> 00:47:03,830
the cold war so you heard it often in

1117
00:47:08,710 --> 00:47:06,260
the 60s less so amid they taunt in the

1118
00:47:10,780 --> 00:47:08,720
70s and then more again in the eighties

1119
00:47:12,730 --> 00:47:10,790
when ambitious Soviet Morris proposals

1120
00:47:16,180 --> 00:47:12,740
led to jokes about it indeed becoming

1121
00:47:18,940 --> 00:47:16,190
the red planet but that of course the

1122
00:47:21,040 --> 00:47:18,950
Cold War ended in the 90s as the

1123
00:47:22,650 --> 00:47:21,050
superpower standoff gave way to global

1124
00:47:25,180 --> 00:47:22,660
competition and the high-tech economy

1125
00:47:27,610 --> 00:47:25,190
the justification for planetary

1126
00:47:29,230 --> 00:47:27,620
exploration shifted from missions as

1127
00:47:32,110 --> 00:47:29,240
symbols of international strategic

1128
00:47:35,620 --> 00:47:32,120
standing to missions as engines of

1129
00:47:37,450 --> 00:47:35,630
economic growth planetary exploration in

1130
00:47:39,580 --> 00:47:37,460
this argument supported the high-tech

1131
00:47:41,710 --> 00:47:39,590
space industry it incubated new

1132
00:47:44,290 --> 00:47:41,720
technologies and entrepreneurial firms

1133
00:47:46,360 --> 00:47:44,300
and perhaps most important inspired

1134
00:47:48,760 --> 00:47:46,370
young Americans to careers in science

1135
00:47:52,360 --> 00:47:48,770
and technology and hence help supply the

1136
00:47:53,740 --> 00:47:52,370
high tech labor force now perhaps to

1137
00:47:55,300 --> 00:47:53,750
compensate for this mundane

1138
00:47:57,160 --> 00:47:55,310

justification of economic

1139
00:47:59,110 --> 00:47:57,170
competitiveness the end of the Cold War

1140
00:48:02,920 --> 00:47:59,120
also encouraged more transcendent

1141
00:48:05,860 --> 00:48:02,930
motives in particular the possibility of

1142
00:48:07,750 --> 00:48:05,870
life and the cosmos the search for

1143
00:48:10,330 --> 00:48:07,760
extraterrestrial life in a way turned

1144
00:48:12,490 --> 00:48:10,340
planetary exploration into a biology

1145
00:48:14,470 --> 00:48:12,500
program which messed with wider

1146
00:48:17,830 --> 00:48:14,480
scientific and economic interest in

1147
00:48:20,710 --> 00:48:17,840
biotech finally however one notes the

1148
00:48:22,870 --> 00:48:20,720
many American flags waving around JPL's

1149
00:48:25,109 --> 00:48:22,880
Mission Control both for EM ER and more

1150
00:48:27,519 --> 00:48:25,119
recently for curiosity

1151
00:48:29,829 --> 00:48:27,529
space exploration as a vehicle for

1152
00:48:32,200 --> 00:48:29,839
national pride and patriotism was

1153
00:48:35,559 --> 00:48:32,210
evidently not just a cold war phenomenon

1154
00:48:38,109 --> 00:48:35,569
and that brings us to the motivation for

1155
00:48:40,210 --> 00:48:38,119
other spacefaring countries for Europe

1156
00:48:42,180 --> 00:48:40,220
it was perhaps less patriotism and more

1157
00:48:46,000 --> 00:48:42,190
a way to foster European integration

1158
00:48:49,240 --> 00:48:46,010
while balancing American scientific and

1159
00:48:51,130 --> 00:48:49,250
technological hegemony and Europe too

1160
00:48:53,650 --> 00:48:51,140
once these economic competitiveness as a

1161
00:48:55,930 --> 00:48:53,660
motive and that is space missions as a

1162
00:48:58,299 --> 00:48:55,940
stimulus or perhaps a subsidy for

1163
00:49:00,010 --> 00:48:58,309

high-tech industry and even stronger and

1164
00:49:03,430 --> 00:49:00,020
earlier than in the u.s. I think

1165
00:49:05,019 --> 00:49:03,440
probably likewise for Japan but national

1166
00:49:07,210 --> 00:49:05,029
pride remains a powerful factor

1167
00:49:09,400 --> 00:49:07,220
especially for nations experiencing that

1168
00:49:12,910 --> 00:49:09,410
other key development of the 20th

1169
00:49:15,190 --> 00:49:12,920
century post-colonialism for a

1170
00:49:17,410 --> 00:49:15,200
developing country like India a space

1171
00:49:20,410 --> 00:49:17,420
program symbolizes status as a modern

1172
00:49:22,779 --> 00:49:20,420
independent international power much as

1173
00:49:25,150 --> 00:49:22,789
nuclear weapons do and let us not forget

1174
00:49:27,400 --> 00:49:25,160
