
AbSciCon
2017
MESA, ARIZONA

1
00:00:12,250 --> 00:00:06,150
you

2
00:00:17,710 --> 00:00:14,129
[Music]

3
00:00:20,350 --> 00:00:17,720
so welcome everybody on behalf of the

4
00:00:22,060 --> 00:00:20,360
astrobiology Science Conference and ASU

5
00:00:25,089 --> 00:00:22,070
planet works I'd like to welcome you to

6
00:00:28,269 --> 00:00:25,099
this public event managing earth as a

7
00:00:29,230 --> 00:00:28,279
planet Mr Al Anbar I'm a professor in

8
00:00:31,210 --> 00:00:29,240
the school of Earth and space

9
00:00:34,090 --> 00:00:31,220
exploration at ASU and also director of

10
00:00:35,799 --> 00:00:34,100
planet works and I'm one of 800

11
00:00:38,259 --> 00:00:35,809
astrobiologists who spent the past four

12
00:00:40,330 --> 00:00:38,269
days here thinking and learning about

13
00:00:43,270 --> 00:00:40,340

one of the most fantastic scientific

14
00:00:46,150 --> 00:00:43,280
quests that humanity is undertaking the

15
00:00:47,799 --> 00:00:46,160
search for life beyond Earth it's

16
00:00:49,150 --> 00:00:47,809
impossible to think about that topic is

17
00:00:50,979 --> 00:00:49,160
impossible to think about life on other

18
00:00:54,100 --> 00:00:50,989
worlds without also thinking about the

19
00:00:57,069 --> 00:00:54,110
future of this world and that future is

20
00:00:59,020 --> 00:00:57,079
in our hands in human hands because

21
00:01:00,790 --> 00:00:59,030
we're entering a remarkable new epoch of

22
00:01:02,139 --> 00:01:00,800
Earth's evolution an epoch that

23
00:01:04,299 --> 00:01:02,149
scientists are starting to call the

24
00:01:05,650 --> 00:01:04,309
Anthropocene that's what we call this

25
00:01:07,150 --> 00:01:05,660
new epoch during which humanity is

26
00:01:09,490 --> 00:01:07,160
becoming one of the most powerful forces

27
00:01:12,820 --> 00:01:09,500
on the planet and it's an era that's

28
00:01:14,380 --> 00:01:12,830
both remarkable and frightening because

29
00:01:16,899 --> 00:01:14,390
we have to grapple with it with a very

30
00:01:18,910 --> 00:01:16,909
big question do we as a species have the

31
00:01:21,370 --> 00:01:18,920
wisdom to manage the future of this

32
00:01:22,539 --> 00:01:21,380
planet so working with the origins

33
00:01:25,090 --> 00:01:22,549
project we've assembled a fantastic

34
00:01:26,880 --> 00:01:25,100
panel to discuss this future and so I'm

35
00:01:29,590 --> 00:01:26,890
pleased to turn the proceedings over to

36
00:01:36,460 --> 00:01:29,600
Lawrence Krauss the director of the ASU

37
00:01:38,950 --> 00:01:36,470
origins project Thank You Carol does

38
00:01:41,140 --> 00:01:38,960

this work is this working okay I can

39
00:01:43,539 --> 00:01:41,150
hear myself good well thank you for

40
00:01:48,340 --> 00:01:43,549
coming and finding this room which is no

41
00:01:50,950 --> 00:01:48,350
small feat and we are pleased to have a

42
00:01:53,469 --> 00:01:50,960
wonderful panel here to discuss that the

43
00:01:57,670 --> 00:01:53,479
official title the long the long form

44
00:01:59,620 --> 00:01:57,680
title of this panel is managing earth as

45
00:02:02,350 --> 00:01:59,630
a planet how astrobiology and

46
00:02:04,990 --> 00:02:02,360
exploration inform a perspective of

47
00:02:06,639 --> 00:02:05,000
planetary stewardship so we're going to

48
00:02:09,880 --> 00:02:06,649
talk about planetary stewardship in this

49
00:02:11,710 --> 00:02:09,890
particular era which which is a RAL

50
00:02:14,759 --> 00:02:11,720
mentioned as the Anthropocene now the

51
00:02:16,780 --> 00:02:14,769
interesting thing is this meeting is of

52
00:02:18,550 --> 00:02:16,790
astrobiology one of the main parts of

53
00:02:19,900 --> 00:02:18,560
astrobiology is to look for life

54
00:02:22,030 --> 00:02:19,910
elsewhere in the universe and to find

55
00:02:25,270 --> 00:02:22,040
out whether there are habitable planets

56
00:02:26,230 --> 00:02:25,280
at every every week almost 1:1 here's

57
00:02:28,000 --> 00:02:26,240
about a new habitable

58
00:02:31,000 --> 00:02:28,010
and I was just talking about one on or

59
00:02:34,120 --> 00:02:31,010
two on on TV yesterday actually in our

60
00:02:35,740 --> 00:02:34,130
PBS station and discoveries are made all

61
00:02:37,450 --> 00:02:35,750
the time of what are potentially

62
00:02:39,550 --> 00:02:37,460
habitable planets and right now

63
00:02:41,320 --> 00:02:39,560

habitable planets are often defined as

64
00:02:43,450 --> 00:02:41,330
water worlds worlds that have liquid

65
00:02:45,520 --> 00:02:43,460
water now the interesting thing is

66
00:02:47,740 --> 00:02:45,530
that's a gross sort of a gross

67
00:02:50,350 --> 00:02:47,750
definition because we live in a

68
00:02:52,780 --> 00:02:50,360
habitable planet but that but what's

69
00:02:55,450 --> 00:02:52,790
rather interesting and sad is that while

70
00:02:57,280 --> 00:02:55,460
we live in a habitable planet rather

71
00:02:59,560 --> 00:02:57,290
quickly large parts of the planet are

72
00:03:02,230 --> 00:02:59,570
becoming inhabitable at least for

73
00:03:05,050 --> 00:03:02,240
life-forms like ourselves and that's a

74
00:03:07,090 --> 00:03:05,060
concern and and it's a concern because

75
00:03:09,580 --> 00:03:07,100
indeed as I mentioned we're entering an

76
00:03:11,890 --> 00:03:09,590
era where humans are having a global

77
00:03:13,300 --> 00:03:11,900
impact on the environment in a way

78
00:03:14,560 --> 00:03:13,310
that's never happened before changing

79
00:03:19,600 --> 00:03:14,570
the environment and changing the climate

80
00:03:22,780 --> 00:03:19,610
of this planet and in ways that that at

81
00:03:25,180 --> 00:03:22,790
this point are inevitable I'm sad to say

82
00:03:27,250 --> 00:03:25,190
the climate change is happening it's not

83
00:03:29,170 --> 00:03:27,260
something in the future and the carbon

84
00:03:30,880 --> 00:03:29,180
that we put up in the in the carbon

85
00:03:32,680 --> 00:03:30,890
dioxide that we put up in the atmosphere

86
00:03:34,960 --> 00:03:32,690
is going to stay there for about a

87
00:03:37,000 --> 00:03:34,970
thousand years unless we do something

88
00:03:39,580 --> 00:03:37,010

about it and that means that they're

89
00:03:41,500 --> 00:03:39,590
going to have huge impacts on the planet

90
00:03:45,130 --> 00:03:41,510
from obviously sea level rise and the

91
00:03:47,440 --> 00:03:45,140
acidification of oceans and more severe

92
00:03:49,690 --> 00:03:47,450
storms and and drop droughts around the

93
00:03:51,370 --> 00:03:49,700
world maybe in the southwest as well I

94
00:03:53,200 --> 00:03:51,380
want to start by the way on a low level

95
00:03:54,790 --> 00:03:53,210
and I'm going to allow the panelists to

96
00:03:58,150 --> 00:03:54,800
be a little more optimistic so I'm going

97
00:03:59,950 --> 00:03:58,160
to present the pessimistic view and that

98
00:04:02,560 --> 00:03:59,960
means we have to consider ways we either

99
00:04:05,050 --> 00:04:02,570
live with that and die with that or we

100
00:04:10,150 --> 00:04:05,060
think about ways to manage the planet we

101
00:04:12,100 --> 00:04:10,160
live on in this new era where as as my

102
00:04:13,900 --> 00:04:12,110
my I think my friend Jim Hanson use

103
00:04:16,539 --> 00:04:13,910
always says if you broke it you fix it

104
00:04:18,820 --> 00:04:16,549
it's yours and we've broken it and now

105
00:04:22,150 --> 00:04:18,830
it's up to us to own up with to that

106
00:04:24,600 --> 00:04:22,160
problem and that means trying to

107
00:04:27,130 --> 00:04:24,610
understand the processes that affect

108
00:04:28,570 --> 00:04:27,140
this planet and one of the ways to think

109
00:04:29,740 --> 00:04:28,580
about that is to think about planets

110
00:04:32,020 --> 00:04:29,750
more generally which is one of the

111
00:04:33,250 --> 00:04:32,030
reasons why it's useful to have this

112
00:04:36,370 --> 00:04:33,260
group here at this particular meeting

113
00:04:38,440 --> 00:04:36,380

and also ways to model the future and

114
00:04:39,519 --> 00:04:38,450
ways to try and impact the future in

115
00:04:40,749 --> 00:04:39,529
each of our

116
00:04:42,999 --> 00:04:40,759
analyst is going to talk in different

117
00:04:44,859 --> 00:04:43,009
ways about viewing the planet and that

118
00:04:48,299 --> 00:04:44,869
means thinking in new terms thinking

119
00:04:51,099 --> 00:04:48,309
about the cost of things that that that

120
00:04:52,659 --> 00:04:51,109
economists never thought of is costing

121
00:04:54,609 --> 00:04:52,669
things because if they're an infinite

122
00:04:57,219 --> 00:04:54,619
number of resources you never have to

123
00:04:59,769 --> 00:04:57,229
really take into account the cost of

124
00:05:01,919 --> 00:04:59,779
resources but we're well past that we

125
00:05:03,819 --> 00:05:01,929
have to think of the cost of carbon

126
00:05:06,039 --> 00:05:03,829
people talk about that a lot but they

127
00:05:07,809 --> 00:05:06,049
don't talk about the cost of water which

128
00:05:09,399 --> 00:05:07,819
is probably going to be equally severe

129
00:05:10,839 --> 00:05:09,409
and one of the reasons I want to sort of

130
00:05:12,759 --> 00:05:10,849
end my little introduction with water

131
00:05:16,059 --> 00:05:12,769
which in one ways because we live in a

132
00:05:18,579 --> 00:05:16,069
water planet is that climate change and

133
00:05:20,829 --> 00:05:18,589
the availability of fresh water not just

134
00:05:22,929 --> 00:05:20,839
ocean sea level rise are intimately

135
00:05:26,979 --> 00:05:22,939
related and and the origins project is

136
00:05:29,229 --> 00:05:26,989
actually after sponsoring this this

137
00:05:31,689 --> 00:05:29,239
panel took over the next weekend is

138
00:05:33,489 --> 00:05:31,699

having a a weekend on climate change

139
00:05:35,499 --> 00:05:33,499
awareness we're having a scientific

140
00:05:37,269 --> 00:05:35,509
conference on the coming water wars

141
00:05:40,299 --> 00:05:37,279
where we're going to bring people in to

142
00:05:42,579 --> 00:05:40,309
talk about everything from locally the

143
00:05:45,939 --> 00:05:42,589
availability fresh water to to globally

144
00:05:48,039 --> 00:05:45,949
that problem and issues of available

145
00:05:50,199 --> 00:05:48,049
fresh water and sea level rise and

146
00:05:52,179 --> 00:05:50,209
climate change more generally and as we

147
00:05:53,799 --> 00:05:52,189
also like to do we also have several

148
00:05:55,299 --> 00:05:53,809
public events associated with that and

149
00:05:57,819 --> 00:05:55,309
this is in some sense is that the

150
00:06:00,999 --> 00:05:57,829
opening public event the the next two

151
00:06:02,859 --> 00:06:01,009
nights in Gammage auditorium we're going

152
00:06:04,509 --> 00:06:02,869
to have show some films related to this

153
00:06:06,929 --> 00:06:04,519
and have the directors involved and

154
00:06:09,009 --> 00:06:06,939
tomorrow night we're going to have

155
00:06:11,289 --> 00:06:09,019
Fisher Stevens who along with Leo

156
00:06:13,409 --> 00:06:11,299
DiCaprio created a movie called before

157
00:06:15,099 --> 00:06:13,419
the flood and at Gammage auditorium

158
00:06:16,479 --> 00:06:15,109
we're going to have we're going to

159
00:06:19,479 --> 00:06:16,489
screen the movie and then Fisher Stevens

160
00:06:22,449 --> 00:06:19,489
will be here to talk about it with me

161
00:06:23,889 --> 00:06:22,459
afterwards Leo DiCaprio was actually

162
00:06:25,569 --> 00:06:23,899
going to be with us but he has a climate

163
00:06:28,119 --> 00:06:25,579

change March in Washington the next day

164
00:06:29,259 --> 00:06:28,129
and then and then and then Saturday

165
00:06:30,519 --> 00:06:29,269
night and you can get tickets through

166
00:06:34,029 --> 00:06:30,529
both nights we're going to have a

167
00:06:40,119 --> 00:06:34,039
different view a fictional view of an

168
00:06:42,429 --> 00:06:40,129
eco drama of a possible tragic set of

169
00:06:44,049 --> 00:06:42,439
events that relate to water and the

170
00:06:46,149 --> 00:06:44,059
director is the famous director Verner

171
00:06:48,429 --> 00:06:46,159
Hertzog at the movies called salt and

172
00:06:51,939 --> 00:06:48,439
fire and Verner Hertzog will be here

173
00:06:53,500 --> 00:06:51,949
with us on Saturday night and we're also

174
00:06:57,430 --> 00:06:53,510
going to as well as talking

175
00:06:59,650 --> 00:06:57,440
of that fictional tragedy or crisis

176
00:07:01,900 --> 00:06:59,660
we're going to have Jeffrey Sachs one of

177
00:07:03,400 --> 00:07:01,910
the world's most famous economists who

178
00:07:05,050 --> 00:07:03,410
has thought a lot about climate change

179
00:07:07,990 --> 00:07:05,060
and advised the UN among other things

180
00:07:09,280 --> 00:07:08,000
and he'll be there so so Verner Jeffry

181
00:07:10,930 --> 00:07:09,290
and I will have a dialogue after the

182
00:07:12,520 --> 00:07:10,940
movie so I encourage you to consider

183
00:07:15,640 --> 00:07:12,530
their tickets available still for both

184
00:07:19,660 --> 00:07:15,650
at Gammage auditorium at ASU so having

185
00:07:22,450 --> 00:07:19,670
made that that announcement let me just

186
00:07:25,120 --> 00:07:22,460
talk to you about one aspect of water

187
00:07:26,770 --> 00:07:25,130
and the end the end the Anthropocene

188
00:07:28,840 --> 00:07:26,780

before I turn to our panelists just to

189
00:07:30,550 --> 00:07:28,850
start as I say lo there's a wonderful

190
00:07:32,770 --> 00:07:30,560
book which one my colleagues gave to me

191
00:07:35,830 --> 00:07:32,780
called water the epic struggle for

192
00:07:39,730 --> 00:07:35,840
wealth power and something else which I

193
00:07:41,260 --> 00:07:39,740
can't read and and one of the first

194
00:07:44,350 --> 00:07:41,270
things in here is that water is quickly

195
00:07:48,070 --> 00:07:44,360
overtaking oil as the world's scarcest

196
00:07:50,110 --> 00:07:48,080
critical natural resource today at the

197
00:07:52,630 --> 00:07:50,120
beginning of the 21st century there's

198
00:07:55,630 --> 00:07:52,640
hardly an accessible freshwater source

199
00:07:57,280 --> 00:07:55,640
or a strategically placed waterway on an

200
00:07:59,410 --> 00:07:57,290
economically advanced part of the planet

201
00:08:01,540 --> 00:07:59,420
that has not been radically and often

202
00:08:04,150 --> 00:08:01,550
monumentally engineered by man's

203
00:08:05,920 --> 00:08:04,160
prodigious industrial power as world

204
00:08:09,430 --> 00:08:05,930
population continues to be propelled

205
00:08:10,930 --> 00:08:09,440
towards 9 billion by 2050 with so many

206
00:08:12,880 --> 00:08:10,940
third world and happened and starting to

207
00:08:14,890 --> 00:08:12,890
move up towards consumption and waste

208
00:08:16,600 --> 00:08:14,900
generation levels of the one fifth

209
00:08:18,490 --> 00:08:16,610
living in industrialised nations now

210
00:08:19,690 --> 00:08:18,500
demand for more fresh water is

211
00:08:22,960 --> 00:08:19,700
continuing to soar

212
00:08:24,940 --> 00:08:22,970
yet as written here but we'll see

213
00:08:26,950 --> 00:08:24,950

whether our panelists can affect discuss

214
00:08:28,840 --> 00:08:26,960
that as well as other things yet no new

215
00:08:32,020 --> 00:08:28,850
innovative breakthrough capable of

216
00:08:33,550 --> 00:08:32,030
expanding usable water supply on a large

217
00:08:36,400 --> 00:08:33,560
enough scale to meet the demand is

218
00:08:39,040 --> 00:08:36,410
anywhere evident on the horizon over the

219
00:08:41,550 --> 00:08:39,050
past two centuries fresh water usage has

220
00:08:43,750 --> 00:08:41,560
grown two times faster than population

221
00:08:45,850 --> 00:08:43,760
humans are affecting every part of this

222
00:08:48,160 --> 00:08:45,860
planet and we need to understand that

223
00:08:50,230 --> 00:08:48,170
and deal with it and that's why if we

224
00:08:52,300 --> 00:08:50,240
fortune favors the prepared mind and

225
00:08:56,140 --> 00:08:52,310
that's why we've invited for prepared

226
00:08:58,450 --> 00:08:56,150
minds to UM to talk today and the first

227
00:08:59,860 --> 00:08:58,460
the first panel if someone introduces an

228
00:09:02,560 --> 00:08:59,870
old friend of mine John Grunsfeld who's

229
00:09:04,360 --> 00:09:02,570
a famous for being an astronaut among

230
00:09:06,100 --> 00:09:04,370
other things one of my favorite

231
00:09:07,730 --> 00:09:06,110
astronauts of the whole of the whole

232
00:09:11,750 --> 00:09:07,740
crew because he's an ass

233
00:09:13,220 --> 00:09:11,760
not scientist and and truly excels in

234
00:09:15,380 --> 00:09:13,230
both of those things not only is John

235
00:09:18,080 --> 00:09:15,390
been on five different trips to the

236
00:09:19,910 --> 00:09:18,090
Space Shuttle to these International

237
00:09:22,340 --> 00:09:19,920
Space Station's with the spacial he has

238
00:09:28,760 --> 00:09:22,350

he has fixed the Hubble Space Telescope

239
00:09:32,090 --> 00:09:28,770
three times three times and he is a is a

240
00:09:34,220 --> 00:09:32,100
scientist he graduated from MIT in

241
00:09:36,560 --> 00:09:34,230
physics and then at the University of

242
00:09:37,880 --> 00:09:36,570
Chicago did his PhD in physics then went

243
00:09:40,820 --> 00:09:37,890
to Caltech where he's a research

244
00:09:44,870 --> 00:09:40,830
professor and then decided to become an

245
00:09:47,330 --> 00:09:44,880
astronaut and and and radically affect

246
00:09:49,220 --> 00:09:47,340
our the future of science by helping

247
00:09:52,850 --> 00:09:49,230
repair the Hubble Space Telescope and

248
00:09:54,830 --> 00:09:52,860
then and then he after after ending that

249
00:09:58,100 --> 00:09:54,840
period he went and actually was deputy

250
00:10:01,370 --> 00:09:58,110
director of the of the Hubble Space

251
00:10:03,650 --> 00:10:01,380
Telescope Institute and then decided he

252
00:10:06,320 --> 00:10:03,660
missed NASA too much and he went back to

253
00:10:08,270 --> 00:10:06,330
be the associate administrator basically

254
00:10:10,100 --> 00:10:08,280
the head of science at NASA and he's

255
00:10:11,930 --> 00:10:10,110
been spearheading science at NASA during

256
00:10:14,020 --> 00:10:11,940
that time from which he's just retired

257
00:10:18,580 --> 00:10:14,030
and is now going back to be an

258
00:10:26,170 --> 00:10:18,590
astrobiologist john thank you very much

259
00:10:32,780 --> 00:10:30,800
all righty so astronauts are not really

260
00:10:34,250 --> 00:10:32,790
well known for their humanity and

261
00:10:36,590 --> 00:10:34,260
certainly not scientists you know we

262
00:10:41,329 --> 00:10:36,600
tend to like our science and to avoid

263
00:10:43,220 --> 00:10:41,339

all human contact but the story that

264
00:10:44,720 --> 00:10:43,230
Lawrence just laid out it is a human

265
00:10:46,460 --> 00:10:44,730
story it's about planet Earth but it's

266
00:10:48,410 --> 00:10:46,470
about humans on planet Earth in our

267
00:10:49,880 --> 00:10:48,420
interaction with the planet so I thought

268
00:10:52,340 --> 00:10:49,890
I would give you the human perspective

269
00:10:55,250 --> 00:10:52,350
from orbit you know not the Hubble Space

270
00:10:56,449 --> 00:10:55,260
Telescope repair stuff and I don't know

271
00:10:58,370 --> 00:10:56,459
how well you can see but this is

272
00:11:01,220 --> 00:10:58,380
actually a picture of me working in a

273
00:11:02,810 --> 00:11:01,230
vacuum which is really made total sense

274
00:11:04,460 --> 00:11:02,820
to me because all my life people have

275
00:11:08,240 --> 00:11:04,470
been saying what you work in a vacuum

276
00:11:10,310 --> 00:11:08,250
and and in fact yes I do

277
00:11:12,170 --> 00:11:10,320
but what selling about this picture is I

278
00:11:13,940 --> 00:11:12,180
am out in a vacuum in my spacesuit which

279
00:11:16,269 --> 00:11:13,950
is sort of like a mini earth it has its

280
00:11:19,790 --> 00:11:16,279
own environmental control system but

281
00:11:23,750 --> 00:11:19,800
reflected in my visor is a reflection of

282
00:11:26,030 --> 00:11:23,760
planet Earth and truly the view from

283
00:11:28,730 --> 00:11:26,040
space is the best place to look at the

284
00:11:30,740 --> 00:11:28,740
earth and something that I enjoy greatly

285
00:11:33,350 --> 00:11:30,750
and you can see on my face is a huge

286
00:11:35,870 --> 00:11:33,360
grin and that grin I have almost all the

287
00:11:37,400 --> 00:11:35,880
time when I'm in space now most of what

288
00:11:39,980 --> 00:11:37,410

you're going to see here is the images

289
00:11:42,019 --> 00:11:39,990
that I took on a mission in 2009 to the

290
00:11:43,760 --> 00:11:42,029
Hubble Space Telescope through the space

291
00:11:45,590 --> 00:11:43,770
shuttle windows and so they're not

292
00:11:47,240 --> 00:11:45,600
always super clear because somebody else

293
00:11:49,040 --> 00:11:47,250
tucked their face up against the window

294
00:11:51,860 --> 00:11:49,050
and gotten you know some grease on it

295
00:11:53,329 --> 00:11:51,870
but we really have this fabulous view

296
00:11:56,240 --> 00:11:53,339
with the space shuttle and now the space

297
00:11:59,300 --> 00:11:56,250
station the images were taken with a

298
00:12:01,670 --> 00:11:59,310
standard you know Nikon digital camera

299
00:12:04,699 --> 00:12:01,680
sometimes a wide-angle lens sometimes a

300
00:12:06,050 --> 00:12:04,709
long lens so you know this is the kind

301
00:12:09,140 --> 00:12:06,060
of use there's something in the way in

302
00:12:10,940 --> 00:12:09,150
this picture of the earth that's the

303
00:12:13,460 --> 00:12:10,950
Hubble Space Telescope after we deployed

304
00:12:15,740 --> 00:12:13,470
it and you know the views of the earth

305
00:12:17,750 --> 00:12:15,750
that you've heard about from astronauts

306
00:12:20,240 --> 00:12:17,760
you know maybe you've heard a lot of

307
00:12:22,280 --> 00:12:20,250
flowery talk about you know how the

308
00:12:24,620 --> 00:12:22,290
earth looks perfect and there's no

309
00:12:28,449 --> 00:12:24,630
borders and you know you can't see the

310
00:12:31,819 --> 00:12:28,459
strife of humans on earth from space

311
00:12:34,489 --> 00:12:31,829
none of that's true but that doesn't

312
00:12:36,559 --> 00:12:34,499
change the beauty of the earth

313
00:12:38,299 --> 00:12:36,569

since this is an astrobiology conference

314
00:12:40,159 --> 00:12:38,309
what I thought I would do is take the

315
00:12:41,839 --> 00:12:40,169
view of you know what if some alien

316
00:12:44,989 --> 00:12:41,849
species were coming into our solar

317
00:12:47,269 --> 00:12:44,999
system and you know wanted to look at

318
00:12:49,609 --> 00:12:47,279
the earth now for the astrobiologists in

319
00:12:51,019 --> 00:12:49,619
the audience I do want to just say you

320
00:12:52,579 --> 00:12:51,029
know that one of the things that strikes

321
00:12:55,279 --> 00:12:52,589
me the most and for all of you in fact

322
00:12:57,739 --> 00:12:55,289
is that the Earth's atmosphere really is

323
00:13:00,529 --> 00:12:57,749
tremendously thin and fragile and this

324
00:13:03,469 --> 00:13:00,539
is a sunrise over the Earth's limb and

325
00:13:05,209 --> 00:13:03,479
that thin line is a hundred kilometers

326
00:13:07,399 --> 00:13:05,219
or so of our atmosphere of which are

327
00:13:10,219 --> 00:13:07,409
habitable part of the atmosphere is only

328
00:13:12,829 --> 00:13:10,229
a very thin one and also when we do

329
00:13:14,329 --> 00:13:12,839
transit spectroscopy that's the amount

330
00:13:17,659 --> 00:13:14,339
of atmosphere we're able to look through

331
00:13:19,399 --> 00:13:17,669
which is to me pretty incredible so here

332
00:13:21,649 --> 00:13:19,409
we are on our voyage we're approaching

333
00:13:23,119 --> 00:13:21,659
the earth and I and this is acts an

334
00:13:25,639 --> 00:13:23,129
image that was taken with the Lunar

335
00:13:28,339 --> 00:13:25,649
Reconnaissance Orbiter camera centered

336
00:13:30,319 --> 00:13:28,349
here at Arizona State University at CC

337
00:13:33,139 --> 00:13:30,329
by Mark Robinson and his team and

338
00:13:35,059 --> 00:13:33,149

students it's a satellite orbiting the

339
00:13:37,429 --> 00:13:35,069
moon and it looked back at Planet Earth

340
00:13:39,409 --> 00:13:37,439
and from this distance in fact you can

341
00:13:41,419 --> 00:13:39,419
see the earth as kind of this pristine

342
00:13:43,699 --> 00:13:41,429
you know planet that you know is

343
00:13:45,349 --> 00:13:43,709
unaffected by the goings on if you watch

344
00:13:48,489 --> 00:13:45,359
for a while you would see you know

345
00:13:51,829 --> 00:13:48,499
Africa going through its seasons and

346
00:13:53,960 --> 00:13:51,839
lots of storms but as we get closer we

347
00:13:56,269 --> 00:13:53,970
immediately start to see ah there's

348
00:13:59,449 --> 00:13:56,279
something funny going on there this is a

349
00:14:01,489 --> 00:13:59,459
picture of the Big Island of Hawaii as

350
00:14:03,229 --> 00:14:01,499
we flew over and if you look in the

351
00:14:05,869 --> 00:14:03,239
upper right of that photo and and also

352
00:14:08,269 --> 00:14:05,879
in a sort of center right you can see

353
00:14:09,919 --> 00:14:08,279
contrails you know nature doesn't

354
00:14:11,719 --> 00:14:09,929
usually make these long straight things

355
00:14:14,449 --> 00:14:11,729
and those are of course airplanes going

356
00:14:16,399 --> 00:14:14,459
in and out of Kona and to Hilo carrying

357
00:14:18,619 --> 00:14:16,409
lots of tourists and a few astronomers

358
00:14:20,960 --> 00:14:18,629
if you look closely with that long lens

359
00:14:22,999 --> 00:14:20,970
on the summit of Mauna Kea those little

360
00:14:24,589 --> 00:14:23,009
white dots are the observatories and you

361
00:14:26,210 --> 00:14:24,599
can see the Keck Observatory and

362
00:14:29,799 --> 00:14:26,220
infrared telescope facility in the

363
00:14:33,049 --> 00:14:29,809

Subaru telescope and little teeny roads

364
00:14:35,149 --> 00:14:33,059
if you fly over Kennedy Space Center ah

365
00:14:37,819 --> 00:14:35,159
now you find out that not only are there

366
00:14:42,079 --> 00:14:37,829
humans doing industrial things they have

367
00:14:43,909 --> 00:14:42,089
launch pads and runways and bridges and

368
00:14:45,889 --> 00:14:43,919
you know this is what you see when you

369
00:14:48,530 --> 00:14:45,899
look at Florida's you fly over it's

370
00:14:50,000 --> 00:14:48,540
pretty clear there's something going

371
00:14:52,160 --> 00:14:50,010
on there now whether you would assume

372
00:14:54,280 --> 00:14:52,170
its life or some kind of you know robot

373
00:14:57,760 --> 00:14:54,290
automatons you know you might not know

374
00:15:00,110 --> 00:14:57,770
even if you looked at the large scales

375
00:15:01,760 --> 00:15:00,120
what you see there is on this is

376
00:15:03,980 --> 00:15:01,770
obviously the middle east on the left

377
00:15:06,530 --> 00:15:03,990
you can see the great Nile Delta and the

378
00:15:09,460 --> 00:15:06,540
Nile River to the left actually is Lake

379
00:15:12,830 --> 00:15:09,470
Nasser which was only created in about

380
00:15:15,860 --> 00:15:12,840
1990 and they've been diverting the Nile

381
00:15:18,320 --> 00:15:15,870
and so I watched that grow from you know

382
00:15:19,970 --> 00:15:18,330
a puddle to this huge lake that now has

383
00:15:22,160 --> 00:15:19,980
millions and millions of people living

384
00:15:24,440 --> 00:15:22,170
around it and is affecting what goes on

385
00:15:26,600 --> 00:15:24,450
in the Delta as well but if you look to

386
00:15:30,170 --> 00:15:26,610
the right you can see there's sort of a

387
00:15:32,870 --> 00:15:30,180
it looks like a darker patch but off to

388
00:15:36,500 --> 00:15:32,880

the right is Israel and they do have

389
00:15:38,030 --> 00:15:36,510
large-scale desalinization and so

390
00:15:40,850 --> 00:15:38,040
compared to their neighbors they have a

391
00:15:42,170 --> 00:15:40,860
very vibrant agriculture that's not

392
00:15:44,090 --> 00:15:42,180
shared by anyone else and that

393
00:15:47,450 --> 00:15:44,100
highlights them like a random McNally

394
00:15:49,160 --> 00:15:47,460
map that you can see from space you know

395
00:15:50,620 --> 00:15:49,170
that there are borders and that those

396
00:15:53,930 --> 00:15:50,630
borders are different socioeconomic

397
00:15:57,650 --> 00:15:53,940
environments flying a little bit to the

398
00:16:00,890 --> 00:15:57,660
to the east over Iran out in the desert

399
00:16:04,520 --> 00:16:00,900
where nothing grows there's little bats

400
00:16:06,320 --> 00:16:04,530
and if this were a talk earlier in the

401
00:16:08,000 --> 00:16:06,330
week we'd be talking about membranes

402
00:16:11,960 --> 00:16:08,010
surrounding you know some kind of

403
00:16:14,120 --> 00:16:11,970
protoplasm a you know organic molecule

404
00:16:16,190 --> 00:16:14,130
this is center point of irrigation

405
00:16:18,470 --> 00:16:16,200
they've dug down and they're pumping out

406
00:16:20,450 --> 00:16:18,480
water from deep below the desert to do

407
00:16:22,550 --> 00:16:20,460
agriculture in a desert that you know

408
00:16:25,160 --> 00:16:22,560
really shouldn't be growing plants but

409
00:16:26,780 --> 00:16:25,170
it's to feed people and what you see is

410
00:16:28,160 --> 00:16:26,790
that they're successful for a few

411
00:16:29,660 --> 00:16:28,170
decades and then they pumped out the

412
00:16:33,140 --> 00:16:29,670
aquifers and then they dry up and they

413
00:16:35,780 --> 00:16:33,150

move a little bit and so this is an easy

414
00:16:39,290 --> 00:16:35,790
thing to see from space if you're a very

415
00:16:42,200 --> 00:16:39,300
rich country you can expand your land

416
00:16:44,450 --> 00:16:42,210
use this is in Dubai

417
00:16:46,160 --> 00:16:44,460
and the sort of gray area in the middle

418
00:16:48,350 --> 00:16:46,170
is the city millions of people and

419
00:16:50,450 --> 00:16:48,360
they've decided to make huge palm tree

420
00:16:52,790 --> 00:16:50,460
islands out of sand so you see those two

421
00:16:54,290 --> 00:16:52,800
palm trees surrounded by you know some

422
00:16:57,320 --> 00:16:54,300
kind of a dike and they're building

423
00:16:59,390 --> 00:16:57,330
houses there and you can also see more

424
00:17:00,639 --> 00:16:59,400
to the right planet Earth they're

425
00:17:03,639 --> 00:17:00,649
building continents

426
00:17:04,990 --> 00:17:03,649
and a horizon out of sand which is

427
00:17:07,649 --> 00:17:05,000
really hard to maintain because the

428
00:17:10,559 --> 00:17:07,659
tides keep trying to take the sand out

429
00:17:12,669 --> 00:17:10,569
what will the aliens think of that

430
00:17:14,409 --> 00:17:12,679
there's a lot of talk about Sun glint

431
00:17:16,360 --> 00:17:14,419
off of exoplanets so I thought I'd put a

432
00:17:17,980 --> 00:17:16,370
Sun glint picture in this is the Sun

433
00:17:20,740 --> 00:17:17,990
reflecting it just the right angle so

434
00:17:22,990 --> 00:17:20,750
these shrimp farming fields are very

435
00:17:25,240 --> 00:17:23,000
bright along the coast of South America

436
00:17:27,069 --> 00:17:25,250
and you can see some rivers going out

437
00:17:28,990 --> 00:17:27,079
and it allows you to see the patterns of

438
00:17:30,399 --> 00:17:29,000

wind on the water so you can learn a lot

439
00:17:33,100 --> 00:17:30,409
but these are definitely geometric

440
00:17:34,210 --> 00:17:33,110
structures that are not natural and if

441
00:17:36,760 --> 00:17:34,220
you go a little further south in

442
00:17:40,299 --> 00:17:36,770
Argentina this used to be you know

443
00:17:41,620 --> 00:17:40,309
grasslands and forests and it's now been

444
00:17:44,649 --> 00:17:41,630
carved up into all those little pieces

445
00:17:45,970 --> 00:17:44,659
and you see this massive fire and that's

446
00:17:48,250 --> 00:17:45,980
one of the characteristics now that you

447
00:17:50,500 --> 00:17:48,260
see all over planet Earth are massive

448
00:17:52,210 --> 00:17:50,510
fires as they slash and burn forests and

449
00:17:55,620 --> 00:17:52,220
so this is also in South America

450
00:17:57,850 --> 00:17:55,630
clearing rainforests for cattle to graze

451
00:18:01,990 --> 00:17:57,860
incredibly inefficient but that's what's

452
00:18:05,549 --> 00:18:02,000
going on and when I first flew in 1995

453
00:18:09,279 --> 00:18:05,559
there were large tracts of untouched

454
00:18:12,159 --> 00:18:09,289
Amazon basin rainforest especially here

455
00:18:16,960 --> 00:18:12,169
on a tributary the Orinoco River and

456
00:18:18,549 --> 00:18:16,970
that was 1995 by 2009 you just about

457
00:18:20,260 --> 00:18:18,559
can't find some place on planet Earth

458
00:18:23,500 --> 00:18:20,270
that doesn't look like this almost like

459
00:18:25,450 --> 00:18:23,510
it has some kind of a disease but these

460
00:18:26,740 --> 00:18:25,460
are people and companies who want to

461
00:18:28,180 --> 00:18:26,750
farm they want to make a living and

462
00:18:30,310 --> 00:18:28,190
again it's what Lauren said you know

463
00:18:32,080 --> 00:18:30,320

people are modifying the earth and if

464
00:18:34,720 --> 00:18:32,090
you really want to know that there's

465
00:18:36,250 --> 00:18:34,730
life on Earth just look at the Nightside

466
00:18:38,289 --> 00:18:36,260
this is actually from the International

467
00:18:40,389 --> 00:18:38,299
Space Station these are city lights and

468
00:18:42,340 --> 00:18:40,399
it traces out you know the population

469
00:18:44,019 --> 00:18:42,350
this is the central u.s. you'll see like

470
00:18:46,810 --> 00:18:44,029
Michigan coming up in Chicago where I

471
00:18:50,860 --> 00:18:46,820
was born and the dull glow of the

472
00:18:53,049 --> 00:18:50,870
atmosphere and so there's no question

473
00:18:54,600 --> 00:18:53,059
when when those alien spacecraft are on

474
00:18:56,919 --> 00:18:54,610
the backside you know people are

475
00:19:01,570 --> 00:18:56,929
converting coal and natural gas and

476
00:19:03,730 --> 00:19:01,580
other things into into light so for me I

477
00:19:05,380 --> 00:19:03,740
come back and land on planet earth you

478
00:19:07,000 --> 00:19:05,390
know what will the aliens do if they're

479
00:19:08,919 --> 00:19:07,010
not here already you know maybe they'll

480
00:19:11,470 --> 00:19:08,929
say oh no intelligent life on Earth

481
00:19:13,480 --> 00:19:11,480
we're going to go elsewhere but it's

482
00:19:14,500 --> 00:19:13,490
very clear from space that we are

483
00:19:16,000 --> 00:19:14,510
modifying

484
00:19:19,180 --> 00:19:16,010
everywhere on the surface of the earth

485
00:19:22,120 --> 00:19:19,190
the big surprise to me is that in flying

486
00:19:24,280 --> 00:19:22,130
you know something like 58 days in space

487
00:19:26,260 --> 00:19:24,290
looking at the earth I never saw a place

488
00:19:28,690 --> 00:19:26,270

that I couldn't view out the window

489
00:19:30,610 --> 00:19:28,700
I couldn't pretty quickly find someplace

490
00:19:32,799 --> 00:19:30,620
even the open oceans you know a ship

491
00:19:34,360 --> 00:19:32,809
wake with a smokestack where there

492
00:19:36,789 --> 00:19:34,370
wasn't evidence of humans on planet

493
00:19:38,830 --> 00:19:36,799
Earth and so to try and be optimistic a

494
00:19:41,440 --> 00:19:38,840
little bit we now know that we can

495
00:19:43,360 --> 00:19:41,450
modify the atmosphere of a planet we

496
00:19:45,400 --> 00:19:43,370
know we can modify the surface land of a

497
00:19:47,590 --> 00:19:45,410
planet now the question is you know can

498
00:19:49,690 --> 00:19:47,600
we do it in an intelligent way you know

499
00:19:51,880 --> 00:19:49,700
that doesn't make it uninhabitable and

500
00:19:54,430 --> 00:19:51,890
keeps us as a habitable planet so I'll

501
00:20:00,750 --> 00:19:54,440
turn it over back to you Lawrence thanks

502
00:20:06,160 --> 00:20:03,190
thank thanks Joan you always are the

503
00:20:07,750 --> 00:20:06,170
best pictures and and it's always why I

504
00:20:10,210 --> 00:20:07,760
can just watch it for an hour so thank

505
00:20:11,890 --> 00:20:10,220
you or the global mind yeah you got more

506
00:20:13,390 --> 00:20:11,900
well maybe we'll show more later for

507
00:20:16,210 --> 00:20:13,400
that global perspective now we'll move

508
00:20:18,400 --> 00:20:16,220
to we're going to start globally in a

509
00:20:21,690 --> 00:20:18,410
number of ways locally in space and then

510
00:20:24,430 --> 00:20:21,700
globally in time and I want to I want to

511
00:20:26,200 --> 00:20:24,440
ask the next panelist David Grinspoon to

512
00:20:28,110 --> 00:20:26,210
to talk he's going to talk about the

513
00:20:32,290 --> 00:20:28,120

challenge of now how to be a self-aware

514
00:20:34,690 --> 00:20:32,300
geological force and David actually this

515
00:20:38,170 --> 00:20:34,700
PhD is university Arizona which we

516
00:20:41,440 --> 00:20:38,180
forgive him for and in planetary science

517
00:20:43,180 --> 00:20:41,450
and then was in Colorado when he was

518
00:20:45,880 --> 00:20:43,190
actually the curator of planetary

519
00:20:49,150 --> 00:20:45,890
science at the Museum there and then was

520
00:20:51,760 --> 00:20:49,160
the inaugural chair in astrobiology at

521
00:20:54,250 --> 00:20:51,770
the Library of Congress and and is now

522
00:20:57,400 --> 00:20:54,260
at the Planetary Science Institute so

523
00:21:01,090 --> 00:20:57,410
David thank you very much thank you all

524
00:21:06,160 --> 00:21:01,100
for coming out this evening as mentioned

525
00:21:09,850 --> 00:21:06,170
I'm an astrobiologist I I mostly work in

526
00:21:12,070 --> 00:21:09,860
offices so I don't have pictures of what

527
00:21:15,970 --> 00:21:12,080
I do and where I work that anywhere near

528
00:21:18,990 --> 00:21:15,980
as cool as John's so no one does yeah

529
00:21:22,960 --> 00:21:19,000
exactly so so I'm not going to try to

530
00:21:25,180 --> 00:21:22,970
follow that with any visual so I'm just

531
00:21:26,890 --> 00:21:25,190
going to sit here and talk for a few

532
00:21:31,480 --> 00:21:26,900
minutes and share a few thoughts with

533
00:21:35,290 --> 00:21:31,490
you what I do for my research is I model

534
00:21:38,470 --> 00:21:35,300
climate change on other planets and try

535
00:21:41,080 --> 00:21:38,480
to understand the possible locations for

536
00:21:44,260 --> 00:21:41,090
life in the universe but I spent a lot

537
00:21:46,480 --> 00:21:44,270
of time over the last few years studying

538
00:21:49,690 --> 00:21:46,490

and writing about the human presence on

539
00:21:53,500 --> 00:21:49,700
earth from the viewpoint of astrobiology

540
00:21:56,580 --> 00:21:53,510
and asking the question given all the

541
00:21:59,200 --> 00:21:56,590
radical changes and catastrophes and

542
00:22:01,080 --> 00:21:59,210
transformations that the earth has been

543
00:22:04,080 --> 00:22:01,090
through what is really different about

544
00:22:07,240 --> 00:22:04,090
these changes that are happening now and

545
00:22:09,520 --> 00:22:07,250
I think that plausibly the answer is or

546
00:22:13,240 --> 00:22:09,530
one way to frame the answer is that

547
00:22:13,970 --> 00:22:13,250
we're seeing and manifesting the advent

548
00:22:17,900 --> 00:22:13,980
of self

549
00:22:20,030 --> 00:22:17,910
we're geological change a geological

550
00:22:22,700 --> 00:22:20,040
force that is coming to realize that it

551
00:22:26,390 --> 00:22:22,710
is a geological force that's something

552
00:22:30,110 --> 00:22:26,400
new on this planet realizing that we are

553
00:22:32,030 --> 00:22:30,120
a geological force so it certainly is

554
00:22:33,770 --> 00:22:32,040
clear as John was saying that our planet

555
00:22:36,680 --> 00:22:33,780
is going through some kind of radical

556
00:22:39,260 --> 00:22:36,690
transformation now let's go back to this

557
00:22:40,460 --> 00:22:39,270
view of these these aliens that John was

558
00:22:42,110 --> 00:22:40,470
talking about who are zooming in on

559
00:22:43,940 --> 00:22:42,120
earth but for a second rather than

560
00:22:44,830 --> 00:22:43,950
zooming in in space because zoom over

561
00:22:48,049 --> 00:22:44,840
time

562
00:22:51,320 --> 00:22:48,059
imagine you were a very patient alien

563
00:22:52,730 --> 00:22:51,330

with a different kind of time sense so

564
00:22:55,010 --> 00:22:52,740
you were watching the earth over

565
00:22:58,490 --> 00:22:55,020
billions of years and noticing its

566
00:22:59,870 --> 00:22:58,500
changes what would you see well you

567
00:23:01,640 --> 00:22:59,880
would have seen a lot happen a lot of

568
00:23:03,289 --> 00:23:01,650
changes on the planet gone through

569
00:23:06,560 --> 00:23:03,299
different phases you would have seen the

570
00:23:08,289 --> 00:23:06,570
continents drifting around through plate

571
00:23:10,850 --> 00:23:08,299
tectonics and continental drift

572
00:23:12,590 --> 00:23:10,860
coalescing into super continents and

573
00:23:16,909 --> 00:23:12,600
breaking apart again you would have seen

574
00:23:18,950 --> 00:23:16,919
climate changing ice ages hothouse ages

575
00:23:24,669 --> 00:23:18,960
the polar caps growing and shrinking

576
00:23:32,720 --> 00:23:28,360
to this patient attentive observe

577
00:23:34,610 --> 00:23:32,730
observant alien very recently you would

578
00:23:35,990 --> 00:23:34,620
notice something striking that you

579
00:23:38,390 --> 00:23:36,000
hadn't noticed over all these billions

580
00:23:41,120 --> 00:23:38,400
of years a whole series of brand-new

581
00:23:44,330 --> 00:23:41,130
things happening most noticeably

582
00:23:46,669 --> 00:23:44,340
probably the night side suddenly lights

583
00:23:48,500 --> 00:23:46,679
up starting in a few dots and some

584
00:23:52,960 --> 00:23:48,510
coastal areas and then spreading in webs

585
00:23:55,580 --> 00:23:52,970
and then filling much of the nighttime

586
00:23:57,409 --> 00:23:55,590
continents at the same time all these

587
00:23:59,210 --> 00:23:57,419
other changes start happening changes in

588
00:24:02,150 --> 00:23:59,220

the composition of the atmosphere in the

589
00:24:04,970 --> 00:24:02,160
ocean changes in patterns of the land

590
00:24:08,210 --> 00:24:04,980
surface strange new geometry squares and

591
00:24:10,669 --> 00:24:08,220
circles and even the hydrological cycle

592
00:24:13,430 --> 00:24:10,679
of the planet as Lorenz mentioned really

593
00:24:15,020 --> 00:24:13,440
suddenly being altered and then these

594
00:24:18,289 --> 00:24:15,030
linear clouds start streaking through

595
00:24:20,780 --> 00:24:18,299
the skies and then very recently in the

596
00:24:23,659 --> 00:24:20,790
last 60 years which is a blink in the

597
00:24:26,139 --> 00:24:23,669
eye of the planet little bits of the

598
00:24:28,479 --> 00:24:26,149
planet start launching into space

599
00:24:30,489 --> 00:24:28,489
which is a really strange new thing what

600
00:24:32,439 --> 00:24:30,499
what a strange way for a planet to

601
00:24:33,999 --> 00:24:32,449
behave everything four billion years ago

602
00:24:35,589 --> 00:24:34,009
fell from space and now all of a sudden

603
00:24:37,179 --> 00:24:35,599
some tiny little bits of it are

604
00:24:38,589 --> 00:24:37,189
launching back into space circling

605
00:24:40,809 --> 00:24:38,599
around the planet visiting the

606
00:24:43,749 --> 00:24:40,819
neighbours sending radio signals back so

607
00:24:45,879 --> 00:24:43,759
it's clear to you the attentive patient

608
00:24:48,609 --> 00:24:45,889
alien that something radical and new is

609
00:24:51,219 --> 00:24:48,619
happening on this planet what's going on

610
00:24:53,469 --> 00:24:51,229
so we have a species that is both

611
00:24:55,719 --> 00:24:53,479
changing the planet and also studying

612
00:24:57,849 --> 00:24:55,729
the planet trying to understand how it

613
00:25:00,789 --> 00:24:57,859

works and trying to understand our own

614
00:25:03,339 --> 00:25:00,799
role within it but when we study the

615
00:25:05,259 --> 00:25:03,349
long history of Earth one thing we

616
00:25:06,519 --> 00:25:05,269
quickly learn is that we are not the

617
00:25:09,009 --> 00:25:06,529
first species to come along and

618
00:25:11,379 --> 00:25:09,019
radically change the planet that has

619
00:25:12,939 --> 00:25:11,389
happened before that biology has changed

620
00:25:13,929 --> 00:25:12,949
earth for instance two and a half

621
00:25:17,579 --> 00:25:13,939
billion years ago

622
00:25:19,829 --> 00:25:17,589
these little bacteria the cyanobacteria

623
00:25:22,089 --> 00:25:19,839
discovered a new energy source and

624
00:25:22,629 --> 00:25:22,099
realized that they could exploit it like

625
00:25:24,969 --> 00:25:22,639
crazy

626
00:25:26,709 --> 00:25:24,979
and in the process polluted the entire

627
00:25:29,559 --> 00:25:26,719
atmosphere and caused a climate

628
00:25:31,479 --> 00:25:29,569
catastrophe sound familiar

629
00:25:33,609 --> 00:25:31,489
but the cyanobacteria did that when they

630
00:25:34,959 --> 00:25:33,619
discovered solar energy photosynthesis

631
00:25:37,239 --> 00:25:34,969
and they polluted the atmosphere with

632
00:25:40,119 --> 00:25:37,249
oxygen which at that time was a was a

633
00:25:44,249 --> 00:25:40,129
poison and caused caused a horrible

634
00:25:47,169 --> 00:25:44,259
climate change so so we're not the first

635
00:25:48,309 --> 00:25:47,179
to do some of these things what is

636
00:25:50,409 --> 00:25:48,319
really different about what is happening

637
00:25:52,359 --> 00:25:50,419
to the planet now it's not new for

638
00:25:55,779 --> 00:25:52,369

biological processes to radically change

639
00:26:00,729 --> 00:25:55,789
the planet but it is new for cognitive

640
00:26:04,209 --> 00:26:00,739
processes to change the planet mental

641
00:26:06,899 --> 00:26:04,219
processes enabled with technology the

642
00:26:09,129 --> 00:26:06,909
ability to manipulate the environment

643
00:26:12,129 --> 00:26:09,139
feeding back and causing global change

644
00:26:14,619 --> 00:26:12,139
that's something brand new earth gave

645
00:26:17,109 --> 00:26:14,629
rise to biology which somehow gave rise

646
00:26:20,129 --> 00:26:17,119
to these mental processes which are now

647
00:26:23,589 --> 00:26:20,139
feeding back and changing the planet a

648
00:26:26,379 --> 00:26:23,599
planet with brains fancy that

649
00:26:29,799 --> 00:26:26,389
not only brains but limbs with which to

650
00:26:31,209 --> 00:26:29,809
manipulate and build tools we're just

651
00:26:33,899 --> 00:26:31,219
beginning to come to grips with this

652
00:26:36,969 --> 00:26:33,909
strange new development like like a

653
00:26:38,619 --> 00:26:36,979
infant staring at its hands we're

654
00:26:39,640 --> 00:26:38,629
becoming aware of our powers but we

655
00:26:42,880 --> 00:26:39,650
haven't yet gained

656
00:26:44,980 --> 00:26:42,890
troll over them how can we change that

657
00:26:48,430 --> 00:26:44,990
maybe by understanding more fully what's

658
00:26:50,170 --> 00:26:48,440
what's going on here this cognitive

659
00:26:52,360 --> 00:26:50,180
influence on the planet I think there's

660
00:26:56,890 --> 00:26:52,370
two categories that we can break that

661
00:26:58,980 --> 00:26:56,900
into two ways this can unfold two kinds

662
00:27:02,560 --> 00:26:58,990
of cognitively driven planetary change

663
00:27:05,050 --> 00:27:02,570

inadvertent changes and intentional

664
00:27:08,170 --> 00:27:05,060
changes and I think we have examples of

665
00:27:09,790 --> 00:27:08,180
both the obvious inadvertent example is

666
00:27:12,940 --> 00:27:09,800
that we decided fossil fuels would be a

667
00:27:15,100 --> 00:27:12,950
great source of energy they were but

668
00:27:17,580 --> 00:27:15,110
without realizing it we started changing

669
00:27:20,740 --> 00:27:17,590
the atmosphere putting carbon dioxide

670
00:27:23,980 --> 00:27:20,750
emissions and causing what we're now

671
00:27:26,530 --> 00:27:23,990
realizing is a climate crisis completely

672
00:27:28,510 --> 00:27:26,540
unintentional when we started an

673
00:27:30,910 --> 00:27:28,520
unintended consequence another example

674
00:27:32,740 --> 00:27:30,920
of an unintended consequences the ozone

675
00:27:35,980 --> 00:27:32,750
hole which you've heard about in the

676
00:27:38,980 --> 00:27:35,990
1970s we realized that this this very

677
00:27:41,020 --> 00:27:38,990
crucial life-support system of our

678
00:27:42,910 --> 00:27:41,030
planet the the ozone layer up in the

679
00:27:44,310 --> 00:27:42,920
stratosphere was being affected by these

680
00:27:46,780 --> 00:27:44,320
chemicals these CFCs chlorofluorocarbons

681
00:27:48,790 --> 00:27:46,790
which we thought were perfectly safe and

682
00:27:50,800 --> 00:27:48,800
non-toxic because they are down here

683
00:27:52,540 --> 00:27:50,810
where we live in in the troposphere but

684
00:27:55,870 --> 00:27:52,550
when they drift up into the stratosphere

685
00:27:58,120 --> 00:27:55,880
they start interacting with under the

686
00:28:00,070 --> 00:27:58,130
influence of ultraviolet light with the

687
00:28:03,970 --> 00:28:00,080
oxygen compounds in destroying the ozone

688
00:28:05,620 --> 00:28:03,980

this was a real crisis but we responded

689
00:28:08,020 --> 00:28:05,630
to this crisis in an interesting way it

690
00:28:10,210 --> 00:28:08,030
definitely started off as an inadvertent

691
00:28:12,000 --> 00:28:10,220
accidental change but then something

692
00:28:14,710 --> 00:28:12,010
interesting happened there were global

693
00:28:16,990 --> 00:28:14,720
discussions arguments at first about

694
00:28:19,300 --> 00:28:17,000
this the scientists raised the alarm

695
00:28:20,440 --> 00:28:19,310
there was denial there you know people

696
00:28:22,900 --> 00:28:20,450
didn't want to deal with it but

697
00:28:25,240 --> 00:28:22,910
ultimately it became very clear that

698
00:28:27,730 --> 00:28:25,250
this was the truth this was happening

699
00:28:30,430 --> 00:28:27,740
and the truth won out in this case they

700
00:28:34,600 --> 00:28:30,440
were global agreements made at a

701
00:28:36,730 --> 00:28:34,610
Montreal Protocol as it was was the key

702
00:28:38,290 --> 00:28:36,740
one and and we changed our behavior the

703
00:28:40,800 --> 00:28:38,300
companies phased out those chemicals

704
00:28:44,020 --> 00:28:40,810
phased in new chemicals so that's a

705
00:28:46,540 --> 00:28:44,030
genuine example of an intentional global

706
00:28:48,250 --> 00:28:46,550
change in response to a problem it's a

707
00:28:51,400 --> 00:28:48,260
proof of concept it shows that we're

708
00:28:53,410 --> 00:28:51,410
capable of a another way of responding

709
00:28:55,210 --> 00:28:53,420
to global problems it doesn't mean that

710
00:28:57,250 --> 00:28:55,220
it's inevitable or easy but it shows

711
00:28:59,650 --> 00:28:57,260
it's possible so one way of looking at

712
00:29:01,570 --> 00:28:59,660
the challenge of now is that we have to

713
00:29:03,340 --> 00:29:01,580

shift our global influence more and more

714
00:29:05,470 --> 00:29:03,350
to the intentional side of things and

715
00:29:08,890 --> 00:29:05,480
away from the accidental inadvertent

716
00:29:10,810 --> 00:29:08,900
change changes we have become planet

717
00:29:12,490 --> 00:29:10,820
changers and I don't believe that we

718
00:29:14,860 --> 00:29:12,500
have the choice anymore to not be

719
00:29:17,470 --> 00:29:14,870
planted changers so our challenge is to

720
00:29:19,990 --> 00:29:17,480
learn how to do it well learn how to

721
00:29:22,390 --> 00:29:20,000
gracefully integrate our activities with

722
00:29:24,220 --> 00:29:22,400
the great natural cycles of the world

723
00:29:27,700 --> 00:29:24,230
and learn to be a constructive rather

724
00:29:31,180 --> 00:29:27,710
than a destructive force when we study

725
00:29:33,400 --> 00:29:31,190
the deep history of our species we learn

726
00:29:35,680 --> 00:29:33,410
that we've responded to existential

727
00:29:37,750 --> 00:29:35,690
threats before many times by reinventing

728
00:29:40,300 --> 00:29:37,760
ourselves and redefining our

729
00:29:43,030 --> 00:29:40,310
relationship with nature in response to

730
00:29:45,450 --> 00:29:43,040
climate threats this has happened before

731
00:29:47,950 --> 00:29:45,460
now we need to do do this again and

732
00:29:51,640 --> 00:29:47,960
after we get over our current climate

733
00:29:53,200 --> 00:29:51,650
vandalism and destruction of species we

734
00:29:56,440 --> 00:29:53,210
will have many opportunities to play a

735
00:29:58,900 --> 00:29:56,450
constructive role on the planet after we

736
00:30:01,630 --> 00:29:58,910
stop threatening a mass extinction we

737
00:30:03,700 --> 00:30:01,640
can prevent the next mass extinction we

738
00:30:05,950 --> 00:30:03,710

can stop that next dangerous asteroid

739
00:30:08,410 --> 00:30:05,960
that is heading our way and ultimately

740
00:30:10,120 --> 00:30:08,420
we can prevent the next ice age and

741
00:30:12,040 --> 00:30:10,130
other dangerous climate changes which on

742
00:30:14,770 --> 00:30:12,050
a long enough time scale will happen

743
00:30:16,720 --> 00:30:14,780
left to its own with the planet left to

744
00:30:19,030 --> 00:30:16,730
its own devices I think we're just

745
00:30:20,710 --> 00:30:19,040
getting started on this planet we are

746
00:30:22,870 --> 00:30:20,720
facing some huge challenges in the 21st

747
00:30:26,530 --> 00:30:22,880
century but remember there will be a

748
00:30:28,900 --> 00:30:26,540
22nd and a 23rd century we will soon

749
00:30:31,960 --> 00:30:28,910
have a stabilized global population and

750
00:30:33,970 --> 00:30:31,970
will soon be off of fossil fuels the

751
00:30:37,810 --> 00:30:33,980
transition is painfully slow right now

752
00:30:39,010 --> 00:30:37,820
but it is also inevitable and I think

753
00:30:40,960 --> 00:30:39,020
soon we'll be in the process of

754
00:30:43,570 --> 00:30:40,970
repairing the damage that we're doing

755
00:30:45,280 --> 00:30:43,580
now and that in the long run we can save

756
00:30:48,070 --> 00:30:45,290
many more species than we're currently

757
00:30:51,820 --> 00:30:48,080
threatening we've got a lot to learn

758
00:30:53,920 --> 00:30:51,830
about the planet and about ourselves but

759
00:30:56,500 --> 00:30:53,930
eventually we may be the best thing that

760
00:31:03,390 --> 00:30:56,510
ever happened to planet Earth thank you

761
00:31:05,920 --> 00:31:03,400
[Applause]