that civil space programs remain a

1175
00:49:31,240 --> 00:49:27,410
barely veiled signal of military space

1176
00:49:33,609 --> 00:49:31,250
capability but an injury is in countries

1177
00:49:34,900 --> 00:49:33,619
like India and China where hundreds of

1178
00:49:37,230 --> 00:49:34,910
millions of people struggle with

1179
00:49:40,299 --> 00:49:37,240
desperate poverty despite pell-mell

1180
00:49:43,569 --> 00:49:40,309
modernisation sister Maria Kenda's

1181
00:49:45,279 --> 00:49:43,579
question remains acute that is how can

1182
00:49:49,180 --> 00:49:45,289
these countries justify spending so much

1183
00:49:51,490 --> 00:49:49,190
money on space so the broad historical

1184
00:49:54,430 --> 00:49:51,500
developments of the last 50 years from

1185
00:49:55,990 --> 00:49:54,440
the Cold War and post-colonialism to

1186
00:49:58,779 --> 00:49:56,000
global economic development and

1187
00:50:02,230 --> 00:49:58,789
high-tech industry help answer why we've

1188
00:50:05,079 --> 00:50:02,240

done it the corollary of course is what

1189
00:50:06,760 --> 00:50:05,089
have we got for it some people like

1190
00:50:09,849 --> 00:50:06,770
stooling or like to cite the spin-offs

1191
00:50:11,980 --> 00:50:09,859
from space exploration there are

1192
00:50:15,640 --> 00:50:11,990
certainly many examples you can point to

1193
00:50:18,480 --> 00:50:15,650
a computer animation outer JPL solar

1194
00:50:21,760 --> 00:50:18,490
power technology teluk telecommuting

1195
00:50:24,490 --> 00:50:21,770
telecommuting a telecommunication coding

1196
00:50:26,109 --> 00:50:24,500
algorithms from the DSN engineers my

1197
00:50:29,410 --> 00:50:26,119
personal favorite is the super soaker

1198
00:50:31,210 --> 00:50:29,420
squirt gun invented by a JPL engineer so

1199
00:50:34,569 --> 00:50:31,220
next time you're squirted by some kid on

1200
00:50:36,700 --> 00:50:34,579
the summer day thank JPL but arguing

1201
00:50:38,410 --> 00:50:36,710
that super soakers justify planetary

1202
00:50:40,990 --> 00:50:38,420
exploration seems to me

1203
00:50:43,240 --> 00:50:41,000
a thin Reed justifying a program with

1204
00:50:45,849 --> 00:50:43,250
spin-offs seems a tacit admission that

1205
00:50:49,720 --> 00:50:45,859
the primary returns are not sufficient

1206
00:50:56,020 --> 00:50:49,730
and the primary returns alone I think

1207
00:50:58,960 --> 00:50:56,030
should suffice consider what we have

1208
00:51:00,670 --> 00:50:58,970
learned about our solar system ranger

1209
00:51:02,170 --> 00:51:00,680
and surveyor a returned evidence that

1210
00:51:04,390 --> 00:51:02,180
the moon had not always been cold and

1211
00:51:06,240 --> 00:51:04,400
hard although they could not resolve

1212
00:51:08,980 --> 00:51:06,250
competing theories about lunar origin

1213
00:51:11,230 --> 00:51:08,990

Mariner flights confirmed Venus to be a

1214
00:51:13,210 --> 00:51:11,240
hellhole of a planet with 900 degree

1215
00:51:15,490 --> 00:51:13,220
temperatures and pressures 90 times

1216
00:51:17,620 --> 00:51:15,500
greater than here on earth Mariner

1217
00:51:19,539 --> 00:51:17,630
images of mercury craters meanwhile

1218
00:51:21,640 --> 00:51:19,549
supported the great bombardment theory

1219
00:51:24,250 --> 00:51:21,650
of the early history of the solar system

1220
00:51:25,839 --> 00:51:24,260
which reinforced catastrophic theories

1221
00:51:29,200 --> 00:51:25,849
of Earth's geological and biological

1222
00:51:31,120 --> 00:51:29,210
history Voyager and his successors

1223
00:51:33,280 --> 00:51:31,130
Galileo and Cassini turned the outer

1224
00:51:36,069 --> 00:51:33,290
planets and their moons from blurry

1225
00:51:39,220 --> 00:51:36,079
smears on astronomers plates to complex

1226
00:51:41,200 --> 00:51:39,230
diverse individual bodies from the from

1227
00:51:43,539 --> 00:51:41,210
the soul theorist calderas of Io to the

1228
00:51:46,359 --> 00:51:43,549
icy ocean of Europa each undergoing

1229
00:51:47,920 --> 00:51:46,369
dynamic processes external bombardment

1230
00:51:50,260 --> 00:51:47,930
to the point of cracking or splitting

1231
00:51:52,990 --> 00:51:50,270
entirely or flexing gravitationally

1232
00:51:56,980 --> 00:51:53,000
outgassing and erupting almost literally

1233
00:51:59,799 --> 00:51:56,990
living and breathing planetary missions

1234
00:52:01,980 --> 00:51:59,809
in short revealed the solar system to be

1235
00:52:04,660 --> 00:52:01,990
full of Marvel's worthy of Herodotus

1236
00:52:08,109 --> 00:52:04,670
methane Lakes miles high geysers

1237
00:52:10,740 --> 00:52:08,119
supersonic winds canyons thousands of

1238
00:52:14,319 --> 00:52:10,750

miles long and several miles deep

1239
00:52:16,089 --> 00:52:14,329
volcanoes that dwarf Everest they thus

1240
00:52:18,160 --> 00:52:16,099
helped to correct the geocentric

1241
00:52:20,109 --> 00:52:18,170
perspective of planetary scientists

1242
00:52:22,660 --> 00:52:20,119
evident for example in the surprise at

1243
00:52:25,079 --> 00:52:22,670
volcanic and tectonic activity in the

1244
00:52:27,400 --> 00:52:25,089
cold outer reaches of the solar system

1245
00:52:29,190 --> 00:52:27,410
more fundamental still is the

1246
00:52:31,599 --> 00:52:29,200
possibility of extraterrestrial life

1247
00:52:34,690 --> 00:52:31,609
thanks to evidence of water on Mars

1248
00:52:38,559 --> 00:52:34,700
Europa and Enceladus and hydrocarbons on

1249
00:52:41,200 --> 00:52:38,569
Titan all this suggests that we shift

1250
00:52:43,750 --> 00:52:41,210
our frame of reference perhaps it is not

1251
00:52:46,120 --> 00:52:43,760
what we as individual taxpayers have got

1252
00:52:48,700 --> 00:52:46,130
out of planetary exploration but rather

1253
00:52:51,010 --> 00:52:48,710
what we as a species have gained from it

1254
00:52:52,240 --> 00:52:51,020
and perhaps we need to shift our

1255
00:52:54,430 --> 00:52:52,250
chronological frame of rap

1256
00:52:58,050 --> 00:52:54,440
as well our frame of reference should

1257
00:53:00,520 --> 00:52:58,060
span centuries not just years or decades

1258
00:53:02,920 --> 00:53:00,530
some see planetary exploration as a

1259
00:53:04,540 --> 00:53:02,930
third age of human exploration a

1260
00:53:06,730 --> 00:53:04,550
fundamental turning point in human

1261
00:53:09,280 --> 00:53:06,740
history comparable to the oceanic

1262
00:53:12,010 --> 00:53:09,290
voyages of Columbus and cook in the 16th

1263
00:53:15,460 --> 00:53:12,020

and eighteenth centuries I would look

1264
00:53:17,590 --> 00:53:15,470
rather to science the physicist niels

1265
00:53:20,590 --> 00:53:17,600
bohr said that science is the gradual

1266
00:53:22,720 --> 00:53:20,600
removal of prejudices if so then

1267
00:53:24,460 --> 00:53:22,730
planetary exploration would have to rank

1268
00:53:27,100 --> 00:53:24,470
with the Copernican and Darwinian

1269
00:53:31,570 --> 00:53:27,110
revolutions in removing the prejudices

1270
00:53:40,720 --> 00:53:31,580
of geocentrism and anthropocentrism from

1271
00:53:43,660 --> 00:53:40,730
humankind okay the title of this talk

1272
00:53:46,630 --> 00:53:43,670
asked three questions who did it how

1273
00:53:49,980 --> 00:53:46,640
they did it and why let me wrap up here

1274
00:53:52,600 --> 00:53:49,990
by adding a fourth why are we here I

1275
00:53:54,160 --> 00:53:52,610
mean not in the existential sense though

1276
00:53:56,260 --> 00:53:54,170
planetary exploration certainly

1277
00:53:58,000 --> 00:53:56,270
encourages such questions but I mean

1278
00:54:00,880 --> 00:53:58,010
rather what are we doing in this room

1279
00:54:02,380 --> 00:54:00,890
for the next two days I said at the

1280
00:54:04,000 --> 00:54:02,390
outset that 50 years of planetary

1281
00:54:06,490 --> 00:54:04,010
exploration has taught us a lot about

1282
00:54:09,520 --> 00:54:06,500
our solar system but equally about

1283
00:54:11,710 --> 00:54:09,530
ourselves here on earth what does

1284
00:54:15,370 --> 00:54:11,720
planetary exploration tell us about the

1285
00:54:17,950 --> 00:54:15,380
last 50 years of history how does it

1286
00:54:19,870 --> 00:54:17,960
change our view of the Cold War of post

1287
00:54:22,030 --> 00:54:19,880
colonialism of the information

1288
00:54:24,190 --> 00:54:22,040

revolution globalization and economic

1289
00:54:26,830 --> 00:54:24,200
development this planetary exploration

1290
00:54:30,820 --> 00:54:26,840