762
00:31:07,630 --> 00:31:05,930
well I told you we get more optimistic

763
00:31:12,520 --> 00:31:07,640

although I hope to bring us back at at

764
00:31:14,860 --> 00:31:12,530
some point well you can't help but

765
00:31:16,720 --> 00:31:14,870
notice that we segregated the panel and

766
00:31:19,180 --> 00:31:16,730
we didn't do it intentionally but I

767
00:31:23,080 --> 00:31:19,190
wanted to go from this side which is

768
00:31:26,800 --> 00:31:23,090
sort of the I call the vague side to

769
00:31:30,130 --> 00:31:26,810
this side with a can-do side and and I

770
00:31:32,770 --> 00:31:30,140
want to I want to introduce next Jane

771
00:31:36,670 --> 00:31:32,780
long who's going to talk about

772
00:31:39,100 --> 00:31:36,680
geoengineering and and Jane is an

773
00:31:41,070 --> 00:31:39,110
engineer and who did her PhD in at

774
00:31:43,030 --> 00:31:41,080
Berkeley in civil engineering and

775
00:31:45,030 --> 00:31:43,040
geotechnical engineering which I didn't

776
00:31:49,530 --> 00:31:45,040
know at the time was a was a field in

777
00:31:52,570 --> 00:31:49,540
hydrology and has moved primarily around

778
00:31:54,790 --> 00:31:52,580
well at Lawrence Berkeley Lab and then

779
00:31:56,440 --> 00:31:54,800
was being at University of Nevada at

780
00:31:58,510 --> 00:31:56,450
Reno and then went back to Lawrence

781
00:32:00,130 --> 00:31:58,520
Livermore National Laboratory which she

782
00:32:02,890 --> 00:32:00,140
worked on energy in the environment and

783
00:32:05,980 --> 00:32:02,900
now has retired from that so that she

784
00:32:08,530 --> 00:32:05,990
can do science and so she'll talk about

785
00:32:14,710 --> 00:32:08,540
geoengineering well I I just thought I

786
00:32:16,960 --> 00:32:14,720
forgot my hat thank for you

787
00:32:19,270 --> 00:32:16,970
so geotechnical engineering actually

788
00:32:21,760 --> 00:32:19,280

used to mean our geoengineering used to

789
00:32:23,440 --> 00:32:21,770
used to have the meaning of engineers

790
00:32:27,450 --> 00:32:23,450
who dealt with things at the surface of

791
00:32:30,490 --> 00:32:27,460
the earth so foundations and dams and

792
00:32:32,440 --> 00:32:30,500
reservoir engineering and whatnot but in

793
00:32:34,210 --> 00:32:32,450
the last decade or so people have begun

794
00:32:37,600 --> 00:32:34,220
to use that term to mean actually

795
00:32:39,970 --> 00:32:37,610
engineering or modifying because the

796
00:32:43,630 --> 00:32:39,980
concept of strict engineering of the

797
00:32:45,700 --> 00:32:43,640
climate is seems to be elusive but but

798
00:32:48,820 --> 00:32:45,710
intervening in some way in the climate

799
00:32:51,730 --> 00:32:48,830
and of course as you've been hearing a

800
00:32:55,570 --> 00:32:51,740
bit about our our problems on the earth

801
00:32:58,420 --> 00:32:55,580
I'd just like to give you a little bit

802
00:33:00,340 --> 00:32:58,430
more detailed context so that you you

803
00:33:04,180 --> 00:33:00,350
understand some of the motivation a

804
00:33:05,980 --> 00:33:04,190
little bit so Lawrence mentioned the

805
00:33:08,110 --> 00:33:05,990
persistence of carbon dioxide in the

806
00:33:10,630 --> 00:33:08,120
atmosphere for a thousand years how many

807
00:33:14,440 --> 00:33:10,640
people in the audience really understand

808
00:33:16,270 --> 00:33:14,450
that when we emit carbon dioxide into

809
00:33:17,740 --> 00:33:16,280
the atmosphere that we've bought that

810
00:33:19,390 --> 00:33:17,750
carbon dioxide it's going to be there

811
00:33:22,930 --> 00:33:19,400
for a thousand years how many people

812
00:33:25,090 --> 00:33:22,940
really got that so this is a really good

813
00:33:27,010 --> 00:33:25,100

audience I have to tell you usually if I

814
00:33:30,610 --> 00:33:27,020
ask for that I get about three hands

815
00:33:32,410 --> 00:33:30,620
even at graduate students at MIT this is

816
00:33:35,380 --> 00:33:32,420
probably the most important fact about

817
00:33:37,270 --> 00:33:35,390
climate change that that is difficult

818
00:33:38,980 --> 00:33:37,280
for people to understand if achill for

819
00:33:40,990 --> 00:33:38,990
the public to grasp this isn't like the

820
00:33:44,080 --> 00:33:41,000
pollution problems that we've had other

821
00:33:46,060 --> 00:33:44,090
places where if you put contamination

822
00:33:47,680 --> 00:33:46,070
into a river and then you stop doing it

823
00:33:49,540 --> 00:33:47,690
the river gets cleaned up and problem

824
00:33:50,920 --> 00:33:49,550
solved we're done you know but this

825
00:33:54,190 --> 00:33:50,930
isn't like that whatever

826
00:33:56,290 --> 00:33:54,200
until we stop emitting problems just

827
00:33:59,320 --> 00:33:56,300
going to get worse and so we have to go

828
00:34:03,040 --> 00:33:59,330
to zero really a relatively close to

829
00:34:07,150 --> 00:34:03,050
zero to stop the climate change forcing

830
00:34:09,930 --> 00:34:07,160
from increasing we emit now about 40

831
00:34:14,740 --> 00:34:09,940
Giga tons of carbon dioxide a year and

832
00:34:17,350 --> 00:34:14,750
that that that 40 tonnes that 40 Giga

833
00:34:19,030 --> 00:34:17,360
tons is going into the ocean about half

834
00:34:25,630 --> 00:34:19,040
of it and the other half staying in the

835
00:34:28,139 --> 00:34:25,640
atmosphere even if we eliminated the the

836
00:34:30,669 --> 00:34:28,149
extra carbon dioxide in the atmosphere

837
00:34:32,409 --> 00:34:30,679
instantaneously all the stuff we put in

838
00:34:34,090 --> 00:34:32,419

the ocean would come back out or half of

839
00:34:36,040 --> 00:34:34,100
it would come back out so we have a

840
00:34:37,960 --> 00:34:36,050
really difficult time bringing that

841
00:34:44,320 --> 00:34:37,970
atmospheric concentration back to a

842
00:34:50,470 --> 00:34:44,330
pre-industrial area at a range and if we

843
00:34:53,440 --> 00:34:50,480
for example needed to try to do that if

844
00:34:54,669 --> 00:34:53,450
we look at the the IPCC the

845
00:34:57,070 --> 00:34:54,679
International Panel on Climate Change

846
00:35:00,220 --> 00:34:57,080
model results of what is going to happen

847
00:35:02,620 --> 00:35:00,230
to climate for various mitigation

848
00:35:06,880 --> 00:35:02,630
scenarios if we follow the Paris

849
00:35:12,340 --> 00:35:06,890
agreements to say about 1930s re 2030

850
00:35:14,680 --> 00:35:12,350
and then at that point we started taking

851
00:35:17,800 --> 00:35:14,690
carbon dioxide out of the atmosphere we

852
00:35:19,630 --> 00:35:17,810
would have to take out about 10 Giga

853
00:35:21,380 --> 00:35:19,640
tons a year so we'd have to go to zero

854
00:35:23,660 --> 00:35:21,390
and then take

855
00:35:26,930 --> 00:35:23,670
out half as much as we've been putting

856
00:35:28,580 --> 00:35:26,940
in more or less every year in order

857
00:35:30,290 --> 00:35:28,590
sorry not quite half sorry about a

858
00:35:32,840 --> 00:35:30,300
quarter of what we've been putting in

859
00:35:36,920 --> 00:35:32,850
every year in order to have a 50% chance

860
00:35:40,790 --> 00:35:36,930
of staying below 2 degrees so it is it's

861
00:35:44,270 --> 00:35:40,800
really a huge lift that we face in

862
00:35:47,150 --> 00:35:44,280
correcting this huge perturbation that

863
00:35:49,520 --> 00:35:47,160

we've made to our atmosphere and that

864
00:35:51,740 --> 00:35:49,530
means that it's very likely that we're

865
00:35:53,810 --> 00:35:51,750
going to be experiencing some pretty

866
00:35:56,900 --> 00:35:53,820
major effects some large temperature

867
00:35:59,000 --> 00:35:56,910
changes and climate weirding if you like

868
00:36:01,040 --> 00:35:59,010
of what we see what we see

869
00:36:02,540 --> 00:36:01,050
so people have begun to think about what

870
00:36:05,690 --> 00:36:02,550
could you do about it

871
00:36:08,120 --> 00:36:05,700
human ingenuity and Genuity is pretty

872
00:36:09,650 --> 00:36:08,130
amazing and this is a field where only a

873
00:36:12,410 --> 00:36:09,660
few people have started to think about

874
00:36:14,810 --> 00:36:12,420
it it's very very important I think now

875
00:36:18,110 --> 00:36:14,820
for more people to think about how we

876
00:36:20,570 --> 00:36:18,120
might deal with this major perturbation

877
00:36:22,430 --> 00:36:20,580
so that we have a better chance for

878
00:36:24,890 --> 00:36:22,440
survival and that our children have a

879
00:36:29,320 --> 00:36:24,900
better chance and in my case I'm happy

880
00:36:31,580 --> 00:36:29,330
to say my grandchildren but the the the

881
00:36:35,270 --> 00:36:31,590
two kinds of things that people have

882
00:36:39,110 --> 00:36:35,280
thought about doing so far predominantly

883
00:36:41,540 --> 00:36:39,120
are one is to mimic volcanic eruptions

884
00:36:43,700 --> 00:36:41,550
which we know put sulphur dioxide into

885
00:36:45,620 --> 00:36:43,710
the stratosphere and have been shown to

886
00:36:48,110 --> 00:36:45,630
cool the earth for several degrees for a

887
00:36:50,780 --> 00:36:48,120
year so after the eruption so we know

888
00:36:52,790 --> 00:36:50,790

that if we could inject particles that

889
00:36:54,620 --> 00:36:52,800
would reflect radiation back into space

890
00:36:57,410 --> 00:36:54,630
that we could change the radiation

891
00:37:01,910 --> 00:36:57,420
balance of the earth and cool cool the

892
00:37:04,070 --> 00:37:01,920
planet and that has no effect on things

893
00:37:07,850 --> 00:37:04,080
like ocean acidification because that

894
00:37:12,890 --> 00:37:07,860
co2 is still in in the atmosphere so

895
00:37:16,700 --> 00:37:12,900
what it's doing is it's taking a some

896
00:37:19,790 --> 00:37:16,710
unknown or risky situation caused by our

897
00:37:23,090 --> 00:37:19,800
carbon dioxide emissions and adding on

898
00:37:25,010 --> 00:37:23,100
to that a perturbation that is different

899
00:37:27,320 --> 00:37:25,020
than removing the carbon dioxide it's

900
00:37:30,040 --> 00:37:27,330
changing the radiation balance so we

901
00:37:33,530 --> 00:37:30,050
would enter kind of an unknown state

902
00:37:35,120 --> 00:37:33,540
model results show that it would improve

903
00:37:37,820 --> 00:37:35,130
climate pretty much

904
00:37:39,980 --> 00:37:37,830
everywhere but our instinct tells us

905
00:37:41,750 --> 00:37:39,990
something might go wrong and usually

906
00:37:43,190 --> 00:37:41,760
when I'm giving a talk about this the

907
00:37:45,080 --> 00:37:43,200
microphone goes wrong are the

908
00:37:47,720 --> 00:37:45,090
temperatures too hot or you know and

909
00:37:49,430 --> 00:37:47,730
things like that and it's pretty clear

910
00:37:51,770 --> 00:37:49,440
that we have a very hard time

911
00:37:55,400 --> 00:37:51,780
controlling all unintended consequences

912
00:37:58,070 --> 00:37:55,410
of this so it really is going to be a

913
00:38:01,820 --> 00:37:58,080

very difficult decision to do something

914
00:38:03,860 --> 00:38:01,830
like this and what we what we know

915
00:38:05,660 --> 00:38:03,870
though if you think about it is we're

916
00:38:08,060 --> 00:38:05,670
not making a decision we would not be

917
00:38:10,820 --> 00:38:08,070
making a decision to reflect radiation

918
00:38:13,700 --> 00:38:10,830
in the situation that we're in right now

919
00:38:15,470 --> 00:38:13,710
where it isn't this situation it isn't

920
00:38:17,450 --> 00:38:15,480
this climate that we're experiencing now

921
00:38:19,910 --> 00:38:17,460
that we want to change it's going to be

922
00:38:22,670 --> 00:38:19,920
a risk risk decision the risk of doing

923
00:38:25,730 --> 00:38:22,680
nothing versus the risk of trying to

924
00:38:30,770 --> 00:38:25,740
change the radiation balance and that

925
00:38:32,780 --> 00:38:30,780
has that has a very different flavor to

926
00:38:35,000 --> 00:38:32,790
it and it is going to be a very new

927
00:38:38,890 --> 00:38:35,010
ground for people to try to understand

928
00:38:42,500 --> 00:38:38,900
that risk risk type decision we also

929
00:38:44,930 --> 00:38:42,510
know that once we do this if we ever

930
00:38:47,960 --> 00:38:44,940
stopped that the temperature would go

931
00:38:50,780 --> 00:38:47,970
back to the path that was on before we

932
00:38:53,600 --> 00:38:50,790
started reflecting radiation and make a

933
00:38:55,160 --> 00:38:53,610
very sudden increase in temperatures so

934
00:38:56,360 --> 00:38:55,170
we know that it's not something we want

935
00:38:58,040 --> 00:38:56,370
to do all the time

936
00:39:00,380 --> 00:38:58,050
forever and ever we don't want to have

937
00:39:01,850 --> 00:39:00,390
to commit to that and therefore the

938
00:39:04,430 --> 00:39:01,860

thing that we really need to think about

939
00:39:06,530 --> 00:39:04,440
is trying to figure out how to get that

940
00:39:08,710 --> 00:39:06,540
carbon dioxide out of the atmosphere as

941
00:39:11,030 --> 00:39:08,720
quickly as we can and put it somewhere

942
00:39:13,550 --> 00:39:11,040
those techniques are called carbon

943
00:39:16,970 --> 00:39:13,560
dioxide removal techniques and they are

944
00:39:20,240 --> 00:39:16,980
painfully slow very expensive and will

945
00:39:23,690 --> 00:39:20,250
be very very difficult so the idea that

946
00:39:25,700 --> 00:39:23,700
we would use a solar radiation

947
00:39:27,290 --> 00:39:25,710
management type technology for some

948
00:39:29,720 --> 00:39:27,300
period of time while we got our act

949
00:39:31,820 --> 00:39:29,730
together to figure out how to bring the

950
00:39:34,340 --> 00:39:31,830
atmosphere back to a safer situation is

951
00:39:37,700 --> 00:39:34,350
a one that people have only begun to

952
00:39:40,090 --> 00:39:37,710
think about the strategic use of these

953
00:39:42,890 --> 00:39:40,100
technologies to manage our climate is

954
00:39:45,320 --> 00:39:42,900
something that needs a lot more work and

955
00:39:47,680 --> 00:39:45,330
a lot more research and this kind of

956
00:39:49,050 --> 00:39:47,690
research needs to be done in a way that

957
00:39:50,220 --> 00:39:49,060
isn't the

958
00:39:52,720 --> 00:39:50,230
[Music]