change our periodization of say the

1291
00:54:33,100 --> 00:54:30,830
Space Age or the Cold War if the u.s. is

1292
00:54:35,320 --> 00:54:33,110
indeed an imperial decline or at least

1293
00:54:37,540 --> 00:54:35,330
facing increasing strategic competition

1294
00:54:40,330 --> 00:54:37,550
how will that shape planetary

1295
00:54:42,760 --> 00:54:40,340
exploration a note that amid current

1296
00:54:45,250 --> 00:54:42,770
confusion of American space goals China

1297
00:54:47,980 --> 00:54:45,260
recently announced an ambition ambitious

1298
00:54:50,920 --> 00:54:47,990
plan for soft lunar landers and sample

1299
00:54:54,060 --> 00:54:50,930
returns what about the nation state

1300
00:54:57,190 --> 00:54:54,070
itself will the rise of transnational

1301
00:55:00,430 --> 00:54:57,200
multinational sub-state or non-state

1302
00:55:02,050 --> 00:55:00,440
actors introduce new approaches for one

1303
00:55:04,030 --> 00:55:02,060
thing and suggest that we historians

1304
00:55:05,009 --> 00:55:04,040
find alternatives to the states entered

1305
00:55:07,249 --> 00:55:05,019
narratives

1306
00:55:10,109 --> 00:55:07,259
that we usually use for the Space Age

1307
00:55:12,329 --> 00:55:10,119
and we consider following Martin Collins

1308
00:55:14,579 --> 00:55:12,339
how post-modernism affected the

1309
00:55:16,799 --> 00:55:14,589
planetary enterprise perhaps for

1310
00:55:19,259 --> 00:55:16,809
instance in the blurred boundary between

1311
00:55:20,939 --> 00:55:19,269
high culture and low culture or say

1312
00:55:23,579 --> 00:55:20,949
between elite science and mass

1313
00:55:26,189 --> 00:55:23,589

entertainment I think again of will ims

1314
00:55:29,099 --> 00:55:26,199
broadcasting this piece of pop music

1315
00:55:31,799 --> 00:55:29,109
from curiosity or I recall the Mattel

1316
00:55:34,859 --> 00:55:31,809
Hot Wheels Sojourner action packs which

1317
00:55:37,979 --> 00:55:34,869
flew off toys store shelves in 1997 or

1318
00:55:40,349 --> 00:55:37,989
deep impact that is the movie not the

1319
00:55:41,819 --> 00:55:40,359
mission which encouraged JPL manages at

1320
00:55:43,380 --> 00:55:41,829
the time to contemplate what they called

1321
00:55:48,779 --> 00:55:43,390
the merging of entertainment and

1322
00:55:50,549 --> 00:55:48,789
realities historians of our topic should

1323
00:55:52,229 --> 00:55:50,559
be pretty good at big pictures since our

1324
00:55:54,719 --> 00:55:52,239
frame of reference is the entire solar

1325
00:55:56,399 --> 00:55:54,729
system but we should remember to step

1326
00:55:59,009 --> 00:55:56,409
back occasionally and think about the

1327
00:56:00,659 --> 00:55:59,019
big historical picture how planetary

1328
00:56:04,049 --> 00:56:00,669
exploration connects to all these

1329
00:56:06,329 --> 00:56:04,059
broader developments space history can

1330
00:56:08,789 --> 00:56:06,339
be at times an insular field despite the

1331
00:56:10,679 --> 00:56:08,799
example of books like mcdougall's which

1332
00:56:13,829 --> 00:56:10,689
show how space history can shed light on

1333
00:56:15,389 --> 00:56:13,839
fundamental historical changes and by

1334
00:56:17,999 --> 00:56:15,399
tackling these broader questions our

1335
00:56:19,620 --> 00:56:18,009
work may speak not just to other space

1336
00:56:21,569 --> 00:56:19,630
historians but also reach out to

1337
00:56:23,489 --> 00:56:21,579
historians in general but also more

1338
00:56:27,120 --> 00:56:23,499

importantly to the general public and

1339
00:56:29,939 --> 00:56:27,130
that by the way includes the need for at

1340
00:56:32,039 --> 00:56:29,949
times critical voices many of us study

1341
00:56:34,829 --> 00:56:32,049
this topic because we ourselves started

1342
00:56:37,459 --> 00:56:34,839
out as space buffs but we should include

1343
00:56:39,779 --> 00:56:37,469
the viewpoints of the unbelievers

1344
00:56:42,359 --> 00:56:39,789
planetary exploration after all is a

1345
00:56:43,919 --> 00:56:42,369
human enterprise and it does reflects

1346
00:56:46,589 --> 00:56:43,929
not just the great achievements of

1347
00:56:49,620 --> 00:56:46,599
humankind but also the very human

1348
00:56:51,509 --> 00:56:49,630
foibles and failings so yes let us

1349
00:56:53,789 --> 00:56:51,519
appreciate these remarkable achievements

1350
00:56:57,989 --> 00:56:53,799
of space exploration but let us also

1351
00:57:00,029 --> 00:56:57,999
consider the costs and let us also

1352
00:57:02,789 --> 00:57:00,039
recognize that our topic runs up to the

1353
00:57:06,239 --> 00:57:02,799
present where the ice gets thin for

1354
00:57:09,479 --> 00:57:06,249
historians times change and so will

1355
00:57:12,479 --> 00:57:09,489
historians judgments Sir Walter Raleigh

1356
00:57:14,189 --> 00:57:12,489
many years ago warned that whosoever in

1357
00:57:16,829 --> 00:57:14,199
writing a modern history should follow

1358
00:57:18,450 --> 00:57:16,839
truth too near the heels it may happily

1359
00:57:21,180 --> 00:57:18,460
strike out his teeth

1360
00:57:22,650 --> 00:57:21,190
or as Joe and lie supposedly set to

1361
00:57:24,810 --> 00:57:22,660
Henry Kissinger when asked about the

1362
00:57:30,480 --> 00:57:24,820
meaning of the french revolution it's

1363
00:57:41,910 --> 00:57:30,490

too soon to tell but let us begin thank

1364
00:57:43,410 --> 00:57:41,920
you we have some time for questions we

1365
00:57:51,960 --> 00:57:43,420
would ask people to come to the

1366
00:57:57,440 --> 00:57:51,970
microphones are any or not we'll take a

1367
00:57:57,450 --> 00:58:22,030
okay I'm part 1 don't think it's live

1368
00:58:27,970 --> 00:58:25,960
hello okay now ago you mentioned a lot

1369
00:58:30,730 --> 00:58:27,980
of different missions but I noticed they

1370
00:58:32,920 --> 00:58:30,740
were all from JPL and since I'm one of

1371
00:58:34,600 --> 00:58:32,930
the main competitors of JPL over the

1372
00:58:38,170 --> 00:58:34,610
years I'd like to hear about some of the

1373
00:58:40,300 --> 00:58:38,180
other ones once in a while IPL is that a

1374
00:58:47,260 --> 00:58:40,310
lot and Goddard Space Flight Center has

1375
00:58:51,760 --> 00:58:47,270
also done several uh I plead guilty on

1376
00:58:53,350 --> 00:58:51,770
several counts here first of all of well

1377
00:58:55,870 --> 00:58:53,360
I plead guilty I guess of talking about

1378
00:58:57,550 --> 00:58:55,880
what I know best so I've written a

1379
00:58:59,200 --> 00:58:57,560
history of JPL so I know mostly about

1380
00:59:02,230 --> 00:58:59,210
that I certainly did not mean to slight

1381
00:59:06,160 --> 00:59:02,240
the competitors I mentioned the Ames

1382
00:59:09,160 --> 00:59:06,170
versus JPL standoff over the Pioneer

1383
00:59:11,410 --> 00:59:09,170
versus the Mariner spacecraft models

1384
00:59:13,330 --> 00:59:11,420
back in the 60s and 70s what led into

1385
00:59:15,760 --> 00:59:13,340
Galileo Galileo being I think a

1386
00:59:19,480 --> 00:59:15,770
remarkable example of this compromise

1387
00:59:22,210 --> 00:59:19,490
between not only technologies and

1388
00:59:26,460 --> 00:59:22,220

mission goals but also institutions I

1389
00:59:29,920 --> 00:59:26,470
think all the JPL ended up building it

1390
00:59:34,170 --> 00:59:29,930
so yes I did slight the many other

1391
00:59:37,960 --> 00:59:34,180
competitors within NASA and without

1392
00:59:39,850 --> 00:59:37,970
Goddard but also places like a PL which

1393
00:59:42,190 --> 00:59:39,860
is a very interesting story I think

1394
00:59:45,370 --> 00:59:42,200
especially the 90s when APL starts to

1395
00:59:47,170 --> 00:59:45,380
get into the game I would also add to

1396
00:59:49,600 --> 00:59:47,180
your criticism and say that I've not

1397
00:59:51,520 --> 00:59:49,610
only concentrated on JPL but I've also

1398
00:59:54,100 --> 00:59:51,530
concentrated almost exclusively on the

1399
00:59:59,590 --> 00:59:54,110
United States and I think we have a lot

1400
01:00:01,300 --> 00:59:59,600
to learn and let me just put it that way

1401
01:00:03,340 --> 01:00:01,310
we have a lot to learn from studying

1402
01:00:06,820 --> 01:00:03,350
histories of other planetary exploration

1403
01:00:09,070 --> 01:00:06,830
programs we know of we know much more

1404
01:00:10,960 --> 01:00:09,080
about we solve a lot to learn about the

1405
01:00:13,000 --> 01:00:10,970
American planetary exploration program