959
00:39:54,430 --> 00:39:52,730
academia is currently configured to do

960
00:39:57,250 --> 00:39:54,440
research for example or even national

961
00:39:59,530 --> 00:39:57,260
labs anymore we this needs to be a kind

962
00:40:01,510 --> 00:39:59,540
of research program which is systematic

963
00:40:02,890 --> 00:40:01,520

research probably much more akin to the

964
00:40:05,319 --> 00:40:02,900
kinds of things that we're done at NASA

965
00:40:07,240 --> 00:40:05,329
for example in programmatic research

966
00:40:10,109 --> 00:40:07,250
where we think about what the whole

967
00:40:11,980 --> 00:40:10,119
system issue is and assign people to

968
00:40:14,740 --> 00:40:11,990
investigate the components of that

969
00:40:17,079 --> 00:40:14,750
system and how they interact this is not

970
00:40:19,690 --> 00:40:17,089
curiosity driven research this is going

971
00:40:22,060 --> 00:40:19,700
to have to be much more like engineering

972
00:40:25,240 --> 00:40:22,070
research and that hasn't happened yet

973
00:40:27,970 --> 00:40:25,250
either so I think these challenges to

974
00:40:31,030 --> 00:40:27,980
bring about what David has so eloquently

975
00:40:33,069 --> 00:40:31,040
described we do have a few babies

976
00:40:34,329 --> 00:40:33,079
looking at their hands and trying to

977
00:40:36,520 --> 00:40:34,339
figure out what they're doing with it

978
00:40:39,819 --> 00:40:36,530
but nowhere near enough people have

979
00:40:42,700 --> 00:40:39,829
looked at this and I think we're we need

980
00:40:44,200 --> 00:40:42,710
to engage people and how other things

981
00:40:47,500 --> 00:40:44,210
that I just want to say one other thing

982
00:40:50,470 --> 00:40:47,510
about this now stuff you know we have in

983
00:40:52,480 --> 00:40:50,480
the climate community a sense that we

984
00:40:53,980 --> 00:40:52,490
can't tell people how bad this problem

985
00:40:56,620 --> 00:40:53,990
is because they'll lose hope and they

986
00:40:58,839 --> 00:40:56,630
won't do anything I think that we've

987
00:41:01,630 --> 00:40:58,849
done exactly the opposite I think we

988
00:41:03,130 --> 00:41:01,640

have we have papered over how bad this

989
00:41:04,589 --> 00:41:03,140
is so people don't do anything because

990
00:41:08,589 --> 00:41:04,599
they don't think they need to and that

991
00:41:10,960 --> 00:41:08,599
is that is something I think we really

992
00:41:13,120 --> 00:41:10,970
need to start to be more honest and

993
00:41:15,280 --> 00:41:13,130
straightforward about how the magnitude

994
00:41:18,010 --> 00:41:15,290
of the problem we're facing as well as

995
00:41:18,910 --> 00:41:18,020
the magnitude of human ingenuity to do

996
00:41:27,520 --> 00:41:18,920
something about it

997
00:41:32,300 --> 00:41:30,500
Thank You Jane I next want to turn to my

998
00:41:33,890 --> 00:41:32,310
colleague at ASU Hilary Hartnett who's

999
00:41:36,170 --> 00:41:33,900
in the school of Earth and space

1000
00:41:37,550 --> 00:41:36,180
exploration which is the department's

1001
00:41:39,470 --> 00:41:37,560
I'm in as well as the school of

1002
00:41:43,430 --> 00:41:39,480
molecular sciences which in other places

1003
00:41:46,130 --> 00:41:43,440
they call chemistry and she's an

1004
00:41:47,720 --> 00:41:46,140
oceanographer and which is an example of

1005
00:41:50,840 --> 00:41:47,730
the kind of transdisciplinary approach

1006
00:41:53,480 --> 00:41:50,850
that is taken that it's done at ASU I'm

1007
00:41:54,830 --> 00:41:53,490
at one of its great strengths and and

1008
00:41:57,920 --> 00:41:54,840
she did her PhD at University of

1009
00:42:01,750 --> 00:41:57,930
Washington and and then was at Rutgers

1010
00:42:03,620 --> 00:42:01,760
and then came to su and she's a

1011
00:42:05,780 --> 00:42:03,630
biogeochemist which is an interesting

1012
00:42:07,480 --> 00:42:05,790
area and she says basically what that

1013
00:42:10,880 --> 00:42:07,490

means is that she is interested in

1014
00:42:12,500 --> 00:42:10,890
within carbon and water and and and

1015
00:42:14,540 --> 00:42:12,510
wherever you find them she's interested

1016
00:42:17,810 --> 00:42:14,550
in something and she's going to talk

1017
00:42:21,860 --> 00:42:17,820
about the role of universities in

1018
00:42:23,890 --> 00:42:21,870
training planetary managers Thank You

1019
00:42:29,420 --> 00:42:23,900
Lawrence

1020
00:42:31,760 --> 00:42:29,430
and like John I do have a few slides I'm

1021
00:42:34,220 --> 00:42:31,770
really happy to to be going last because

1022
00:42:36,530 --> 00:42:34,230
my fellow panelists have set me up

1023
00:42:40,700 --> 00:42:36,540
beautifully for this so what I'm going

1024
00:42:45,860 --> 00:42:40,710
to describe to you is a new initiative

1025
00:42:47,750 --> 00:42:45,870
at Arizona State where we we wish to

1026
00:42:51,950 --> 00:42:47,760
achieve nothing less than a thriving

1027
00:42:54,170 --> 00:42:51,960
Anthropocene we want to train the next

1028
00:42:57,200 --> 00:42:54,180
generation of planetary stewards or

1029
00:42:58,730 --> 00:42:57,210
managers and this program is called

1030
00:43:00,860 --> 00:42:58,740
planet works I'm the co-director of

1031
00:43:01,970 --> 00:43:00,870
planet works RL who introduced us this

1032
00:43:05,600 --> 00:43:01,980
evening is actually the other

1033
00:43:06,770 --> 00:43:05,610
co-director of planet works and planet

1034
00:43:08,810 --> 00:43:06,780
works with an initiative we think of

1035
00:43:11,870 --> 00:43:08,820
ourselves as a confederation of scholars

1036
00:43:14,000 --> 00:43:11,880
and centers and academic units currently

1037
00:43:16,550 --> 00:43:14,010
at ASU but soon to be beyond our

1038
00:43:19,490 --> 00:43:16,560

University and our goal is to reinvent

1039
00:43:23,090 --> 00:43:19,500
our relationship with planet Earth as we

1040
00:43:25,610 --> 00:43:23,100
enter the Anthropocene and to do that we

1041
00:43:27,410 --> 00:43:25,620
take a systems approach we need to

1042
00:43:30,050 --> 00:43:27,420
understand the past present and future

1043
00:43:33,710 --> 00:43:30,060
of our earth there's a geosciences

1044
00:43:36,080 --> 00:43:33,720
component to that we recognize and begin

1045
00:43:38,790 --> 00:43:36,090
from the premise that humanity is an

1046
00:43:40,230 --> 00:43:38,800
integral part of the Earth System you

1047
00:43:41,970 --> 00:43:40,240
can't think about the earth anymore

1048
00:43:44,730 --> 00:43:41,980
without thinking about how humans

1049
00:43:46,920 --> 00:43:44,740
interact with the planet whether that's

1050
00:43:49,230 --> 00:43:46,930
things we build at the surface like we

1051
00:43:52,470 --> 00:43:49,240
saw in John's pictures or whether that's

1052
00:43:56,070 --> 00:43:52,480
how we change our atmosphere or think

1053
00:43:59,700 --> 00:43:56,080
about changing our atmosphere again the

1054
00:44:03,060 --> 00:43:59,710
Anthropocene is not it's not a problem

1055
00:44:06,270 --> 00:44:03,070
it's not a thing that we can undo it's

1056
00:44:11,220 --> 00:44:06,280
an irreversible evolutionary transition

1057
00:44:12,870 --> 00:44:11,230
in our world right we have entered the

1058
00:44:15,030 --> 00:44:12,880
Anthropocene it is up to us to decide

1059
00:44:19,050 --> 00:44:15,040
what that Africa scene is going to look

1060
00:44:20,670 --> 00:44:19,060
like and the last sort of focus that we

1061
00:44:24,270 --> 00:44:20,680
take in planet works is this idea that

1062
00:44:27,240 --> 00:44:24,280
earth is an intelligently managed design

1063
00:44:29,580 --> 00:44:27,250

space we have this ingenuity that Jane

1064
00:44:32,160 --> 00:44:29,590
talked about we can make conscious

1065
00:44:36,150 --> 00:44:32,170
decisions about what we want our planet

1066
00:44:39,270 --> 00:44:36,160
to look like so we catalyze research

1067
00:44:41,130 --> 00:44:39,280
programs we have a strong element of

1068
00:44:43,500 --> 00:44:41,140
Education in what we do we are

1069
00:44:44,670 --> 00:44:43,510
interested in policy and advocacy and

1070
00:44:48,390 --> 00:44:44,680
those are words that are kind of unusual

1071
00:44:51,390 --> 00:44:48,400
coming from a research scientist but the

1072
00:44:53,580 --> 00:44:51,400
the planet works team is really sure

1073
00:44:56,070 --> 00:44:53,590
that we have to be part of this process

1074
00:44:57,480 --> 00:44:56,080
we can't just sit back and study it and

1075
00:45:01,080 --> 00:44:57,490
write papers about it we have to then

1076
00:45:03,240 --> 00:45:01,090
also put it out there help people to

1077
00:45:05,960 --> 00:45:03,250
think about it build the conversation

1078
00:45:08,490 --> 00:45:05,970
about what the Anthropocene can be like

1079
00:45:13,350 --> 00:45:08,500
so how do we do all this this is this is

1080
00:45:16,040 --> 00:45:13,360
pre grand idea right so we have a sort

1081
00:45:18,450 --> 00:45:16,050
of four aspects of what we think about

1082
00:45:21,150 --> 00:45:18,460
one of them is what we call our Earth's

1083
00:45:23,190 --> 00:45:21,160
intervention collaboratory it's a

1084
00:45:25,860 --> 00:45:23,200
research and development concept where

1085
00:45:28,260 --> 00:45:25,870
we work in teams of scientists and

1086
00:45:31,710 --> 00:45:28,270
engineers and also social scientists and

1087
00:45:34,890 --> 00:45:31,720
people who study law to develop ideas

1088
00:45:36,690 --> 00:45:34,900

about how could we intervene in the

1089
00:45:39,270 --> 00:45:36,700
Earth's climate system right now and I'm

1090
00:45:40,650 --> 00:45:39,280
going to talk about that again another

1091
00:45:41,880 --> 00:45:40,660
element of what we taught what we're

1092
00:45:45,060 --> 00:45:41,890
thinking about is something we call the

1093
00:45:47,400 --> 00:45:45,070
stewardship studio a place literally

1094
00:45:50,070 --> 00:45:47,410
where people can come to learn how to

1095
00:45:52,320 --> 00:45:50,080
think in the system's way to help build

1096
00:45:54,180 --> 00:45:52,330
ideas and think about scenarios

1097
00:45:57,360 --> 00:45:54,190
from what planetary stewardship could

1098
00:46:01,710 --> 00:45:57,370
look like we have a strong education

1099
00:46:03,420 --> 00:46:01,720
component which currently is local

1100
00:46:06,480 --> 00:46:03,430
education in Arizona State but which we

1101
00:46:10,370 --> 00:46:06,490
envision could be mass education taking

1102
00:46:16,980 --> 00:46:13,110
capabilities to take this message very

1103
00:46:20,370 --> 00:46:16,990
very wide and ultimately all of these

1104
00:46:22,380 --> 00:46:20,380
pieces linked to better integrated

1105
00:46:25,680 --> 00:46:22,390
models was how the Earth's system has

1106
00:46:31,380 --> 00:46:25,690
evolved and will evolve and so you can

1107
00:46:33,330 --> 00:46:31,390
see that this is a very much a I'll call

1108
00:46:35,460 --> 00:46:33,340
it a mission driven kind of approach we

1109
00:46:37,980 --> 00:46:35,470
know what we want we want a thriving

1110
00:46:40,380 --> 00:46:37,990
Anthropocene there's basic research that

1111
00:46:42,240 --> 00:46:40,390
goes with this there's applied research

1112
00:46:45,210 --> 00:46:42,250
that goes with this there's learning how

1113
00:46:46,350 --> 00:46:45,220

to talk about this so now I'm going to

1114
00:46:49,860 --> 00:46:46,360
switch gears and I'm going to give you

1115
00:46:52,830 --> 00:46:49,870
an example that that mostly falls into

1116
00:46:55,110 --> 00:46:52,840
the the idea of the earth intervention

1117
00:46:57,720 --> 00:46:55,120
collaboratory but I'm going to put it

1118
00:47:01,710 --> 00:46:57,730
into an educational spin because it

1119
00:47:09,570 --> 00:47:01,720
really did evolve out of it evolved out

1120
00:47:14,850 --> 00:47:09,580
of a class so this is an image of the

1121
00:47:18,450 --> 00:47:14,860
Arctic and here's Greenland North

1122
00:47:21,270 --> 00:47:18,460
America the Russian far north and the

1123
00:47:25,110 --> 00:47:21,280
white that you see is the sea ice

1124
00:47:27,150 --> 00:47:25,120
coverage in September of 2012 this is

1125
00:47:30,330 --> 00:47:27,160
measured with a with a satellite these

1126
00:47:31,470 --> 00:47:30,340
microwave radiation and I don't know how

1127
00:47:34,920 --> 00:47:31,480
well you can see it though there's a

1128
00:47:38,940 --> 00:47:34,930
black line kind of here that black line

1129
00:47:42,630 --> 00:47:38,950
is the average summer time September ice

1130
00:47:44,250 --> 00:47:42,640
extent for the period of 1979 to 2000 so

1131
00:47:47,010 --> 00:47:44,260
the latter part of the 20th century and

1132
00:47:50,130 --> 00:47:47,020
the key thing is that that white that

1133
00:47:52,620 --> 00:47:50,140
you see for September 2012 there's much

1134
00:47:54,930 --> 00:47:52,630
less ice than there ever has been in the

1135
00:47:57,660 --> 00:47:54,940
past and 2012 is a particularly bad year

1136
00:48:00,180 --> 00:47:57,670
but it turns out 2016 is a pretty bad

1137
00:48:00,960 --> 00:48:00,190
year - 2017 is shaping up to be about

1138
00:48:02,850 --> 00:48:00,970

the same

1139
00:48:04,410 --> 00:48:02,860
we have lost your tremendous amount of

1140
00:48:06,960 --> 00:48:04,420
summertime ice

1141
00:48:09,210 --> 00:48:06,970
the Arctic and this ice is important

1142
00:48:10,620 --> 00:48:09,220
because it's white right it's reflective

1143
00:48:13,580 --> 00:48:10,630
and this gets to this idea of the

1144
00:48:16,920 --> 00:48:13,590
radiative budget of the planet our

1145
00:48:18,900 --> 00:48:16,930
climate is carefully balanced between

1146
00:48:20,850 --> 00:48:18,910
how much light comes in how much light

1147
00:48:23,460 --> 00:48:20,860
is reflected back to space due to white

1148
00:48:25,560 --> 00:48:23,470
things like the Arctic sea ice and some

1149
00:48:27,870 --> 00:48:25,570
of that energy which is absorbed by the

1150
00:48:29,580 --> 00:48:27,880
planet and re-radiated and then absorbed

1151
00:48:32,130 --> 00:48:29,590
again by the greenhouse gases that's the

1152
00:48:35,580 --> 00:48:32,140
delicate balance if we lose ice in the

1153
00:48:37,260 --> 00:48:35,590
Arctic the seawater that's revealed it's

1154
00:48:39,570 --> 00:48:37,270
reflect it's not reflected it's black

1155
00:48:42,960 --> 00:48:39,580
and so that's a fundamental change to

1156
00:48:45,090 --> 00:48:42,970
the way the earth absorbs energy so my

1157
00:48:47,480 --> 00:48:45,100
colleague Steve desh who is also the

1158
00:48:49,590 --> 00:48:47,490
chair of the astrobiology conference

1159
00:48:52,200 --> 00:48:49,600
came back from a conference a few years

1160
00:48:55,320 --> 00:48:52,210
ago and he was all he was all head up

1161
00:48:57,750 --> 00:48:55,330
about this problem of climate change and

1162
00:48:59,250 --> 00:48:57,760
sea ice and fundamentally kind of

1163
00:49:05,040 --> 00:48:59,260

stomped around whining away nobody was

1164
00:49:07,320 --> 00:49:05,050
doing anything about this that's fair so

1165
00:49:09,600 --> 00:49:07,330
being academics we decided to teach a

1166
00:49:13,590 --> 00:49:09,610
class basically to talk about this idea

1167
00:49:15,120 --> 00:49:13,600
and so we had seminar class it had

1168
00:49:18,570 --> 00:49:15,130
graduate students had had undergraduates

1169
00:49:21,300 --> 00:49:18,580
it had a couple of faculty and we put

1170
00:49:23,130 --> 00:49:21,310
together some some good minds to think

1171
00:49:25,530 --> 00:49:23,140
about what can we do about ice in the

1172
00:49:27,750 --> 00:49:25,540
Arctic and it manifested itself last

1173
00:49:29,370 --> 00:49:27,760
year in a paper in a journal called

1174
00:49:31,680 --> 00:49:29,380
Earth's future which is published by the

1175
00:49:34,860 --> 00:49:31,690
American Geophysical Union called Arctic

1176
00:49:37,200 --> 00:49:34,870
ice management we've basically put

1177
00:49:38,700 --> 00:49:37,210
together an idea for an actual

1178
00:49:41,670 --> 00:49:38,710
engineering solution that you could

1179
00:49:45,000 --> 00:49:41,680
apply that will help rebuild ice in the

1180
00:49:47,280 --> 00:49:45,010
Arctic in the winter so this data the

1181
00:49:49,410 --> 00:49:47,290
key thing to note is this red line which

1182
00:49:52,710 --> 00:49:49,420
is summertime ice it's been decreasing

1183
00:49:54,180 --> 00:49:52,720
steadily since the 1980s and there are

1184
00:49:59,880 --> 00:49:54,190
predictions that summertime sea ice

1185
00:50:02,310 --> 00:49:59,890
could be gone by 2030 2030 that snot

1186
00:50:04,110 --> 00:50:02,320
that far away we can all think about

1187
00:50:08,010 --> 00:50:04,120
what 2030 might be like it's harder to

1188
00:50:09,920 --> 00:50:08,020

think about 2100 and we're losing sea

1189
00:50:12,840 --> 00:50:09,930
ice because the temperatures are warmer

1190
00:50:15,630 --> 00:50:12,850
so the basic premise behind the ice

1191
00:50:17,430 --> 00:50:15,640
management is that can we take advantage

1192
00:50:18,270 --> 00:50:17,440
of the fact that it's still cold in the

1193
00:50:22,500 --> 00:50:18,280
Arctic in the winter

1194
00:50:25,110 --> 00:50:22,510
can we enhance ice formation it turns

1195
00:50:27,780 --> 00:50:25,120
out ice freezes at the bottom of the sea

1196
00:50:29,580 --> 00:50:27,790
ice and then the heat of fusion has to

1197
00:50:31,290 --> 00:50:29,590
conduct through the ice and that limits

1198
00:50:33,960 --> 00:50:31,300
how thick the ice can grow essentially

1199
00:50:36,990 --> 00:50:33,970
it insulates itself if you could pump

1200
00:50:39,570 --> 00:50:37,000
seawater and here's a very artist's

1201
00:50:41,610 --> 00:50:39,580
rendition of our idea if you could pump

1202
00:50:43,440 --> 00:50:41,620
seawater from below the ice up to the

1203
00:50:47,280 --> 00:50:43,450
top of the ice we have a wind-powered

1204
00:50:49,230 --> 00:50:47,290
pump then you freeze ice at the minus 40

1205
00:50:52,440 --> 00:50:49,240
degrees of the Arctic water temperature

1206
00:50:55,200 --> 00:50:52,450
and our calculation suggested we can

1207
00:50:57,960 --> 00:50:55,210
freeze about almost another extra meter

1208
00:51:00,360 --> 00:50:57,970
of ice each winter if we have enough of

1209
00:51:02,030 --> 00:51:00,370
these pumps this is a very different

1210
00:51:05,610 --> 00:51:02,040
approach to thinking about

1211
00:51:08,570 --> 00:51:05,620
geoengineering this isn't in any of the

1212
00:51:11,130 --> 00:51:08,580
National Academy reports on

1213
00:51:13,860 --> 00:51:11,140

geoengineering techniques we've gotten

1214
00:51:15,990 --> 00:51:13,870
lots of press from all over the place

1215
00:51:18,440 --> 00:51:16,000
about this and most people are like no

1216
00:51:20,280 --> 00:51:18,450
one's ever talked about this before so

1217
00:51:22,680 --> 00:51:20,290
this is a plan it works

1218
00:51:24,420 --> 00:51:22,690
pilot project if you will which is a

1219
00:51:28,050 --> 00:51:24,430
very novel way to think about an

1220
00:51:30,180 --> 00:51:28,060
engineering solution for its climate now

1221
00:51:32,520 --> 00:51:30,190
it is an AI it is an albedo modification

1222
00:51:36,060 --> 00:51:32,530
it says it's a it's a band-aid that will

1223
00:51:37,830 --> 00:51:36,070
help keep the radiative transfer budget

1224
00:51:40,070 --> 00:51:37,840
from changing it's not going to fix the

1225
00:51:42,870 --> 00:51:40,080
co2 problem but it might prevent warming

1226
00:51:45,530 --> 00:51:42,880
because when the ice melts you get a

1227
00:51:47,580 --> 00:51:45,540
positive feedback that warms the planet

1228
00:51:49,350 --> 00:51:47,590
so we're in the process of thinking

1229
00:51:51,720 --> 00:51:49,360
about what do we had we do this what do

1230
00:51:55,070 --> 00:51:51,730
we do next we did some calculations and

1231
00:51:58,470 --> 00:51:55,080
we wrote a paper the next steps are

1232
00:52:00,450 --> 00:51:58,480
myriad we need to test a prototype we

1233
00:52:02,700 --> 00:52:00,460
need to build a prototype we need to

1234
00:52:05,840 --> 00:52:02,710
train students to think about this both

1235
00:52:08,160 --> 00:52:05,850
the engineering side of it and the

1236
00:52:11,040 --> 00:52:08,170
political and social and ethical

1237
00:52:13,020 --> 00:52:11,050
consequences of such an activity we need

1238
00:52:14,550 --> 00:52:13,030

to have better models of what impact

1239
00:52:16,080 --> 00:52:14,560
this will have on the ice and these all

1240
00:52:18,090 --> 00:52:16,090
fit into the different aspects what

1241
00:52:20,220 --> 00:52:18,100
planet works is about but I think the

1242
00:52:22,320 --> 00:52:20,230
really important thing that we need to

1243
00:52:24,750 --> 00:52:22,330
do so we need to widen the dialogue