1406
01:00:15,400 --> 01:00:13,010
but compared to that we know almost

1407
01:00:17,500 --> 01:00:15,410
nothing about the Soviet program the

1408
01:00:19,150 --> 01:00:17,510
Chinese program these other programs and

1409
01:00:21,100 --> 01:00:19,160
one of the things I'm looking forward to

1410
01:00:23,530 --> 01:00:21,110
this conferences there is they have

1411
01:00:25,840 --> 01:00:23,540
assembled actually some very interesting

1412
01:00:27,100 --> 01:00:25,850
papers on some of these other programs

1413
01:00:28,930 --> 01:00:27,110

so I'm looking forward to this

1414
01:00:30,130 --> 01:00:28,940
conference learning about some of these

1415
01:00:32,830 --> 01:00:30,140
other programs because i think these

1416
01:00:35,650 --> 01:00:32,840
comparisons international comparisons to

1417
01:00:35,960 --> 01:00:35,660
these other countries can shed a lot of

1418
01:00:39,109 --> 01:00:35,970
why

1419
01:00:41,330 --> 01:00:39,119
back on the American program the

1420
01:00:44,870 --> 01:00:41,340
institution's the people who are doing

1421
01:00:46,550 --> 01:00:44,880
it the technology is deployed and also

1422
01:00:48,920 --> 01:00:46,560
this very fundamental reason of why they

1423
01:00:52,760 --> 01:00:48,930
do it how do they justify it to

1424
01:00:56,030 --> 01:00:52,770
themselves but also to to the state and

1425
01:01:01,880 --> 01:00:56,040
to the people of the state so I can only

1426
01:01:05,780 --> 01:01:01,890
plead guilty to I didn't mean that by to

1427
01:01:07,250 --> 01:01:05,790
neglect other institutions but I just

1428
01:01:14,120 --> 01:01:07,260
talked about what I knew best matched

1429
01:01:17,300 --> 01:01:14,130
JPL so you're absolutely right hi I'm

1430
01:01:19,310 --> 01:01:17,310
tardes Johnson from JPL and one of the

1431
01:01:23,870 --> 01:01:19,320
things I was struck by your in your

1432
01:01:28,070 --> 01:01:23,880
excellent talk was the intricacy of the

1433
01:01:29,990 --> 01:01:28,080
web of ways in which we explore humans

1434
01:01:31,520 --> 01:01:30,000
tend to make very lineare things you

1435
01:01:32,750 --> 01:01:31,530
know you're going to go someplace fly by

1436
01:01:35,060 --> 01:01:32,760
then you're going to orbit then you're

1437
01:01:38,540 --> 01:01:35,070
going to land but in fact we've done all

1438
01:01:40,670 --> 01:01:38,550

of those things in various mixtures and

1439
01:01:42,710 --> 01:01:40,680
it's interesting to contemplate that

1440
01:01:45,829 --> 01:01:42,720
with respect to the exploration of our

1441
01:01:47,450 --> 01:01:45,839
own earth I mean we've had a sample

1442
01:01:48,980 --> 01:01:47,460
return ever since geologists and

1443
01:01:51,560 --> 01:01:48,990
geochemists started looking at the earth

1444
01:01:55,339 --> 01:01:51,570
we've had seismic stations for over a

1445
01:01:57,290 --> 01:01:55,349
century and yet some of the most

1446
01:01:59,630 --> 01:01:57,300
exciting earth science is being done by

1447
01:02:01,190 --> 01:01:59,640
orbiters now very sophisticated orbiters

1448
01:02:02,660 --> 01:02:01,200
we're doing the same sorts of things now

1449
01:02:05,390 --> 01:02:02,670
with the moon that we've gone to many

1450
01:02:07,160 --> 01:02:05,400
many times and one of the most exciting

1451
01:02:09,770 --> 01:02:07,170
things I've seen recently or gravity

1452
01:02:11,450 --> 01:02:09,780
maps from grill so I think it's a

1453
01:02:14,900 --> 01:02:11,460
complex thing and I think your talk

1454
01:02:16,130 --> 01:02:14,910
write that out very nicely yeah that's

1455
01:02:18,109 --> 01:02:16,140
an excellent point I guess the only

1456
01:02:20,780 --> 01:02:18,119
thing i might add to that is that this

1457
01:02:23,120 --> 01:02:20,790
might touch on this question of you know

1458
01:02:24,770 --> 01:02:23,130
when does exploration end and is there

1459
01:02:28,880 --> 01:02:24,780
some point at which you no longer

1460
01:02:32,480 --> 01:02:28,890
exploring the novelty wears off clearly

1461
01:02:35,390 --> 01:02:32,490
we are still exploring Earth maybe not

1462
01:02:36,680 --> 01:02:35,400
so much in the public perception but you

1463
01:02:38,480 --> 01:02:36,690