1244
00:52:27,690 --> 00:52:24,760
about what geoengineering can look like

1245
00:52:31,170 --> 00:52:27,700
and how we can begin to think

1246
00:52:35,130 --> 00:52:31,180
differently about solutions to

1247
00:52:37,849 --> 00:52:35,140
in this case a climate problem the loss

1248
00:52:49,309 --> 00:52:42,900
so with that okay thank you

1249
00:52:54,299 --> 00:52:51,960
well we moved from the pessimistic to

1250
00:52:56,489 --> 00:52:54,309
the optimistic to the to the can do and

1251
00:52:57,809 --> 00:52:56,499
I want I want to I want to cover all

1252
00:52:59,460 --> 00:52:57,819
those topics a little bit and have a

1253
00:53:01,529 --> 00:52:59,470
little discussion here and then we'll

1254
00:53:05,009 --> 00:53:01,539
open it up to all of you to be able to

1255
00:53:06,599 --> 00:53:05,019
ask questions and and in this case you

1256
00:53:08,460 --> 00:53:06,609
get to ask them in real time unlike many

1257
00:53:10,739 --> 00:53:08,470
of our origins events and what we have

1258
00:53:12,059 --> 00:53:10,749
microphones set up for you but I want to

1259
00:53:17,460 --> 00:53:12,069
ask each of the panelists the questions

1260
00:53:18,930 --> 00:53:17,470
an or two based on what they said and

1261
00:53:21,870 --> 00:53:18,940
then and that may lead to a discussion

1262
00:53:23,819 --> 00:53:21,880
not I want to just make sure we give you

1263
00:53:24,230 --> 00:53:23,829

all time but John I want to start with

1264
00:53:31,890 --> 00:53:24,240
you

1265
00:53:33,180 --> 00:53:31,900
from what what was the range of periods

1266
00:53:36,059 --> 00:53:33,190
from the time you first looked down at

1267
00:53:39,930 --> 00:53:36,069
the earth to the time you lasted so my

1268
00:53:42,029 --> 00:53:39,940
first flight was in 1995 so that's quite

1269
00:53:44,819 --> 00:53:42,039
a long ways from the very first you know

1270
00:53:50,819 --> 00:53:44,829
Gemini you know Apollo astronauts but

1271
00:53:52,739 --> 00:53:50,829
1995 I dental in 1997 1999 2002 so I had

1272
00:53:54,210 --> 00:53:52,749
a pretty good gig going yeah and then we

1273
00:53:58,829 --> 00:53:54,220
lost Columbia so there was then a long

1274
00:54:01,859 --> 00:53:58,839
span 2009 was my last flight okay so 14

1275
00:54:04,769 --> 00:54:01,869
years basically over and and you you did

1276
00:54:06,029 --> 00:54:04,779
see changes what was it and you talk

1277
00:54:07,710 --> 00:54:06,039
about them but I'm wondering what was

1278
00:54:09,450 --> 00:54:07,720
the most jarring change if you can think

1279
00:54:11,579 --> 00:54:09,460
about the thing that really surprised

1280
00:54:13,470 --> 00:54:11,589
you probably a lot of it was was

1281
00:54:15,509 --> 00:54:13,480
expected was there anything that you saw

1282
00:54:18,210 --> 00:54:15,519
from space that you hadn't expected and

1283
00:54:19,680 --> 00:54:18,220
and sort of made you step back and think

1284
00:54:22,859 --> 00:54:19,690
about the situation that we're in right

1285
00:54:23,999 --> 00:54:22,869
now anything well first of all most of

1286
00:54:26,809 --> 00:54:24,009
the time I was concerned about the

1287
00:54:28,710 --> 00:54:26,819
Hubble Space Telescope I'm in on it and

1288
00:54:30,509 --> 00:54:28,720

you know maybe not in the way you think

1289
00:54:32,910 --> 00:54:30,519
it's you know it's don't break the

1290
00:54:35,020 --> 00:54:32,920
Hubble yeah thunders then I shouldn't

1291
00:54:38,040 --> 00:54:35,030
come back yeah yeah

1292
00:54:40,750 --> 00:54:38,050
or at least I'd be in exile in Bolivia

1293
00:54:42,280 --> 00:54:40,760
but there is one thing that I definitely

1294
00:54:44,320 --> 00:54:42,290
noticed I mean though that there were

1295
00:54:46,000 --> 00:54:44,330
the structural changes that you've heard

1296
00:54:50,160 --> 00:54:46,010
and I mentioned like NASA and there were

1297
00:54:53,770 --> 00:54:50,170
lots of things cities growing new roads

1298
00:54:56,860 --> 00:54:53,780
those islands and in the Red Sea but the

1299
00:54:58,270 --> 00:54:56,870
one thing I did notice is that and it's

1300
00:54:59,890 --> 00:54:58,280
somewhat seasonal but I flew enough

1301
00:55:03,070 --> 00:54:59,900
different times the atmosphere has

1302
00:55:05,170 --> 00:55:03,080
gotten a lot more dusty on my first

1303
00:55:07,510 --> 00:55:05,180
flight you know what's pretty clear and

1304
00:55:10,050 --> 00:55:07,520
by 2009 you know there really were no

1305
00:55:12,880 --> 00:55:10,060
places that didn't have kind of a haze

1306
00:55:14,320 --> 00:55:12,890
and looking through the atmosphere the

1307
00:55:15,430 --> 00:55:14,330
sunsets were a little more dynamic and

1308
00:55:17,650 --> 00:55:15,440
you could actually see that in the

1309
00:55:19,960 --> 00:55:17,660
scattered light but and that's something

1310
00:55:21,190 --> 00:55:19,970
that's been described by you know a lot

1311
00:55:23,740 --> 00:55:21,200
of astronauts who have flown over

1312
00:55:26,980 --> 00:55:23,750
different time periods and talking to

1313
00:55:28,840 --> 00:55:26,990

those Apollo astronauts you know they

1314
00:55:30,790 --> 00:55:28,850
talked about a really clear atmosphere

1315
00:55:32,680 --> 00:55:30,800
and being able to see a lot further than

1316
00:55:34,900 --> 00:55:32,690
we could and that stuff that's not the

1317
00:55:37,440 --> 00:55:34,910
kind of Los Angeles age you see that's

1318
00:55:40,510 --> 00:55:37,450
literally dust due to drought or or or

1319
00:55:44,950 --> 00:55:40,520
some combination of factors a lot of it

1320
00:55:48,910 --> 00:55:44,960
is human-made aerosols particularly from

1321
00:55:50,950 --> 00:55:48,920
coal powered electricity plants and some

1322
00:55:53,860 --> 00:55:50,960
of it is dust lofted for instance from

1323
00:55:57,700 --> 00:55:53,870
the Sahara and sub-saharan Africa due to

1324
00:55:59,110 --> 00:55:57,710
the drought okay you know last thing I

1325
00:56:02,310 --> 00:55:59,120
want to ask in and you hit it on it you

1326
00:56:05,110 --> 00:56:02,320
talk about aerosols from coal powered

1327
00:56:07,210 --> 00:56:05,120
coal-fired power plants which is you

1328
00:56:10,390 --> 00:56:07,220
know is something that the current

1329
00:56:14,430 --> 00:56:10,400
administration is keen to keep pushing

1330
00:56:17,260 --> 00:56:14,440
and make worse in their effort to to UM

1331
00:56:22,510 --> 00:56:17,270
to try and make sure that the job that

1332
00:56:25,390 --> 00:56:22,520
you talked about is harder but at the

1333
00:56:27,190 --> 00:56:25,400
same time they're also keen to to stop

1334
00:56:28,500 --> 00:56:27,200
studying the Earth from space although

1335
00:56:31,780 --> 00:56:28,510
you were looking at the Space Telescope

1336
00:56:35,470 --> 00:56:31,790
or the Hubble Space Telescope there many

1337
00:56:37,720 --> 00:56:35,480
NASA satellites that in fact NASA is one

1338
00:56:39,430 --> 00:56:37,730

of the prime places to look down on

1339
00:56:41,230 --> 00:56:39,440
Earth and I want to wonder if you want

1340
00:56:43,570 --> 00:56:41,240
to just talk about the challenge of

1341
00:56:44,800 --> 00:56:43,580
studying the earth so we can as part of

1342
00:56:46,660 --> 00:56:44,810
what was talked about in order to be

1343
00:56:48,069 --> 00:56:46,670
able to deal with it and to proceed we

1344
00:56:48,939 --> 00:56:48,079
have to know what's happening

1345
00:56:50,319 --> 00:56:48,949
and you know what's happening we

1346
00:56:51,519 --> 00:56:50,329
generally have to look from space so I

1347
00:56:53,829 --> 00:56:51,529
thought you might want and that's really

1348
00:56:55,900 --> 00:56:53,839
the important point we can try and

1349
00:56:59,439 --> 00:56:55,910
measure the temperature of the surface

1350
00:57:01,269 --> 00:56:59,449
of the earth and co2 at a few sites

1351
00:57:02,919 --> 00:57:01,279
around the earth and then make some you

1352
00:57:05,319 --> 00:57:02,929
know guess about what happens everywhere

1353
00:57:07,269 --> 00:57:05,329
else but if most of the earth is covered

1354
00:57:09,999 --> 00:57:07,279
by oceans well we can put a few buoys

1355
00:57:12,219 --> 00:57:10,009
out and if you do that there's very

1356
00:57:13,989 --> 00:57:12,229
large uncertainties in what's really

1357
00:57:16,419 --> 00:57:13,999
going on on planet earth and so

1358
00:57:18,039 --> 00:57:16,429
fortunately those little streaks that

1359
00:57:19,390 --> 00:57:18,049
David grin food talked about you know

1360
00:57:21,279 --> 00:57:19,400
those Rockets lunch and a lot of those

1361
00:57:23,079 --> 00:57:21,289
are earth observation satellites and

1362
00:57:25,689 --> 00:57:23,089
some of them are satellites that are

1363
00:57:27,939 --> 00:57:25,699

used to observe the Earth's for our

1364
00:57:30,729 --> 00:57:27,949
daily weather forecast and that's a very

1365
00:57:32,529 --> 00:57:30,739
practical use but over time you know

1366
00:57:34,630 --> 00:57:32,539
they're also very useful to look for

1367
00:57:37,120 --> 00:57:34,640
these other changes and NASA

1368
00:57:38,919 --> 00:57:37,130
specifically launches satellites to look

1369
00:57:41,859 --> 00:57:38,929
at aerosols in the atmosphere to measure

1370
00:57:44,859 --> 00:57:41,869
the sea surface height to measure the

1371
00:57:47,799 --> 00:57:44,869
ice height and thickness to measure co2

1372
00:57:50,499 --> 00:57:47,809
content and that gives you you know a

1373
00:57:52,689 --> 00:57:50,509
view of the whole earth now maybe not

1374
00:57:54,009 --> 00:57:52,699
the pinpoint detail but it allows you to

1375
00:57:55,870 --> 00:57:54,019
actually to measure the properties of

1376
00:57:57,549 --> 00:57:55,880
the earth as a system which is extremely

1377
00:58:00,099 --> 00:57:57,559
important so that we can take our

1378
00:58:01,479 --> 00:58:00,109
climate models and understand you know

1379
00:58:03,130 --> 00:58:01,489
run them to see if we actually

1380
00:58:05,469 --> 00:58:03,140
understand how the earth does work and

1381
00:58:08,259 --> 00:58:05,479
there's two good functions one of which

1382
00:58:10,299 --> 00:58:08,269
is if you want our senior

1383
00:58:13,390 --> 00:58:10,309
decision-makers say the President of the

1384
00:58:16,299 --> 00:58:13,400
United States to make wise decisions he

1385
00:58:19,299 --> 00:58:16,309
has to have good data he or she in this

1386
00:58:23,380 --> 00:58:19,309
case he and this case it but anyway go

1387
00:58:25,509 --> 00:58:23,390
on okay sorry : I couldn't and without

1388
00:58:27,339 --> 00:58:25,519

without that good data you don't make

1389
00:58:29,529 --> 00:58:27,349
good decisions now that assumes that we

1390
00:58:33,189 --> 00:58:29,539
have a rational decision-making process

1391
00:58:34,630 --> 00:58:33,199
now kids data-driven so it's very

1392
00:58:36,910 --> 00:58:34,640
important that we get that data and the

1393
00:58:38,739 --> 00:58:36,920
challenge is you can't take the data for

1394
00:58:39,819 --> 00:58:38,749
five years and then say okay we've got

1395
00:58:41,739 --> 00:58:39,829
the data we'll go off and write a bunch

1396
00:58:43,359 --> 00:58:41,749
of scientific papers and let the

1397
00:58:45,489 --> 00:58:43,369
satellites spiral into the atmosphere

1398
00:58:47,229 --> 00:58:45,499
you know you need data records that are

1399
00:58:48,880 --> 00:58:47,239
not only decades long but eventually

1400
00:58:50,890 --> 00:58:48,890
we're going to need century long data

1401
00:58:53,650 --> 00:58:50,900
records that are you know we've only had

1402
00:58:55,209 --> 00:58:53,660
bass program for 50 years so so it's

1403
00:58:57,429 --> 00:58:55,219
critical that we have those measurements

1404
00:59:00,039 --> 00:58:57,439
now the good news is that even the

1405
00:59:01,280 --> 00:59:00,049
biggest climate skeptics in climate

1406
00:59:03,740 --> 00:59:01,290
change skeptics human

1407
00:59:06,770 --> 00:59:03,750
climate change skeptics in the Congress

1408
00:59:08,150 --> 00:59:06,780
all agree that they want the data they

1409
00:59:10,580 --> 00:59:08,160
just don't want scientists telling them

1410
00:59:13,220 --> 00:59:10,590
what to do about it okay but well

1411
00:59:15,080 --> 00:59:13,230
actually let me let me put on my let me

1412
00:59:16,940 --> 00:59:15,090
keep my this hat on but put on my

1413
00:59:18,770 --> 00:59:16,950

optimistic cat for a moment or at least

1414
00:59:20,120 --> 00:59:18,780
you're optimistic at because I was

1415
00:59:23,090 --> 00:59:20,130
bemoaning the fact that in the budget

1416
00:59:25,880 --> 00:59:23,100
that's been proposed there's a larger a

1417
00:59:28,520 --> 00:59:25,890
lot of talk about cutting the the NASA

1418
00:59:30,230 --> 00:59:28,530
earth monitoring satellites and you

1419
00:59:33,530 --> 00:59:30,240
point out to me that many of them are

1420
00:59:35,480 --> 00:59:33,540
already existing or and and don't cost

1421
00:59:36,890 --> 00:59:35,490
anything and and probably you therefore

1422
00:59:38,210 --> 00:59:36,900
won't be cut so maybe you can make

1423
00:59:40,130 --> 00:59:38,220
people feel better for a moment if you

1424
00:59:42,890 --> 00:59:40,140
just talk about that for a second yeah

1425
00:59:46,640 --> 00:59:42,900
well first of all the the the good news

1426
00:59:49,370 --> 00:59:46,650
is that a number of different federal

1427
00:59:50,930 --> 00:59:49,380
agencies study the earth and there's

1428
00:59:51,740 --> 00:59:50,940
some obvious ones Department of Interior

1429
00:59:53,540 --> 00:59:51,750
yes

1430
00:59:55,490 --> 00:59:53,550
Department of Agriculture progress

1431
00:59:57,920 --> 00:59:55,500
reasons agriculture that's our food

1432
00:59:59,750 --> 00:59:57,930
source so that's important and in order

1433
01:00:01,370 --> 00:59:59,760
to have a study food source they have to

1434
01:00:03,830 --> 01:00:01,380
understand crop health and other things

1435
01:00:06,440 --> 01:00:03,840
which the US Geological Survey operates

1436
01:00:09,050 --> 01:00:06,450
the Landsat satellites which tell us

1437
01:00:11,390 --> 01:00:09,060
about land use but also crop health and

1438
01:00:13,820 --> 01:00:11,400

they also as sort of an ancillary

1439
01:00:15,950 --> 01:00:13,830
benefit because we've had this long-term

1440
01:00:18,590 --> 01:00:15,960
record from the 1970s tell us about

1441
01:00:21,860 --> 01:00:18,600
climate so those things are unaffected

1442
01:00:24,320 --> 01:00:21,870
NASA operates research satellites for

1443
01:00:25,640 --> 01:00:24,330
scientists you know like those at sea at

1444
01:00:28,340 --> 01:00:25,650
the school of Earth and space

1445
01:00:29,840 --> 01:00:28,350
exploration to try and understand the

1446
01:00:32,390 --> 01:00:29,850
basic processes and write scientific

1447
01:00:34,550 --> 01:00:32,400
papers we typically design those

1448
01:00:37,040 --> 01:00:34,560
satellites for a five-year lifetime but

1449
01:00:39,380 --> 01:00:37,050
NASA over achieves and they typically

1450
01:00:42,140 --> 01:00:39,390
last for decades so we get these long

1451
01:00:45,170 --> 01:00:42,150
records the budget for NASA earth

1452
01:00:47,780 --> 01:00:45,180
science research is around about two

1453
01:00:51,230 --> 01:00:47,790
billion dollars a year and this new

1454
01:00:54,530 --> 01:00:51,240
administration lots of bluster lots of

1455
01:00:58,490 --> 01:00:54,540
critique about climate change has

1456
01:00:59,990 --> 01:00:58,500
adjusted that infinitesimally such that

1457
01:01:01,700 --> 01:01:00,000
the bulk of all the research will

1458
01:01:03,200 --> 01:01:01,710
continue in the satellites will continue

1459
01:01:04,490 --> 01:01:03,210
to operate and even if you turn the

1460
01:01:07,610 --> 01:01:04,500
budget off the satellites don't fall out

1461
01:01:09,380 --> 01:01:07,620
of the sky which is good news okay good

1462
01:01:11,930 --> 01:01:09,390
well that's okay now moving from your

1463
01:01:12,370 --> 01:01:11,940

optimism let's let's talk to David who

1464
01:01:16,539 --> 01:01:12,380
seems

1465
01:01:18,490 --> 01:01:16,549
be an incredible optimist and I wanna I

1466
01:01:20,859 --> 01:01:18,500
just want to try and challenge you on

1467
01:01:24,880 --> 01:01:20,869
some of that optimism at least to put to

1468
01:01:27,009 --> 01:01:24,890
bit you know - I mean it's nice to put a

1469
01:01:28,029 --> 01:01:27,019
to realize that we can do good as well

1470
01:01:32,079 --> 01:01:28,039
as bad and I think that's really

1471
01:01:34,680 --> 01:01:32,089
important but but especially in terms of

1472
01:01:37,690 --> 01:01:34,690
what Jane sort of emphasized and

1473
01:01:38,980 --> 01:01:37,700
introduced as well the example of ozone

1474
01:01:40,539 --> 01:01:38,990
is not really a good example right

1475
01:01:44,200 --> 01:01:40,549
because you can solve that problem and

1476
01:01:45,579 --> 01:01:44,210
and and and carbon dioxide is a problem

1477
01:01:47,440 --> 01:01:45,589
it's even actually I think you were a

1478
01:01:51,640 --> 01:01:47,450
little too optimistic in that sense

1479
01:01:53,650 --> 01:01:51,650
because it's not just that that you can

1480
01:01:55,960 --> 01:01:53,660
ignore the problem but it gets worse in

1481
01:01:58,329 --> 01:01:55,970
a much worse way the need if we don't

1482
01:02:01,299 --> 01:01:58,339
act til 2030 we have to we have to

1483
01:02:03,130 --> 01:02:01,309
remove twice as much the technical

1484
01:02:05,259 --> 01:02:03,140
demands and what we can need to do are

1485
01:02:06,940 --> 01:02:05,269
much greater than the now so it's not as

1486
01:02:09,249 --> 01:02:06,950
if we can say we don't have the money

1487
01:02:11,109 --> 01:02:09,259
now we'll wait till later because later

1488
01:02:12,700 --> 01:02:11,119

it's a lot worse so I wonder if you want

1489
01:02:15,370 --> 01:02:12,710
you might want to sort of contrast the

1490
01:02:19,660 --> 01:02:15,380
ozone Asia our carbon oxide yeah first

1491
01:02:22,769 --> 01:02:19,670
of all I think this this optimism versus

1492
01:02:26,380 --> 01:02:22,779
pessimism dichotomy is not really

1493
01:02:29,279 --> 01:02:26,390
necessarily that useful or is maybe an

1494
01:02:35,620 --> 01:02:32,259
people sometimes accuse me of being an

1495
01:02:37,240 --> 01:02:35,630
optimist because I have a vision of that

1496
01:02:41,140 --> 01:02:37,250
I try to talk about of the role that the

1497
01:02:46,109 --> 01:02:41,150
human race could aspire to play in the

1498
01:02:51,460 --> 01:02:46,119
future and at the same time I think that

1499
01:02:53,920 --> 01:02:51,470
we face huge problems that were in a

1500
01:02:55,509 --> 01:02:53,930
serious crisis that that I think Jane

1501
01:03:00,670 --> 01:02:55,519
did a very good job summarizing at the

1502
01:03:03,759 --> 01:03:00,680
in the first part of her talk and I

1503
01:03:05,740 --> 01:03:03,769
think that we can have both those ideas

1504
01:03:07,450 --> 01:03:05,750
in our heads in fact one definition of a

1505
01:03:09,910 --> 01:03:07,460
mature mind is that you can hold

1506
01:03:12,160 --> 01:03:09,920
seemingly contradictory ideas in your

1507
01:03:14,049 --> 01:03:12,170
head at the same time and it's not

1508
01:03:16,269 --> 01:03:14,059
enough to think of what we want to avoid

1509
01:03:19,269 --> 01:03:16,279
on the short-term we have to think about

1510
01:03:21,160 --> 01:03:19,279
that but I think it helps us it can help

1511
01:03:24,249 --> 01:03:21,170
us to think about that if we are armed

1512
01:03:25,060 --> 01:03:24,259
with a vision of what kind of role we

1513
01:03:27,430 --> 01:03:25,070

want to play on the

1514
01:03:31,930 --> 01:03:27,440
planet and what kind of world we want to

1515
01:03:35,110 --> 01:03:31,940
create and there are some encouraging

1516
01:03:37,120 --> 01:03:35,120
signs I mean they it's clear that it

1517
01:03:38,740 --> 01:03:37,130
seems clear that that our world

1518
01:03:41,650 --> 01:03:38,750
population is going to peak and then

1519
01:03:43,630 --> 01:03:41,660
start to decline later this century for

1520
01:03:45,160 --> 01:03:43,640
the right reasons not because death rate

1521
01:03:46,810 --> 01:03:45,170
increases but because fertility is

1522
01:03:49,630 --> 01:03:46,820
decreasing because poverty is decreasing

1523
01:03:52,450 --> 01:03:49,640
and the choices of women are increasing

1524
01:03:54,010 --> 01:03:52,460
when women get more educated in poor

1525
01:03:56,740 --> 01:03:54,020
countries these things are happening

1526
01:04:00,070 --> 01:03:56,750
we've already passed peak birthrate and

1527
01:04:01,180 --> 01:04:00,080
it's also very clear if 100 years from

1528