know the fact that we're still learning

1464
01:02:42,380 --> 01:02:38,490
so much from these new perspectives

1465
01:02:43,730 --> 01:02:42,390
suggest that that will continue also for

1466
01:02:44,960 --> 01:02:43,740
the moon and for the plants I mean the

1467
01:02:47,329 --> 01:02:44,970
fact that we're still learning so much

1468
01:02:49,080 --> 01:02:47,339
about the moon new things about the moon

1469
01:02:53,160 --> 01:02:49,090
all these years after

1470
01:02:56,010 --> 01:02:53,170
Apollo and the sample returns so that

1471
01:03:02,120 --> 01:02:56,020
suggests you know partial answer to that

1472
01:03:07,380 --> 01:03:02,130
part of my talk ken Dylan sensu press I

1473
01:03:11,190 --> 01:03:07,390
wonder what you think of the parallel to

1474
01:03:15,180 --> 01:03:11,200
what you're talking about trying to use

1475
01:03:16,940 --> 01:03:15,190
the space exploration or the solar

1476
01:03:21,150 --> 01:03:16,950
system exploration planetary exploration

1477
01:03:23,670 --> 01:03:21,160
to teach us about the history of the

1478
01:03:26,310 --> 01:03:23,680
last 50 years it can also teach us about

1479
01:03:29,190 --> 01:03:26,320
other times in human history and in

1480
01:03:32,340 --> 01:03:29,200
particular prehistory and ancient

1481
01:03:35,250 --> 01:03:32,350
history it can enlighten us things we

1482
01:03:38,190 --> 01:03:35,260
discover on Mars now can enlighten us

1483
01:03:41,190 --> 01:03:38,200
about what archeo astronomy was about

1484
01:03:44,070 --> 01:03:41,200
and it can shed light on that most

1485
01:03:46,980 --> 01:03:44,080
curious controversy from the past

1486
01:03:50,520 --> 01:03:46,990
century the one started by Immanuel

1487
01:03:53,510 --> 01:03:50,530
Velikovsky on which there's plenty of

1488
01:03:57,510 --> 01:03:53,520

evidence I think that both sides

1489
01:04:01,980 --> 01:03:57,520
velikovsky and his critics had some very

1490
01:04:04,610 --> 01:04:01,990
good points so by exploring the planets

1491
01:04:07,970 --> 01:04:04,620
we're learning about ancient history and

1492
01:04:12,090 --> 01:04:07,980
conversely by studying the ancient

1493
01:04:14,910 --> 01:04:12,100
problems astronomical problems and so on

1494
01:04:18,120 --> 01:04:14,920
that might point us in directions we can

1495
01:04:19,950 --> 01:04:18,130
go today I think that's an excellent

1496
01:04:27,810 --> 01:04:19,960
point I'm not sure I have anything to

1497
01:04:33,140 --> 01:04:27,820
add to it I think I'll just I'll just

1498
01:04:39,890 --> 01:04:36,980
I jim.green from NASA headquarters up

1499
01:04:42,500 --> 01:04:39,900
one thing I didn't quite hear from your

1500
01:04:44,829 --> 01:04:42,510
talk is any opinion about whether you

1501
01:04:48,410 --> 01:04:44,839
feel planetary science in its pursuit

1502
01:04:52,000 --> 01:04:48,420
solar system exploration is essential

1503
01:04:55,599 --> 01:04:52,010
for the survivability of the human race

1504
01:04:59,150 --> 01:04:55,609
not just intellectually but even from

1505
01:05:00,589 --> 01:04:59,160
even from a physical standpoint yeah

1506
01:05:02,720 --> 01:05:00,599
that's actually that might actually

1507
01:05:04,130 --> 01:05:02,730
follow I was going to be my answer to

1508
01:05:06,440 --> 01:05:04,140
the previous question actually and

1509
01:05:08,720 --> 01:05:06,450
that's I had thought about talking about

1510
01:05:10,099 --> 01:05:08,730
this in the talk and for reasons of time

1511
01:05:12,500 --> 01:05:10,109
I cut it out but it's a good question

1512
01:05:15,529 --> 01:05:12,510
and actually I think Glenn is going to

1513
01:05:18,470 --> 01:05:15,539

talk about precursors and I think back

1514
01:05:20,630 --> 01:05:18,480
to the 1970s when things like the Club

1515
01:05:23,410 --> 01:05:20,640
of Rome and Paul Ehrlich and others were

1516
01:05:26,900 --> 01:05:23,420
talking about these Malthusian concerns

1517
01:05:30,099 --> 01:05:26,910
population explosion and publish and

1518
01:05:32,660 --> 01:05:30,109
growth resource scarcity pollution

1519
01:05:35,059 --> 01:05:32,670
called spark these calls for space

1520
01:05:36,349 --> 01:05:35,069
colonization and the l5 society others