01:04:04,180 --> 01:04:01,190
now we're not going to be on fossil

1529
01:04:05,920 --> 01:04:04,190
fuels even if we are as stupid as stupid

1530
01:04:07,840 --> 01:04:05,930
can be there's a point where you move

1531
01:04:09,340 --> 01:04:07,850
beyond that now so there's a best-case

1532
01:04:10,750 --> 01:04:09,350
in a worst-case scenario for how we're

1533
01:04:13,300 --> 01:04:10,760
going to get from here to there and

1534
01:04:14,950 --> 01:04:13,310
being human beings it's not going to be

1535
01:04:17,440 --> 01:04:14,960
either I mean humans can learn from

1536
01:04:18,910 --> 01:04:17,450
foresight and being smart and avoiding

1537
01:04:22,960 --> 01:04:18,920
stuff because you can see what's coming

1538
01:04:24,280 --> 01:04:22,970

and we learn from tragedy and and we do

1539
01:04:25,270 --> 01:04:24,290
both and it's going to be some

1540
01:04:26,620 --> 01:04:25,280
combination it's going to be something

1541
01:04:28,180 --> 01:04:26,630
in between best case and worst case

1542
01:04:30,610 --> 01:04:28,190
scenario so there's going to be some

1543
01:04:32,500 --> 01:04:30,620
damage in the 21st century I have no

1544
01:04:35,740 --> 01:04:32,510
doubt about that the way I look at it if

1545
01:04:37,830 --> 01:04:35,750
if we do this wrong the 21st century

1546
01:04:40,150 --> 01:04:37,840
could be as tragic as the 20th century

1547
01:04:41,590 --> 01:04:40,160
and when I say that people say what are

1548
01:04:43,930 --> 01:04:41,600
you talking about the 20th century was

1549
01:04:45,490 --> 01:04:43,940
great you know woohoo except it wasn't

1550
01:04:47,800 --> 01:04:45,500
for the hundreds of millions of people

1551
01:04:49,390 --> 01:04:47,810
who died in wars and famines I think

1552
01:04:52,300 --> 01:04:49,400
that's the scale of tragedy we're facing

1553
01:04:55,270 --> 01:04:52,310
so that's the so I'm an optimist in that

1554
01:04:57,640 --> 01:04:55,280
I see that we can get through this and

1555
01:04:59,410 --> 01:04:57,650
move on to another phase and I think we

1556
01:05:01,150 --> 01:04:59,420
have to picture what that is and think

1557
01:05:03,070 --> 01:05:01,160
of ourselves as a geological force which

1558
01:05:05,470 --> 01:05:03,080
means thinking on the long-term thinking

1559
01:05:07,110 --> 01:05:05,480
about asteroids and ice ages as well as

1560
01:05:09,760 --> 01:05:07,120
our immediate challenges now

1561
01:05:11,080 --> 01:05:09,770
specifically just you asked about ozone

1562
01:05:13,300 --> 01:05:11,090
I agree

1563
01:05:16,240 --> 01:05:13,310

those are the much simpler much easier

1564
01:05:17,920 --> 01:05:16,250
problem you know we basically with a

1565
01:05:20,860 --> 01:05:17,930
couple companies that had to phase out

1566
01:05:23,800 --> 01:05:20,870
their products and phasing new ones as

1567
01:05:26,530 --> 01:05:23,810
opposed to fossil fuels which our entire

1568
01:05:28,480 --> 01:05:26,540
world economy is based on practically

1569
01:05:30,190 --> 01:05:28,490
and it's huge amounts of money and

1570
01:05:34,120 --> 01:05:30,200
resources and infrastructures that's a

1571
01:05:37,000 --> 01:05:34,130
much harder problem so I I use it as

1572
01:05:38,830 --> 01:05:37,010
proof of concept but it's it's sort of

1573
01:05:41,380 --> 01:05:38,840
idealized and it doesn't mean others

1574
01:05:44,220 --> 01:05:41,390
is going to be easy it means we have

1575
01:05:46,090 --> 01:05:44,230
models that we can try to apply okay I

1576
01:05:50,020 --> 01:05:46,100
actually I think you're overly

1577
01:05:52,750 --> 01:05:50,030
pessimistic about one thing um that go

1578
01:05:54,160 --> 01:05:52,760
to your fantasy that's one of my friend

1579
01:05:56,140 --> 01:05:54,170
Steve Pinker is argued I think pretty

1580
01:05:58,210 --> 01:05:56,150
cogently the 20th century was perhaps

1581
01:06:00,580 --> 01:05:58,220
the most peaceful century with the least

1582
01:06:03,670 --> 01:06:00,590
death and least violence of any century

1583
01:06:05,640 --> 01:06:03,680
and and and it while we tend to think of

1584
01:06:08,200 --> 01:06:05,650
the wars as having done a lot actually

1585
01:06:09,580 --> 01:06:08,210
the general human attitude about murder

1586
01:06:11,680 --> 01:06:09,590
and death is actually getting better

1587
01:06:14,890 --> 01:06:11,690
over time largely he would argue because

1588
01:06:18,070 --> 01:06:14,900

of the Enlightenment and science but I

1589
01:06:19,960 --> 01:06:18,080
will I don't disagree with that I will I

1590
01:06:22,600 --> 01:06:19,970
was amused by the talk by your by your

1591
01:06:25,000 --> 01:06:22,610
person of the fact that the two times

1592
01:06:26,320 --> 01:06:25,010
that we at least two times we've

1593
01:06:26,770 --> 01:06:26,330
dramatically changed a climate which is

1594
01:06:31,060 --> 01:06:26,780
sino

1595
01:06:33,000 --> 01:06:31,070
bacteria and and and humans responding

1596
01:06:35,920 --> 01:06:33,010
to climate change in both those cases

1597
01:06:38,440 --> 01:06:35,930
the oxygen has produced killed a lot of

1598
01:06:41,170 --> 01:06:38,450
most of the so they they change the

1599
01:06:42,610 --> 01:06:41,180
climate by dying it's and and and and

1600
01:06:44,230 --> 01:06:42,620
the same thing happened with hominid

1601
01:06:45,640 --> 01:06:44,240
species probably when they would climate

1602
01:06:47,950 --> 01:06:45,650
change one of the reasons Neanderthals

1603
01:06:49,630 --> 01:06:47,960
probably were were destroyed by Homo

1604
01:06:52,660 --> 01:06:49,640
sapiens was climate change so there's a

1605
01:06:54,790 --> 01:06:52,670
long history of species changing the

1606
01:06:59,140 --> 01:06:54,800
planet and not surviving in the process

1607
01:07:00,100 --> 01:06:59,150
and and I'm wondering whether you might

1608
01:07:02,680 --> 01:07:00,110
want to comment on that

1609
01:07:04,500 --> 01:07:02,690
well this this is absolutely true but

1610
01:07:07,600 --> 01:07:04,510
it's also true there's a long history of

1611
01:07:11,050 --> 01:07:07,610
humans and pre humans interacting with

1612
01:07:13,480 --> 01:07:11,060
climate and learning and growing and

1613
01:07:15,970 --> 01:07:13,490

becoming in a sense successively

1614
01:07:18,760 --> 01:07:15,980
more successful and more human in a

1615
01:07:21,700 --> 01:07:18,770
sense in the process of if you look at

1616
01:07:25,960 --> 01:07:21,710
all the major innovations that led us to

1617
01:07:28,330 --> 01:07:25,970
be modern human we're discovering things

1618
01:07:31,000 --> 01:07:28,340
like upright walking larger brain size

1619
01:07:33,400 --> 01:07:31,010
domestication of fire various kinds of

1620
01:07:35,740 --> 01:07:33,410
social and material technologies almost

1621
01:07:38,410 --> 01:07:35,750
all the big breakthroughs came during

1622
01:07:40,660 --> 01:07:38,420
times of climate chaos and in response

1623
01:07:43,750 --> 01:07:40,670
to climate chaos and there's a

1624
01:07:46,450 --> 01:07:43,760
paleoanthropologist here at ASU named

1625
01:07:48,970 --> 01:07:46,460
Curtis Marion who's worked in this site

1626
01:07:51,370 --> 01:07:48,980
called pinnacle point and that's very

1627
01:07:52,510 --> 01:07:51,380
near the southern tip of Africa which is

1628
01:07:54,910 --> 01:07:52,520
where

1629
01:07:56,650 --> 01:07:54,920
some people think Curtis Marion thinks

1630
01:08:00,490 --> 01:07:56,660
and I think he may be right is the

1631
01:08:02,050 --> 01:08:00,500
origin of modern humans and that was the

1632
01:08:04,090 --> 01:08:02,060
humans that were driven there they

1633
01:08:05,950 --> 01:08:04,100
retreated there in response to an ice

1634
01:08:09,340 --> 01:08:05,960
age about a hundred ninety thousand

1635
01:08:10,780 --> 01:08:09,350
years ago and most of what was going to

1636
01:08:13,120 --> 01:08:10,790
become the human race was wiped out

1637
01:08:14,260 --> 01:08:13,130
there's a genetic bottleneck in fact we

1638
01:08:16,570 --> 01:08:14,270

might have been down to fewer than a

1639
01:08:18,700 --> 01:08:16,580
thousand individual under yeah a few

1640
01:08:20,440 --> 01:08:18,710
hundreds of which is by the way partly

1641
01:08:22,420 --> 01:08:20,450
why the human race is so incredibly

1642
01:08:24,309 --> 01:08:22,430
uniform genetically compared to other

1643
01:08:25,630 --> 01:08:24,319
large mammals we're really all humans

1644
01:08:27,640 --> 01:08:25,640
are the same

1645
01:08:30,099 --> 01:08:27,650
genetically because we survive this

1646
01:08:33,070 --> 01:08:30,109
bottleneck and re-radiated but the

1647
01:08:36,400 --> 01:08:33,080
humans or human ancestors a pinnacle

1648
01:08:40,559 --> 01:08:36,410
point we had to reinvent themselves and

1649
01:08:43,450 --> 01:08:40,569
reinvent what it meant to be a

1650
01:08:44,920 --> 01:08:43,460
cooperative innovative species on the

1651
01:08:46,090 --> 01:08:44,930
planet they could no longer be

1652
01:08:47,769 --> 01:08:46,100
hunter-gatherers in the way they have

1653
01:08:50,650 --> 01:08:47,779
been because Africa was covered with ice

1654
01:08:53,410 --> 01:08:50,660
the game the range wasn't there the game

1655
01:08:57,660 --> 01:08:53,420
died out and so they invented what is

1656
01:09:00,730 --> 01:08:57,670
known as complex recipe long-chain

1657
01:09:05,200 --> 01:09:00,740
complex long-chain recipe technology

1658
01:09:07,480 --> 01:09:05,210
where you're the what you start off with

1659
01:09:10,210 --> 01:09:07,490
is not obviously related to what the

1660
01:09:11,950 --> 01:09:10,220
products are so in things like heat

1661
01:09:14,019 --> 01:09:11,960
treatment of rocks underneath the ground

1662
01:09:16,990 --> 01:09:14,029
to make hardened rocks for new kinds of

1663
01:09:19,450 --> 01:09:17,000

tools and Spears and things and in order

1664
01:09:20,380 --> 01:09:19,460
to do that you needed language to

1665
01:09:22,170 --> 01:09:20,390
because you needed to be able to

1666
01:09:24,730 --> 01:09:22,180
communicate it to the next generation

1667
01:09:28,329 --> 01:09:24,740
this is also the first site where we

1668
01:09:29,980 --> 01:09:28,339
find ochre and pop you know adornment

1669
01:09:31,269 --> 01:09:29,990
and a lot of things that we think oh me

1670
01:09:33,370 --> 01:09:31,279
this is where modern humans might have

1671
01:09:35,530 --> 01:09:33,380
might have formed and they formed in

1672
01:09:37,450 --> 01:09:35,540
response to a climate crisis they

1673
01:09:39,070 --> 01:09:37,460
reinvented themselves they became better

1674
01:09:41,760 --> 01:09:39,080
at the things that we humans have

1675
01:09:46,200 --> 01:09:41,770
distinguished ourselves by which are

1676
01:09:48,940 --> 01:09:46,210
cooperating inventing communicating

1677
01:09:51,340 --> 01:09:48,950
enlarging our sphere of cooperation and

1678
01:09:54,370 --> 01:09:51,350
that we've done this many times in the

1679
01:09:56,230 --> 01:09:54,380
past and I see in a certain sense this

1680
01:09:58,980 --> 01:09:56,240
is encouraging it shows that in a sense

1681
01:10:01,900 --> 01:09:58,990
we have the capacity for reinvention and

1682
01:10:05,710 --> 01:10:01,910
I'll say one more optimistic thing which

1683
01:10:08,350 --> 01:10:05,720
is imagine trying to describe

1684
01:10:10,360 --> 01:10:08,360
a modern city to the people from

1685
01:10:12,820 --> 01:10:10,370
pinnacle point say a hundred thousand

1686
01:10:14,980 --> 01:10:12,830
years ago how we live now you wouldn't

1687
01:10:17,230 --> 01:10:14,990
be able to do it now maybe that's as

1688
01:10:19,330 --> 01:10:17,240

hard as it is for us to imagine the

1689
01:10:21,790 --> 01:10:19,340
fully sustainable society that we will

1690
01:10:23,470 --> 01:10:21,800
have a few thousand years from now well

1691
01:10:27,250 --> 01:10:23,480
I hope it I certainly hope it's the case

1692
01:10:28,750 --> 01:10:27,260
is interesting point that climate severe

1693
01:10:31,530 --> 01:10:28,760
climate change but from an evolutionary

1694
01:10:33,880 --> 01:10:31,540
perspective has often brought new

1695
01:10:36,700 --> 01:10:33,890
opportunities I would argue musial ebuy

1696
01:10:39,370 --> 01:10:36,710
new species but but and for me my point

1697
01:10:41,440 --> 01:10:39,380
of view I'll throw this out of it maybe

1698
01:10:43,330 --> 01:10:41,450
maybe the new silicon-based life forms

1699
01:10:44,860 --> 01:10:43,340
that we're creating now will be the next

1700
01:10:47,080 --> 01:10:44,870
species that will survive into the and

1701
01:10:49,390 --> 01:10:47,090
maybe be better planetary managers than

1702
01:10:51,430 --> 01:10:49,400
we will but we'll see but it doesn't

1703
01:10:54,250 --> 01:10:51,440
necessarily the salient point yes is the

1704
01:10:56,500 --> 01:10:54,260
loss of biodiversity that's how deep a

1705
01:10:58,090 --> 01:10:56,510
hole we might be in yeah or maybe some

1706
01:11:01,120 --> 01:10:58,100
kind of partnership between us and then

1707
01:11:02,320 --> 01:11:01,130
I think that the issues you know stated

1708
01:11:04,630 --> 01:11:02,330
or the things that you've been

1709
01:11:06,700 --> 01:11:04,640
describing David I think are all what I

1710
01:11:09,280 --> 01:11:06,710
would call and merge it you know they're

1711
01:11:10,330 --> 01:11:09,290
they're all actions of individuals or

1712
01:11:12,880 --> 01:11:10,340
groups of small groups of individuals

1713
01:11:15,520 --> 01:11:12,890

that add up to something you know a new

1714
01:11:18,040 --> 01:11:15,530
pattern and the question is is that is

1715
01:11:20,650 --> 01:11:18,050
that the kind of problem that we're

1716
01:11:24,300 --> 01:11:20,660
facing right now because if we need some

1717
01:11:27,130 --> 01:11:24,310
kind of coherent action to change things

1718
01:11:30,220 --> 01:11:27,140
then you know I don't think there are

1719
01:11:31,540 --> 01:11:30,230
too many examples maybe d-day or

1720
01:11:34,930 --> 01:11:31,550
something but even that you could go

1721
01:11:37,150 --> 01:11:34,940
after I I think that the the issue is

1722
01:11:40,240 --> 01:11:37,160
that we don't know how as a species to

1723
01:11:41,440 --> 01:11:40,250
set goals for the species certainly

1724
01:11:43,240 --> 01:11:41,450
we've never really done we've never had

1725
01:11:45,400 --> 01:11:43,250
to do it globally we've never had to do

1726
01:11:47,620 --> 01:11:45,410
it the first time and there's no looking

1727
01:11:50,170 --> 01:11:47,630
out at the world today it's not one

1728
01:11:52,060 --> 01:11:50,180
would not be optimistic that we're doing

1729
01:11:53,350 --> 01:11:52,070
the job of thinking globally yet and I

1730
01:11:55,000 --> 01:11:53,360
want to I want to get there are some

1731
01:11:58,110 --> 01:11:55,010
examples though from the realm of public

1732
01:12:03,010 --> 01:11:58,120
health there are diseases that have been

1733
01:12:04,960 --> 01:12:03,020
eliminated globally we were just leaned

1734
01:12:06,040 --> 01:12:04,970
OTT as good at it as we need to be but

1735
01:12:07,870 --> 01:12:06,050
it's not sure that there are zero

1736
01:12:09,850 --> 01:12:07,880
examples where we've been able to get

1737
01:12:14,170 --> 01:12:09,860
together and solve problems globally

1738
01:12:15,760 --> 01:12:14,180

oh yeah well okay good I'm not winged

1739
01:12:18,390 --> 01:12:15,770
one could argue that but I think I'd

1740
01:12:19,800 --> 01:12:18,400
like it you know I I often say from my

1741
01:12:21,510 --> 01:12:19,810
my friend Cormac MacCarthy would say

1742
01:12:23,520 --> 01:12:21,520
when I asked him why he was so cheerful

1743
01:12:27,180 --> 01:12:23,530
he said I'm a pessimist but that's no

1744
01:12:30,480 --> 01:12:27,190
reason to be gloomy so that's my

1745
01:12:32,010 --> 01:12:30,490
attitude so let me let me however try

1746
01:12:34,380 --> 01:12:32,020
and confront you about one thing so

1747
01:12:35,760 --> 01:12:34,390
there's the two interesting

1748
01:12:39,750 --> 01:12:35,770
geoengineering things you talked about

1749
01:12:42,030 --> 01:12:39,760
where we're putting these aerosols or or

1750
01:12:44,630 --> 01:12:42,040
or something dust or whatever you want

1751
01:12:47,340 --> 01:12:44,640
in the atmosphere to block sunlight or

1752
01:12:53,370 --> 01:12:47,350
potentially block sunlight or extracting

1753
01:12:54,990 --> 01:12:53,380
co2 I I and you said well we may need to

1754
01:13:00,270 --> 01:12:55,000
just keep doing the first until we get

1755
01:13:02,130 --> 01:13:00,280
second-straight I have a problem with

1756
01:13:04,890 --> 01:13:02,140
the with the first and then what and and

1757
01:13:06,120 --> 01:13:04,900
that is that online you lots of problems

1758
01:13:08,520 --> 01:13:06,130
but if you point out that you know you

1759
01:13:09,870 --> 01:13:08,530
don't you know the first you know what

1760
01:13:11,670 --> 01:13:09,880
happens you take the second you know

1761
01:13:13,350 --> 01:13:11,680
what happens you take co2 out we know we

1762
01:13:15,030 --> 01:13:13,360
know what was like back then so we know

1763
01:13:16,440 --> 01:13:15,040

what the results will be but putting

1764
01:13:17,970 --> 01:13:16,450
things in the atmosphere as you point

1765
01:13:21,270 --> 01:13:17,980
out has a lot of unintended consequences

1766
01:13:23,040 --> 01:13:21,280
but for me the worst one is that if we

1767
01:13:25,950 --> 01:13:23,050
choose to if we chose in the United

1768
01:13:28,620 --> 01:13:25,960
States to remove co2 we make a

1769
01:13:32,190 --> 01:13:28,630
unilateral decision but and in it

1770
01:13:33,960 --> 01:13:32,200
improves the world okay but if but

1771
01:13:35,580 --> 01:13:33,970
someone's got to decide to put those

1772
01:13:37,380 --> 01:13:35,590
aerosols in and there isn't going to be

1773
01:13:39,630 --> 01:13:37,390
global consensus necessarily that we're

1774
01:13:41,310 --> 01:13:39,640
willing to arrest but the MIT but one

1775
01:13:43,920 --> 01:13:41,320
country does it and the whole world

1776
01:13:44,820 --> 01:13:43,930
either suffers or not and and who has

1777
01:13:47,370 --> 01:13:44,830
the right to do that

1778
01:13:49,320 --> 01:13:47,380
so I wanted you to come in well this is

1779
01:13:51,240 --> 01:13:49,330
of course the biggest problem with all

1780
01:13:53,130 --> 01:13:51,250
of this is that you know somebody's got

1781
01:13:53,820 --> 01:13:53,140
their hand on the thermostat yeah with

1782
01:13:55,350 --> 01:13:53,830
this concept

1783
01:13:56,880 --> 01:13:55,360
personally I don't I don't think it's

1784
01:13:58,830 --> 01:13:56,890
going to happen that way anyway I think

1785
01:14:00,750 --> 01:13:58,840
things like what Hillary is describing

1786
01:14:02,070 --> 01:14:00,760
or what's going to happen I think I

1787
01:14:04,200 --> 01:14:02,080
think what's going to happen is that

1788
01:14:06,390 --> 01:14:04,210

people are going to start to feel

1789
01:14:08,550 --> 01:14:06,400
impacts and they're going to start to

1790
01:14:11,340 --> 01:14:08,560
want to do something in a much more

1791
01:14:13,170 --> 01:14:11,350
regional basis and that the impacts that

1792
01:14:15,390 --> 01:14:13,180
they feel are going to get bigger and

1793
01:14:16,890 --> 01:14:15,400
more widespread and last longer and the

1794
01:14:18,540 --> 01:14:16,900
kinds of interventions that they choose

1795
01:14:20,070 --> 01:14:18,550
to do are going to get bigger and more

1796
01:14:22,710 --> 01:14:20,080
widespread and people are going to think

1797
01:14:26,040 --> 01:14:22,720
of more things and they're going to

1798
01:14:28,490 --> 01:14:26,050
start to affect the globe again and and

1799
01:14:31,620 --> 01:14:28,500
then I think what you're going to see is

1800
01:14:32,370 --> 01:14:31,630
it's going to I think that it could be

1801
01:14:34,980 --> 01:14:32,380
emerging

1802
01:14:36,810 --> 01:14:34,990
that level that that basically people

1803
01:14:39,060 --> 01:14:36,820
say I can't stand this heatwave it's

1804
01:14:40,500 --> 01:14:39,070
been 130 for a month we've got to do

1805
01:14:42,450 --> 01:14:40,510
something and they're going to start to

1806
01:14:43,560 --> 01:14:42,460
do something locally or they don't have

1807
01:14:45,660 --> 01:14:43,570
them on soon so they're going to

1808
01:14:49,980 --> 01:14:45,670
overturn portions of the ocean and try

1809
01:14:52,590 --> 01:14:49,990
to steer steer rain differently and and

1810
01:14:54,540 --> 01:14:52,600
so these things will people will think

1811
01:14:56,880 --> 01:14:54,550
of more of these things now the question

1812
01:14:58,620 --> 01:14:56,890
is will they work I mean this is the

1813
01:15:00,810 --> 01:14:58,630