1521
01:05:38,089 --> 01:05:36,359
were talking about going out that we

1522
01:05:40,190 --> 01:05:38,099
need to escape and also the prospect of

1523
01:05:42,470 --> 01:05:40,200
nuclear Armageddon but also but we need

1524
01:05:43,700 --> 01:05:42,480
to escape earth because of these was

1525
01:05:45,440 --> 01:05:43,710
because of what we're doing the planet

1526
01:05:46,970 --> 01:05:45,450
in order to serve what in order to

1527
01:05:48,950 --> 01:05:46,980
ensure the survival of the human species

1528
01:05:51,910 --> 01:05:48,960
we need to go out and explore space or

1529
01:05:54,859 --> 01:05:51,920
we're not going to make it as a species

1530
01:05:56,990 --> 01:05:54,869
and thats part calls not only for these

1531
01:05:58,279 --> 01:05:57,000
human space colonies but these before

1532
01:06:00,950 --> 01:05:58,289
you can do that you need to go out and

1533
01:06:02,569 --> 01:06:00,960
explore what's out there with robots and

1534
01:06:07,160 --> 01:06:02,579
that was used as a justification at the

1535
01:06:08,210 --> 01:06:07,170
time i think more by groups like l5 what

1536
01:06:12,019 --> 01:06:08,220
we might think of this is kind of on the

1537
01:06:13,370 --> 01:06:12,029
fringes then from NASA itself although

1538
01:06:15,710 --> 01:06:13,380

this you know these fringe groups

1539
01:06:17,569 --> 01:06:15,720
certainly their ideas percolated in the

1540
01:06:19,490 --> 01:06:17,579
mainstream I have Gerard O'Neill has

1541
01:06:22,670 --> 01:06:19,500
these fantastic plans new space callings

1542
01:06:24,740 --> 01:06:22,680
and I think this certainly ties in to

1543
01:06:26,240 --> 01:06:24,750
current talk about climate change I

1544
01:06:27,980 --> 01:06:26,250
don't think we've seen it too much as

1545
01:06:31,069 --> 01:06:27,990
far as I know at the present but I would

1546
01:06:32,930 --> 01:06:31,079
look at this going forward with global

1547
01:06:34,880 --> 01:06:32,940
warming and climate change that we might

1548
01:06:37,940 --> 01:06:34,890
see a return to these calls for space

1549
01:06:42,500 --> 01:06:37,950
exploration as a way to you know if we

1550
01:06:44,510 --> 01:06:42,510
are indeed facing an end or constraints

1551
01:06:46,700 --> 01:06:44,520
on or survival as a species here on

1552
01:06:48,770 --> 01:06:46,710
earth and this goes back to the

1553
01:06:51,950 --> 01:06:48,780
previous question looking at records of

1554
01:06:53,390 --> 01:06:51,960
the environment going back over the full

1555
01:06:56,800 --> 01:06:53,400
span of human history and what this is

1556
01:06:59,599 --> 01:06:56,810
meant for human civilizations in

1557
01:07:02,720 --> 01:06:59,609
Mesopotamia and Indus River Valley in

1558
01:07:04,339 --> 01:07:02,730
the Yangtze River Valley I've just been

1559
01:07:07,400 --> 01:07:04,349
reading a marvelous book about this by

1560
01:07:10,339 --> 01:07:07,410
inna Morris but talking about how

1561
01:07:11,930 --> 01:07:10,349
environmental change has affected the

1562
01:07:13,880 --> 01:07:11,940
rise of decline of human civilizations

1563
01:07:17,150 --> 01:07:13,890

that we might be in another such cycle

1564
01:07:19,099 --> 01:07:17,160
now and did this might actually maybe

1565
01:07:21,109 --> 01:07:19,109
not at this particular moment but in the

1566
01:07:23,480 --> 01:07:21,119
very near future provide another major

1567
01:07:27,620 --> 01:07:23,490
justification for a planetary

1568
01:07:29,120 --> 01:07:27,630
exploration as a precursor to getting

1569
01:07:32,030 --> 01:07:29,130
humans off the planet so I think those

1570
01:07:37,700 --> 01:07:32,040
two questions actually tie together very

1571
01:07:39,680 --> 01:07:37,710
well II to draw to a close at this point

1572
01:07:42,980 --> 01:07:39,690
I'd like to thank everybody for

1573
01:07:45,079 --> 01:07:42,990
participating in the discussion Peter

1574
01:07:46,310 --> 01:07:45,089
will be here through the conference so

1575
01:07:48,170 --> 01:07:46,320
you can certainly hit him up during

1576
01:07:51,260 --> 01:07:48,180
breaks and let's take one right now for

1577
01:07:52,670 --> 01:07:51,270
about five minutes and as we do so the