other piece of it why do people keep

1814
01:15:02,640 --> 01:15:00,820
coming back to this SRM idea solar

1815
01:15:05,940 --> 01:15:02,650
radiation management because we know it

1816
01:15:08,460 --> 01:15:05,950
works and that is really pretty amazing

1817
01:15:11,700 --> 01:15:08,470
and also don't we get works at item

1818
01:15:13,140 --> 01:15:11,710
level it also also often kills craps and

1819
01:15:14,400 --> 01:15:13,150
people I mean if you look at what

1820
01:15:17,010 --> 01:15:14,410
happened to volcanoes there was a lot of

1821
01:15:18,840 --> 01:15:17,020
there was a lot of starvation as a

1822
01:15:21,450 --> 01:15:18,850
result of that because of unexpected

1823
01:15:22,920 --> 01:15:21,460
climate changes resulting in well yes so

1824
01:15:25,470 --> 01:15:22,930
the question is do you get smart enough

1825
01:15:27,390 --> 01:15:25,480
to do it right and I'd say I don't know

1826
01:15:29,220 --> 01:15:27,400
you know I think but we damn well better

1827
01:15:31,200 --> 01:15:29,230
do research because even if you don't

1828
01:15:33,090 --> 01:15:31,210
think you should do it somebody else may

1829
01:15:34,440 --> 01:15:33,100
do it yeah well that's what actually

1830
01:15:36,120 --> 01:15:34,450
that's why I want to add the second I

1831
01:15:38,520 --> 01:15:36,130
want to ask you in the number to Hillary

1832
01:15:40,470 --> 01:15:38,530
in sec was I'm worried because I act

1833
01:15:41,700 --> 01:15:40,480
they've been I remember on a regular

1834
01:15:43,710 --> 01:15:41,710
program with the net scientist who's

1835
01:15:45,390 --> 01:15:43,720
strongly advocating this and there are

1836
01:15:47,670 --> 01:15:45,400
scientists were strongly advocating is

1837
01:15:48,870 --> 01:15:47,680
and it seems like a quick fix a quick

1838
01:15:50,370 --> 01:15:48,880

and easy fix which means you don't have

1839
01:15:52,020 --> 01:15:50,380
to think you don't have to change the

1840
01:15:53,820 --> 01:15:52,030
way society works you don't have to do

1841
01:15:55,860 --> 01:15:53,830
the hard problems and what worries me

1842
01:15:57,930 --> 01:15:55,870
that's that appeals tremendously to

1843
01:15:59,340 --> 01:15:57,940
politicians certain polls you're right

1844
01:16:01,620 --> 01:15:59,350
you're right that's a huge problem

1845
01:16:03,360 --> 01:16:01,630
because it's just not true that's why

1846
01:16:05,580 --> 01:16:03,370
it's a problem it's just fundamentally

1847
01:16:08,370 --> 01:16:05,590
not true if you don't mitigate if you

1848
01:16:12,210 --> 01:16:08,380
don't stop emitting then the gap between

1849
01:16:15,390 --> 01:16:12,220
what you're trying to do radiation

1850
01:16:17,220 --> 01:16:15,400
balance management with grows and it

1851
01:16:19,290 --> 01:16:17,230
grows and you get farther and farther

1852
01:16:21,240 --> 01:16:19,300
and farther away from any known state of

1853
01:16:25,230 --> 01:16:21,250
climate that we've ever been in so if

1854
01:16:27,300 --> 01:16:25,240
you the fundamental strategy is first

1855
01:16:30,240 --> 01:16:27,310
and foremost mitigation you have to stop

1856
01:16:32,580 --> 01:16:30,250
emitting and you know just I just have

1857
01:16:34,680 --> 01:16:32,590
to get in my one other dig I don't I

1858
01:16:36,750 --> 01:16:34,690
really get upset

1859
01:16:38,400 --> 01:16:36,760
when I hear people say just leave it in

1860
01:16:41,100 --> 01:16:38,410
the ground or we won't be using fossil

1861
01:16:43,410 --> 01:16:41,110
fuel because what that does is it leaves

1862
01:16:45,690 --> 01:16:43,420
out a whole raft of solutions that

1863
01:16:46,169 --> 01:16:45,700

actually do involve fossil energy but

1864
01:16:48,810 --> 01:16:46,179
don't

1865
01:16:51,209 --> 01:16:48,820
it and we have to we have to be open to

1866
01:16:53,040 --> 01:16:51,219
all of these things we have to be open

1867
01:16:55,229 --> 01:16:53,050
to nuclear power we have to be open to

1868
01:16:58,290 --> 01:16:55,239
carbon capture and storage we have to be

1869
01:17:00,629 --> 01:16:58,300
open to some amount of renewable energy

1870
01:17:03,509 --> 01:17:00,639
but we have to be doing all of it and

1871
01:17:05,850 --> 01:17:03,519
you know just to say we're not going to

1872
01:17:08,729 --> 01:17:05,860
use fossil fuel anymore is I think

1873
01:17:11,310 --> 01:17:08,739
cutting off one of your arms in terms of

1874
01:17:13,109 --> 01:17:11,320
getting forward on this so did you and

1875
01:17:14,989 --> 01:17:13,119
and this will lead me into Hillary I

1876
01:17:21,060 --> 01:17:14,999
think nicely well but do you think we as

1877
01:17:23,580 --> 01:17:21,070
as scientists is it at this point should

1878
01:17:25,140 --> 01:17:23,590
one ad so what worries me is advocating

1879
01:17:27,330 --> 01:17:25,150
a potential solution or advocating

1880
01:17:29,520 --> 01:17:27,340
research to look into the possible

1881
01:17:32,759 --> 01:17:29,530
effects of that solution but is it more

1882
01:17:39,000 --> 01:17:32,769
is it irresponsible to say - not for

1883
01:17:40,469 --> 01:17:39,010
those two arguments and and and research

1884
01:17:43,319 --> 01:17:40,479
into that way that's and that's a common

1885
01:17:45,449 --> 01:17:43,329
thing yeah I think that's unethical oh

1886
01:17:47,009 --> 01:17:45,459
okay I would agree but I want to see

1887
01:17:48,359 --> 01:17:47,019
what well and then that leads me to

1888
01:17:49,679 --> 01:17:48,369

Hillary who talked about two things I

1889
01:17:52,109 --> 01:17:49,689
want to want to try and confront you

1890
01:17:53,879 --> 01:17:52,119
with or at least one well - one you

1891
01:17:56,129 --> 01:17:53,889
talked about planet works and I wanted

1892
01:17:57,989 --> 01:17:56,139
to say one of the reasons I'm so happy

1893
01:18:01,140 --> 01:17:57,999
to be doing this with with planet works

1894
01:18:02,489 --> 01:18:01,150
is that is that you know by moaning the

1895
01:18:03,750 --> 01:18:02,499
problems is one things but thinking

1896
01:18:05,339 --> 01:18:03,760
about how to solve them is really much

1897
01:18:07,969 --> 01:18:05,349
more productive and that's what we're

1898
01:18:10,199 --> 01:18:07,979
trying to do in a number of things in

1899
01:18:11,850 --> 01:18:10,209
programs are working on and I hope that

1900
01:18:13,979 --> 01:18:11,860
the lesson is that we need to think

1901
01:18:16,020 --> 01:18:13,989
about these things that that there are

1902
01:18:19,109 --> 01:18:16,030
huge challenges but fortune favors the

1903
01:18:22,410 --> 01:18:19,119
prepared mind and we need to prepare but

1904
01:18:25,529 --> 01:18:22,420
but you said advocacy and I'm wondering

1905
01:18:27,149 --> 01:18:25,539
so for example my friend Jim Hanson is

1906
01:18:28,560 --> 01:18:27,159
an advocate a lot of scientists wonder

1907
01:18:35,969 --> 01:18:28,570
whether it's too much of an advocate and

1908
01:18:38,370 --> 01:18:35,979
and should we be should we be advocating

1909
01:18:40,529 --> 01:18:38,380
specific policies or or a scientist

1910
01:18:44,069 --> 01:18:40,539
should we be should we be pointing out

1911
01:18:46,560 --> 01:18:44,079
the science and and encouraging the

1912
01:18:49,859 --> 01:18:46,570
people who are elected to determine

1913
01:18:50,640 --> 01:18:49,869

policies I'm wondering when you raise an

1914
01:18:53,939 --> 01:18:50,650
excellent point

1915
01:18:57,699 --> 01:18:53,949
Lawrence and advocacy is a pretty

1916
01:18:59,770 --> 01:18:57,709
fraught term right now

1917
01:19:01,419 --> 01:18:59,780
and there's no question that is

1918
01:19:03,640 --> 01:19:01,429
scientists a lot of our credibility

1919
01:19:05,770 --> 01:19:03,650
comes from the fact that we produce

1920
01:19:07,089 --> 01:19:05,780
information and we are willing to say

1921
01:19:09,819 --> 01:19:07,099
this is the best information that we

1922
01:19:11,290 --> 01:19:09,829
know how to make but I do think as we

1923
01:19:14,229 --> 01:19:11,300
move into the Anthropocene that

1924
01:19:16,149 --> 01:19:14,239
scientists are also responsible for

1925
01:19:19,270 --> 01:19:16,159
interpreting their information and

1926
01:19:21,790 --> 01:19:19,280
providing a way to read the information

1927
01:19:23,739 --> 01:19:21,800
that we generate as scientists for the

1928
01:19:26,560 --> 01:19:23,749
public yeah and if that's advocacy then

1929
01:19:28,839 --> 01:19:26,570
I'm good with that maybe we need a new

1930
01:19:30,669 --> 01:19:28,849
term for it but I do think we have a

1931
01:19:33,429 --> 01:19:30,679
responsibility as scientists who also

1932
01:19:35,259 --> 01:19:33,439
interpret our information in the best

1933
01:19:38,919 --> 01:19:35,269
possible way we can the idea of

1934
01:19:41,020 --> 01:19:38,929
generating data producing information

1935
01:19:43,719 --> 01:19:41,030
and then leaving it at the hands of a

1936
01:19:46,390 --> 01:19:43,729
you know a regulator or a politician who

1937
01:19:49,270 --> 01:19:46,400
doesn't have the tools to interpret it I

1938
01:19:51,310 --> 01:19:49,280

think that's also unethical and and and

1939
01:19:53,859 --> 01:19:51,320
my wife needs to work for the government

1940
01:19:56,169 --> 01:19:53,869
in Australia and and point out that

1941
01:19:58,509 --> 01:19:56,179
scientists and and and government

1942
01:19:59,770 --> 01:19:58,519
officials don't the scientists think

1943
01:20:01,089 --> 01:19:59,780
they know what the what the important

1944
01:20:02,259 --> 01:20:01,099
things are and they're very different

1945
01:20:03,939 --> 01:20:02,269
questions and what the government

1946
01:20:05,080 --> 01:20:03,949
officials do and they need to be able to

1947
01:20:06,699 --> 01:20:05,090
communicate and learn how to communicate

1948
01:20:09,489 --> 01:20:06,709
to each other that's a critically

1949
01:20:11,679 --> 01:20:09,499
important point right and I didn't I

1950
01:20:13,330 --> 01:20:11,689
could have talked for a long time yeah

1951
01:20:15,009 --> 01:20:13,340
it's really important to remember that

1952
01:20:17,339 --> 01:20:15,019
planet works is not just the scientists

1953
01:20:20,290 --> 01:20:17,349
and the engineers we are absolutely

1954
01:20:24,279 --> 01:20:20,300
involving social scientists and people

1955
01:20:27,969 --> 01:20:24,289
who study politics and law and ethics

1956
01:20:29,859 --> 01:20:27,979
and human humanists as well that

1957
01:20:31,449 --> 01:20:29,869
conversation all of what we're talking

1958
01:20:33,069 --> 01:20:31,459
about is really about how humans make

1959
01:20:35,439 --> 01:20:33,079
decisions and which decisions do they

1960
01:20:37,330 --> 01:20:35,449
make and why science isn't going to

1961
01:20:40,239 --> 01:20:37,340
answer those questions those are the

1962
01:20:42,310 --> 01:20:40,249
questions that we need we need the human

1963
01:20:43,629 --> 01:20:42,320

endeavor to answer those questions okay

1964
01:20:45,219 --> 01:20:43,639
let me give you another sort of Devil's

1965
01:20:46,629 --> 01:20:45,229
Advocate last Devils I have a question

1966
01:20:49,469 --> 01:20:46,639
and then we'll move for about 50 minutes

1967
01:20:51,219 --> 01:20:49,479
of public questions if there are them I

1968
01:20:52,750 --> 01:20:51,229
couldn't help when you were talking

1969
01:20:56,290 --> 01:20:52,760
thinking of a line from the Rocky Horror

1970
01:20:58,660 --> 01:20:56,300
Picture Show which was you know treating

1971
01:21:01,509 --> 01:20:58,670
the symptoms and not the disease and and

1972
01:21:02,709 --> 01:21:01,519
and it's it's and and and so do you

1973
01:21:04,660 --> 01:21:02,719
think there's a problem let's say you

1974
01:21:06,939 --> 01:21:04,670
know this is a hey this is a neat way to

1975
01:21:09,790 --> 01:21:06,949
make more ice we don't have to worry

1976
01:21:11,700 --> 01:21:09,800
about I mean that that that providing

1977
01:21:12,810 --> 01:21:11,710
these things provides an impetus

1978
01:21:14,670 --> 01:21:12,820
could provide an impetus to see

1979
01:21:16,260 --> 01:21:14,680
business-as-usual look we got the

1980
01:21:20,520 --> 01:21:16,270
technical solutions we don't have to

1981
01:21:22,560 --> 01:21:20,530
change the way we live that's sure one

1982
01:21:24,300 --> 01:21:22,570
could say that but it's exactly the same

1983
01:21:27,960 --> 01:21:24,310
thing that Jane's saying about sulfate

1984
01:21:29,820 --> 01:21:27,970
aerosol exactly it's we we have to do

1985
01:21:31,830 --> 01:21:29,830
everything we possibly can right now and

1986
01:21:33,930 --> 01:21:31,840
if that means buying ourselves some time

1987
01:21:36,240 --> 01:21:33,940
then we should buy ourselves some time

1988
01:21:38,640 --> 01:21:36,250

but we have to recognize the co2 problem

1989
01:21:41,790 --> 01:21:38,650
gets worse the co2 problem is currently

1990
01:21:43,470 --> 01:21:41,800
accelerating and we can we can moderate

1991
01:21:45,630 --> 01:21:43,480
temperature all we want however we

1992
01:21:47,910 --> 01:21:45,640
decide to do it but the co2 problem is

1993
01:21:50,520 --> 01:21:47,920
growing underneath that actually we have

1994
01:21:51,870 --> 01:21:50,530
to make that point in that regard I was

1995
01:21:55,110 --> 01:21:51,880
going to ask in your paper I because I

1996
01:21:57,210 --> 01:21:55,120
haven't read it is presumably obviously

1997
01:21:58,710 --> 01:21:57,220
in this kind of sea ice thing it's a lot

1998
01:22:00,750 --> 01:21:58,720
easier to impact on the problem now than

1999
01:22:02,490 --> 01:22:00,760
it will be in 20 years when if we if

2000
01:22:04,860 --> 01:22:02,500
business as usual because then you know

2001
01:22:06,300 --> 01:22:04,870
to recreate all the Arctic sea ice is a

2002
01:22:08,580 --> 01:22:06,310
little bit different than then

2003
01:22:10,080 --> 01:22:08,590
increasing it by a bio meter or

2004
01:22:13,290 --> 01:22:10,090
something oh that's absolutely right in

2005
01:22:15,420 --> 01:22:13,300
fact I'm pretty sure that you can't

2006
01:22:17,460 --> 01:22:15,430
recreate sea ice you can only thicken

2007
01:22:20,820 --> 01:22:17,470
existing sea ice because it won't freeze

2008
01:22:22,980 --> 01:22:20,830
at the seawater temperature so so that's

2009
01:22:27,180 --> 01:22:22,990
sort of in 2030 this problem will be too

2010
01:22:28,320 --> 01:22:27,190
late - oh yeah so okay well having so do

2011
01:22:31,020 --> 01:22:28,330
you want you want to say things yeah I

2012
01:22:32,610 --> 01:22:31,030
want to maybe address this issue I think

2013
01:22:34,920 --> 01:22:32,620

one of the one of the things that we

2014
01:22:36,330 --> 01:22:34,930
really need to do like doing one second

2015
01:22:37,470 --> 01:22:36,340
while you're talking it looks like

2016
01:22:38,940 --> 01:22:37,480
people junk but go ahead

2017
01:22:40,020 --> 01:22:38,950
feel free to go to the microphones and

2018
01:22:42,480 --> 01:22:40,030
get ready if you have some questions

2019
01:22:45,780 --> 01:22:42,490
yeah Wilson is one of my heroes in his

2020
01:22:48,540 --> 01:22:45,790
book Concilium we are still training

2021
01:22:50,520 --> 01:22:48,550
people to be reductionist and part of

2022
01:22:53,220 --> 01:22:50,530
the science needs to be the system

2023
01:22:54,600 --> 01:22:53,230
science and this because we need to be

2024
01:22:57,060 --> 01:22:54,610
putting these things in context for

2025
01:22:59,250 --> 01:22:57,070
people and second thing I want to say is

2026
01:23:01,320 --> 01:22:59,260
I think we need a new career path for

2027
01:23:03,150 --> 01:23:01,330
people that are neither scientists nor

2028
01:23:05,840 --> 01:23:03,160
humanists that they're somewhere in the

2029
01:23:09,270 --> 01:23:05,850
middle and they're translating they're

2030
01:23:10,860 --> 01:23:09,280
moving forward trying to understand what

2031
01:23:13,170 --> 01:23:10,870
the meaning is and communicate that

2032
01:23:15,090 --> 01:23:13,180
after what seen studies yeah well it

2033
01:23:15,900 --> 01:23:15,100
would be great to have science who it

2034
01:23:17,510 --> 01:23:15,910
would be wonderful to have

2035
01:23:19,500 --> 01:23:17,520
scientifically literate humanists and

2036
01:23:21,870 --> 01:23:19,510
humanistically they're its scientists

2037
01:23:24,730 --> 01:23:21,880
anyway so let's let them on that off a

2038
01:23:26,710 --> 01:23:24,740

minute I know I am I think it's a

2039
01:23:28,330 --> 01:23:26,720
I think it's a it's a goal and I think I

2040
01:23:30,700 --> 01:23:28,340
think it was actually we've moved away

2041
01:23:32,080 --> 01:23:30,710
from that it used to be as an educated

2042
01:23:34,000 --> 01:23:32,090
person at the beginning of the 19th

2043
01:23:35,440 --> 01:23:34,010
century if you didn't have some basic

2044
01:23:37,720 --> 01:23:35,450
understanding of science it was you were

2045
01:23:40,030 --> 01:23:37,730
considered not educated and that has

2046
01:23:42,760 --> 01:23:40,040
changed but let's let's go to the

2047
01:23:46,750 --> 01:23:42,770
question so so my name is Moe Teague tea

2048
01:23:47,470 --> 01:23:46,760
party from JPL I have a comment and a

2049
01:23:49,600 --> 01:23:47,480
question

2050
01:23:54,700 --> 01:23:49,610
ok the comment be short I hope yeah a

2051
01:23:59,560 --> 01:23:54,710
comment is that we we tell that we

2052
01:24:01,720 --> 01:23:59,570
humans are putting it in danger but

2053
01:24:03,730 --> 01:24:01,730
actually we are not putting it in danger

2054
01:24:06,010 --> 01:24:03,740
but we are putting our own cells in

2055
01:24:07,630 --> 01:24:06,020
danger so that is the key point that we

2056
01:24:11,620 --> 01:24:07,640
need to give it to the common public

2057
01:24:14,230 --> 01:24:11,630
that tail children and grandchildren or

2058
01:24:16,180 --> 01:24:14,240
great-grandchildren other humanity is in

2059
01:24:18,700 --> 01:24:16,190
danger not earth because earth will

2060
01:24:21,220 --> 01:24:18,710
exist without us that's a comment we

2061
01:24:24,250 --> 01:24:21,230
have to change that paradigm and impose

2062
01:24:26,650 --> 01:24:24,260
on human humanity rather than earth ok

2063
01:24:32,610 --> 01:24:26,660

that will be there as long as the Sun is

2064
01:24:38,110 --> 01:24:32,620
there so the question is energy is

2065
01:24:41,320 --> 01:24:38,120
pollution and energy is addiction and as

2066
01:24:44,200 --> 01:24:41,330
a Taylor are not what ed Weiler said not

2067
01:24:46,480 --> 01:24:44,210
Ed Weiler so surely had no know someone

2068
01:24:50,680 --> 01:24:46,490
and someone said no one said if someone

2069
01:24:55,060 --> 01:24:50,690
said energy consumption is equivalent to

2070
01:24:57,250 --> 01:24:55,070
prosperity now we have as you all said 9

2071
01:25:01,390 --> 01:24:57,260
billion people here it will be rising to

2072
01:25:05,800 --> 01:25:01,400
15 billion sometime how do we reconcile

2073
01:25:08,350 --> 01:25:05,810
the energy consumption to the human

2074
01:25:11,110 --> 01:25:08,360
population and how do we tell them

2075
01:25:14,950 --> 01:25:11,120
starting from the second that you go to

2076
01:25:18,030 --> 01:25:14,960
sleep to the next 24 hours how you

2077
01:25:21,220 --> 01:25:18,040
consume energy is going to actually

2078
01:25:25,150 --> 01:25:21,230
dictate how humanity is going to be in

2079
01:25:27,520 --> 01:25:25,160
the future okay okay well I'll alternate

2080
01:25:31,300 --> 01:25:27,530
to Ivan my own ideas by one on anyone

2081
01:25:33,600 --> 01:25:31,310
anyone want to address that question you

2082
01:25:36,520 --> 01:25:33,610
want to start why do you start doing I

2083
01:25:37,660 --> 01:25:36,530
think your point is well-taken but we as

2084
01:25:39,010 --> 01:25:37,670
weak

2085
01:25:41,709 --> 01:25:39,020
I think one thing to think about is that

2086
01:25:45,280 --> 01:25:41,719
when we talk about energy consumption we

2087
01:25:47,740 --> 01:25:45,290
are talking about mid to late 20th

2088
01:25:49,600 --> 01:25:47,750

century energy consumption rates that

2089
01:25:55,030 --> 01:25:49,610
haven't changed I think there's an awful

2090
01:25:57,640 --> 01:25:55,040
lot of ingenuity that can change is

2091
01:25:59,680 --> 01:25:57,650
really efficiencies that can change the

2092
01:26:01,030 --> 01:25:59,690
way energy gets used in the future but I

2093
01:26:04,150 --> 01:26:01,040
your point is well-taken about

2094
01:26:08,260 --> 01:26:04,160
population I I will say that that I mean

2095
01:26:10,770 --> 01:26:08,270
that part of it part of the effort to

2096
01:26:13,900 --> 01:26:10,780
think about managing the planet is

2097
01:26:16,060 --> 01:26:13,910
related to the fact that many of the

2098
01:26:18,160 --> 01:26:16,070
much of consumption not just for energy

2099
01:26:20,470 --> 01:26:18,170
but water and all of the fundamental

2100
01:26:23,110 --> 01:26:20,480
things that humans use to live has been

2101
01:26:24,700 --> 01:26:23,120
done you know you know in a world where

2102
01:26:27,120 --> 01:26:24,710
it seemed limitless you could be

2103
01:26:29,890 --> 01:26:27,130
incredibly inefficient and incredibly

2104
01:26:32,890 --> 01:26:29,900
use far more than you need in many

2105
01:26:35,260 --> 01:26:32,900
things and so there are a lot of easy

2106
01:26:37,930 --> 01:26:35,270
there's a lot of low-hanging fruit that

2107
01:26:39,550 --> 01:26:37,940
comes from just simply increasing

2108
01:26:41,020 --> 01:26:39,560
efficiency because things have been so

2109
01:26:42,640 --> 01:26:41,030
inefficient because it hasn't been a

2110
01:26:45,370 --> 01:26:42,650
problem it's been cheap Energy's cheap

2111
01:26:49,419 --> 01:26:45,380
in the first world water was was was

2112
01:26:51,820 --> 01:26:49,429
plentiful and so why not use it all and

2113
01:26:55,180 --> 01:26:51,830

do so many things why not over cool

2114
01:26:57,850 --> 01:26:55,190
buildings in major cities so that you

2115
01:26:59,560 --> 01:26:57,860
have to you you or overheat them with

2116
01:27:01,930 --> 01:26:59,570
lights so that you have to cool them

2117
01:27:03,250 --> 01:27:01,940
unduly in the summer time instead of not

2118
01:27:05,200 --> 01:27:03,260
overheating them with lights lots of

2119
01:27:08,800 --> 01:27:05,210
things like that that that I think can

2120
01:27:10,390 --> 01:27:08,810
be done very effectively to reduce the

2121
01:27:12,280 --> 01:27:10,400
net consumption even in the first world

2122
01:27:13,870 --> 01:27:12,290
you know there's one other aspect that I

2123
01:27:15,490 --> 01:27:13,880
think should be mentioned that we

2124
01:27:17,890 --> 01:27:15,500
haven't really mentioned yet this

2125
01:27:20,680 --> 01:27:17,900
evening that Murray's question makes me

2126
01:27:22,720 --> 01:27:20,690
want to bring up which is that we talked

2127
01:27:24,280 --> 01:27:22,730
about we we human beings are doing this

2128
01:27:26,590 --> 01:27:24,290
we human beings are doing that we have

2129
01:27:28,689 --> 01:27:26,600
to limit our energy use but we also have

2130
01:27:30,850 --> 01:27:28,699
to remember they're issues of global

2131
01:27:32,919 --> 01:27:30,860
equity and there were rich countries and

2132
01:27:35,050 --> 01:27:32,929
poor countries and we we Americans have

2133
01:27:37,060 --> 01:27:35,060
used up more than our share of energy

2134
01:27:40,570 --> 01:27:37,070
and yeah we have to learn to radically

2135
01:27:42,630 --> 01:27:40,580
curtail and transform our energy use but

2136
01:27:45,370 --> 01:27:42,640
there's also a lot of people in poor

2137
01:27:47,919 --> 01:27:45,380
underdeveloped countries that are going

2138
01:27:50,410 --> 01:27:47,929

to in this next century have the desire

2139
01:27:51,020 --> 01:27:50,420
and the right to increase their energy

2140
01:27:53,200 --> 01:27:51,030
you

2141
01:27:56,720 --> 01:27:53,210
to bring up their standard of living and

2142
01:27:58,910 --> 01:27:56,730
so it will be really smart for us

2143
01:28:02,569 --> 01:27:58,920
thinking of the global situation to help

2144
01:28:05,180 --> 01:28:02,579
them do it in a way that is less

2145
01:28:07,609 --> 01:28:05,190
globally destructive and so alternative

2146
01:28:10,370 --> 01:28:07,619
energy for for poor countries letting

2147
01:28:13,910 --> 01:28:10,380
them use more energy as is their right

2148
01:28:16,279 --> 01:28:13,920
helping them but but helping with the

2149
01:28:18,439 --> 01:28:16,289
technology and everything that goes with

2150
01:28:21,169 --> 01:28:18,449
that technology so that they can do it

2151
01:28:23,209 --> 01:28:21,179
in a way that is compatible with a

2152
01:28:25,729 --> 01:28:23,219
better future for all of us is going to

2153
01:28:28,430 --> 01:28:25,739
be really important okay and next

2154
01:28:30,740 --> 01:28:28,440
question how do you deal with the oh

2155
01:28:33,260 --> 01:28:30,750
okay there yeah then how do they deal

2156
01:28:35,810 --> 01:28:33,270
with the issue of the good side of

2157
01:28:37,160 --> 01:28:35,820
global warming I can think of people who

2158
01:28:39,919 --> 01:28:37,170
might think it's a good idea to have a

2159
01:28:42,169 --> 01:28:39,929
warmer Siberia and arctic ocean that's

2160
01:28:44,930 --> 01:28:42,179
open to shipping and Development and a

2161
01:28:46,399 --> 01:28:44,940
warm water port for Russia so how do you

2162
01:28:47,990 --> 01:28:46,409
there must be some people want more

2163
01:28:52,459 --> 01:28:48,000

global warming and how do you counter

2164
01:28:54,290 --> 01:28:52,469
them there are a number one of who may

2165
01:28:57,140 --> 01:28:54,300
be come the president's science advisor

2166
01:29:01,700 --> 01:28:57,150
fact who strongly believes it that

2167
01:29:05,510 --> 01:29:01,710
plants need more carbon dioxide so I so

2168
01:29:08,240 --> 01:29:05,520
you know I think well again I feeling

2169
01:29:10,910 --> 01:29:08,250
I'll start it but I'd be happy to what

2170
01:29:12,680 --> 01:29:10,920
other panelists say is it one has to

2171
01:29:15,140 --> 01:29:12,690
talk about all of the implications and

2172
01:29:18,669 --> 01:29:15,150
you it's really important to have an

2173
01:29:38,480 --> 01:29:18,679
informed discussion and and and and

2174
01:29:41,900 --> 01:29:40,220
anyone maybe with your especially

2175
01:29:43,370 --> 01:29:41,910
someone else's microphone he didn't hear

2176
01:29:45,560 --> 01:29:43,380
me I wasn't saying anything for whatever

2177
01:29:47,240 --> 01:29:45,570
said that's the problem that's only one

2178
01:29:49,580 --> 01:29:47,250
part of the problem right if you are

2179
01:29:51,950 --> 01:29:49,590
going to manage the globe and do it in a

2180
01:29:53,570 --> 01:29:51,960
top-down way and then if you think

2181
01:29:56,780 --> 01:29:53,580
you're going to do it in a democratic

2182
01:29:59,630 --> 01:29:56,790
way you know I think we're getting a

2183
01:30:02,690 --> 01:29:59,640
real Civic lesson in what democracy can

2184
01:30:05,150 --> 01:30:02,700
bring us in this country today so I mean

2185
01:30:08,480 --> 01:30:05,160
I think the issue is that we don't as a

2186
01:30:11,750 --> 01:30:08,490
as a people we don't know how to do that

2187
01:30:14,180 --> 01:30:11,760
and that's and yet we're facing problems

2188
01:30:15,980 --> 01:30:14,190

that have that magnitude that require

2189
01:30:18,200 --> 01:30:15,990
that probably requires some kind of

2190
01:30:20,060 --> 01:30:18,210
top-down or some kind of global decision

2191
01:30:22,340 --> 01:30:20,070
you know I mean how many people in the

2192
01:30:26,060 --> 01:30:22,350
room have taken some action to reduce

2193
01:30:28,490 --> 01:30:26,070
their carbon footprint everybody right

2194
01:30:31,160 --> 01:30:28,500
and so what's the net impact of each of

2195
01:30:33,080 --> 01:30:31,170
your actions practically nothing and yet

2196
01:30:35,000 --> 01:30:33,090
if we could do something on a global

2197
01:30:36,950 --> 01:30:35,010
level it would maybe have an impact but

2198
01:30:41,900 --> 01:30:36,960
we can't make decisions like you just

2199
01:30:44,060 --> 01:30:41,910
did to do that so I think we're we're

2200
01:30:46,040 --> 01:30:44,070
probably looking at things that have to

2201
01:30:48,110 --> 01:30:46,050
do again with more regional solutions

2202
01:30:49,760 --> 01:30:48,120
where people can make decisions and they

2203
01:30:52,070 --> 01:30:49,770
do have some impact and those things

2204
01:30:54,740 --> 01:30:52,080
growing in some way and I think that's

2205
01:30:58,040 --> 01:30:54,750
probably what's going to happen I will

2206
01:30:59,330 --> 01:30:58,050
say that you know Einstein said after

2207
01:31:00,650 --> 01:30:59,340
the first nuclear weapon was dropped

2208
01:31:03,200 --> 01:31:00,660
that everything's changed saved the way

2209
01:31:04,760 --> 01:31:03,210
we think and we still think the same way

2210
01:31:06,410 --> 01:31:04,770
even then there's a clear example of a

2211
01:31:09,230 --> 01:31:06,420
global threat that we have an address

2212
01:31:10,790 --> 01:31:09,240
well let me just say that the way I

2213
01:31:13,670 --> 01:31:10,800

distill that question that you asked is

2214
01:31:16,760 --> 01:31:13,680
not about ports or better agriculture

2215
01:31:20,300 --> 01:31:16,770
which is specious anyway it's really the

2216
01:31:22,360 --> 01:31:20,310
question what's good for me or what's

2217
01:31:25,010 --> 01:31:22,370
good for us yeah

2218
01:31:26,270 --> 01:31:25,020
and I think what's good for us it's a

2219
01:31:28,010 --> 01:31:26,280
very different dialogue and then you

2220
01:31:29,870 --> 01:31:28,020
have to get to the systems question of

2221
01:31:31,280 --> 01:31:29,880
looking at the earth physicist and you

2222
01:31:32,600 --> 01:31:31,290
have to think of us so stated was

2223
01:31:34,220 --> 01:31:32,610
pointing out this is a real concern to

2224
01:31:35,930 --> 01:31:34,230
me especially in this country now where

2225
01:31:39,290 --> 01:31:35,940
policies being driven by me instead of

2226
01:31:40,820 --> 01:31:39,300
us in on just a national level the AH

2227
01:31:42,800 --> 01:31:40,830
step we should be thinking about is not

2228
01:31:44,650 --> 01:31:42,810
us in the United States or us the US

2229
01:31:47,300 --> 01:31:44,660
should be global and that's never

2230
01:31:49,250 --> 01:31:47,310
happened and but it needs to happen and

2231
01:31:49,820 --> 01:31:49,260
I understand I said it before but it's

2232
01:31:53,600 --> 01:31:49,830
not just

2233
01:31:55,970 --> 01:31:53,610
human being yeah you know it's about

2234
01:31:58,190 --> 01:31:55,980
global biodiversity because a world

2235
01:32:00,110 --> 01:31:58,200
without bass without bees and it's a

2236
01:32:02,570 --> 01:32:00,120
world without fruit and that's going to

2237
01:32:04,610 --> 01:32:02,580
be an icky world I like fruit yeah and

2238
01:32:07,370 --> 01:32:04,620

and the oceans probably have already

2239
01:32:10,340 --> 01:32:07,380
begun to be impacted more than any other

2240
01:32:12,050 --> 01:32:10,350
area and and and and so we're

2241
01:32:13,430 --> 01:32:12,060
dramatically affecting life in the

2242
01:32:16,280 --> 01:32:13,440
oceans already so from a certain

2243
01:32:18,680 --> 01:32:16,290
perspective on a certain shorter time

2244
01:32:22,190 --> 01:32:18,690
scale there would be regional winners

2245
01:32:24,710 --> 01:32:22,200
and losers but from a larger and longer

2246
01:32:27,230 --> 01:32:24,720
term perspective they're not going to be

2247
01:32:29,270 --> 01:32:27,240
any winners if we push our global

2248
01:32:31,250 --> 01:32:29,280
systems beyond safe boundaries

2249
01:32:32,840 --> 01:32:31,260
okay well we'll try to take some more

2250
01:32:34,850 --> 01:32:32,850
questions in what pride debriefer but

2251
01:32:36,440 --> 01:32:34,860
well go a little long I think it's if

2252
01:32:38,690 --> 01:32:36,450
they're long as their audience questions

2253
01:32:41,660 --> 01:32:38,700
yeah the first thing about I've got some

2254
01:32:43,670 --> 01:32:41,670
home maintenance and repair issues this

2255
01:32:45,230 --> 01:32:43,680
week I just wonder dr. Grunsfeld with

2256
01:32:46,430 --> 01:32:45,240
that third time you went up to repair

2257
01:32:49,220 --> 01:32:46,440
the Hubble that thing's still under

2258
01:32:51,530 --> 01:32:49,230
warranty the water ran out actually five

2259
01:32:55,370 --> 01:32:51,540
years afterwards but I will still

2260
01:32:57,320 --> 01:32:55,380
service it all right actually the good

2261
01:32:58,760 --> 01:32:57,330
news is that you know we thought it

2262
01:33:00,350 --> 01:32:58,770
would last about five more years after

2263
01:33:03,620 --> 01:33:00,360

the mission and everything's going great

2264
01:33:06,260 --> 01:33:03,630
and so with that and a very calm solar

2265
01:33:08,900 --> 01:33:06,270
cycle it's actually important for the

2266
01:33:10,760 --> 01:33:08,910
earth to publish should continue operate

2267
01:33:12,770 --> 01:33:10,770
in another five or so years before the

2268
01:33:15,890 --> 01:33:12,780
next thing that we can anticipate will

2269
01:33:17,450 --> 01:33:15,900
happen to it let me in that regard so

2270
01:33:20,390 --> 01:33:17,460
the James Webb Space Telescope is going

2271
01:33:21,980 --> 01:33:20,400
up next year October 20 and and so

2272
01:33:23,630 --> 01:33:21,990
they'll run in tandem and there's a

2273
01:33:25,520 --> 01:33:23,640
budget and there's budget funds to keep

2274
01:33:28,460 --> 01:33:25,530
the Hubble going for well there five

2275
01:33:29,990 --> 01:33:28,470
years who knows that that I mean what

2276
01:33:32,060 --> 01:33:30,000
big question because people may say we

2277
01:33:33,530 --> 01:33:32,070
have the James Webb so turn off Kabul

2278
01:33:36,230 --> 01:33:33,540
but scientifically it's very exciting

2279
01:33:37,790 --> 01:33:36,240
temple okay thank you I think I'm an

2280
01:33:41,750 --> 01:33:37,800
only allowed ask one just because we

2281
01:33:43,490 --> 01:33:41,760
have so many next thanks yeah I wanted

2282
01:33:45,560 --> 01:33:43,500
to say a quick hi to my daughter Marissa

2283
01:33:49,160 --> 01:33:45,570
who was in Argonne watching this dream

2284
01:33:50,570 --> 01:33:49,170
and told me about this but I felt like

2285
01:33:54,560 --> 01:33:50,580
maybe you were flirting with this a

2286
01:33:57,260 --> 01:33:54,570
little bit is it crazy to think that if

2287
01:34:00,350 --> 01:33:57,270
we don't find ways to protect you know

2288
01:34:02,900 --> 01:34:00,360

our fragile planet that the planet will

2289
01:34:03,649 --> 01:34:02,910
figure out ways to handle it for us like

2290
01:34:05,569 --> 01:34:03,659
I'm

2291
01:34:08,169 --> 01:34:05,579
you know pandemics things like that I

2292
01:34:10,669 --> 01:34:08,179
mean do you worry about that a lot

2293
01:34:14,089 --> 01:34:10,679
any what that I'm not gonna touch that

2294
01:34:21,290 --> 01:34:14,099
when you wouldn't I do worry about that

2295
01:34:26,899 --> 01:34:21,300
I mean it's certainly true that that we

2296
01:34:30,199 --> 01:34:26,909
are being challenged there are problems

2297
01:34:31,810 --> 01:34:30,209
it's it you know biologically we may be

2298
01:34:34,310 --> 01:34:31,820
able to survive

2299
01:34:36,799 --> 01:34:34,320
climate the the worst parts of climate

2300
01:34:38,479 --> 01:34:36,809
change but what is really important and

2301
01:34:40,790 --> 01:34:38,489
it's relevant I think what Hillary said

2302
01:34:42,799 --> 01:34:40,800
is there a incredible socio-political

2303
01:34:46,159 --> 01:34:42,809
impacts that are going to produce

2304
01:34:47,839 --> 01:34:46,169
tensions and Wars and and for scarce

2305
01:34:53,239 --> 01:34:47,849
resources not just water but other

2306
01:34:57,399 --> 01:34:53,249
things energy and space land and food

2307
01:35:00,379 --> 01:34:57,409
and that so that I personally think the

2308
01:35:02,000 --> 01:35:00,389
the greatest danger to humanity is the

2309
01:35:03,830 --> 01:35:02,010
socio-political implications the

2310
01:35:05,299 --> 01:35:03,840
tensions the international tensions that

2311
01:35:09,229 --> 01:35:05,309
will result from these things which

2312
01:35:11,659 --> 01:35:09,239
could lead to devastation via global

2313
01:35:15,379 --> 01:35:11,669

Wars I think that's a that's a in my own

2314
01:35:17,299 --> 01:35:15,389
mind of a big bigger problem this

2315
01:35:19,069 --> 01:35:17,309
question is mostly directed to Jane but

2316
01:35:20,600 --> 01:35:19,079
I'd like to hear all your views on it

2317
01:35:22,489 --> 01:35:20,610
what do you think of the carbon

2318
01:35:24,500 --> 01:35:22,499
sequestration technique of locking the

2319
01:35:25,850 --> 01:35:24,510
co2 up and carbonate it's obviously

2320
01:35:27,620 --> 01:35:25,860
still a band-aid solution because

2321
01:35:29,419 --> 01:35:27,630
eventually we'll run out of space put

2322
01:35:31,790 --> 01:35:29,429
all the carbonate but as far as

2323
01:35:32,989 --> 01:35:31,800
band-aids go what do you think of it and

2324
01:35:35,569 --> 01:35:32,999
if you don't like it what's your

2325
01:35:39,560 --> 01:35:35,579
favorite sequestration technique I don't

2326
01:35:41,989 --> 01:35:39,570
think like is kind of the way like I

2327
01:35:44,779 --> 01:35:41,999
think it's just slow you know I think

2328
01:35:48,109 --> 01:35:44,789
these these carbonate is a great way to

2329
01:35:50,449 --> 01:35:48,119
go and also can serve as a buffer in the

2330
01:35:52,429 --> 01:35:50,459
ocean and I think those are really great

2331
01:35:54,739 --> 01:35:52,439
technologies but and some of them are

2332
01:35:57,319 --> 01:35:54,749
even downhill reactions you would be

2333
01:35:59,899 --> 01:35:57,329
able to react more than I want react

2334
01:36:03,319 --> 01:35:59,909
sorry you'll be able to discuss that

2335
01:36:06,469 --> 01:36:03,329
more than I would but the fact is if

2336
01:36:08,719 --> 01:36:06,479
they're either Maps limited or rate

2337
01:36:11,299 --> 01:36:08,729
limited you know you can't you just

2338
01:36:13,669 --> 01:36:11,309

can't get things moving fast enough

2339
01:36:14,870 --> 01:36:13,679
either because you can't get enough mass

2340
01:36:16,620 --> 01:36:14,880
involved in the reaction where the

2341
01:36:21,120 --> 01:36:16,630
reaction is too slow

2342
01:36:23,669 --> 01:36:21,130
and I think that's that's where I have I

2343
01:36:25,620 --> 01:36:23,679
have a lot of doubt about whether any of

2344
01:36:29,040 --> 01:36:25,630
the carbon sequestration technologies

2345
01:36:34,890 --> 01:36:29,050
that we're talking about now will pan

2346
01:36:38,220 --> 01:36:34,900
out in the long term as being is being

2347
01:36:39,810 --> 01:36:38,230
meaningful and scale wise so that's why

2348
01:36:42,270 --> 01:36:39,820
people are starting to talk about air

2349
01:36:44,490 --> 01:36:42,280
capture actually filtering out of the

2350
01:36:46,590 --> 01:36:44,500
air and I and then you still have a

2351
01:36:48,450 --> 01:36:46,600
problem because although people think

2352
01:36:49,890 --> 01:36:48,460
that like you said before as well this

2353
01:36:51,629 --> 01:36:49,900
is just natural we're just going back

2354
01:36:53,399 --> 01:36:51,639
you're actually not going back because

2355
01:36:55,200 --> 01:36:53,409
you have still to put the co2 someplace

2356
01:36:57,149 --> 01:36:55,210
someplace and so I think well I

2357
01:36:59,820 --> 01:36:57,159
personally think what we'll be doing is

2358
01:37:01,919 --> 01:36:59,830
taking it out of the air and putting it

2359
01:37:04,350 --> 01:37:01,929
into the deep ocean sacrificing the deep

2360
01:37:05,240 --> 01:37:04,360
ocean that's what I think will happen in

2361
01:37:07,800 --> 01:37:05,250
the long term

2362
01:37:08,939 --> 01:37:07,810
okay well we'll proceed but I want to

2363
01:37:12,479 --> 01:37:08,949

try and get through as many questions as

2364
01:37:15,060 --> 01:37:12,489
we can yes okay um everybody's heard

2365
01:37:17,160 --> 01:37:15,070
about Venus having twenty through two

2366
01:37:20,610 --> 01:37:17,170
hundred thousand times as much co2 as

2367
01:37:24,750 --> 01:37:20,620
the earth and being warm enough stool to

2368
01:37:27,330 --> 01:37:24,760
melt lead nobody talks about Mars having

2369
01:37:31,800 --> 01:37:27,340
20 times the co2 is the earth and can't

2370
01:37:36,000 --> 01:37:31,810
melt ice anyhow in the climate near the

2371
01:37:39,689 --> 01:37:36,010
ground by rudolf geiger translated from

2372
01:37:46,129 --> 01:37:39,699
the German 1951 he points out how how

2373
01:37:50,490 --> 01:37:46,139
nonsensical the co2 greenhouse gas

2374
01:37:53,640 --> 01:37:50,500
theory is because water vapors like six

2375
01:37:58,709 --> 01:37:53,650
to twenty times the greenhouse gases co2

2376
01:38:00,930 --> 01:37:58,719
and also nobody talks about by a higher

2377
01:38:02,340 --> 01:38:00,940
level okay so so do you have a question

2378
01:38:03,840 --> 01:38:02,350
I mean yeah that's what a lot of people

2379
01:38:05,810 --> 01:38:03,850
do talk about all of these things okay

2380
01:38:08,580 --> 01:38:05,820
when the climate scientists actually

2381
01:38:10,979 --> 01:38:08,590
spend their lives worrying about just

2382
01:38:15,419 --> 01:38:10,989
these questions whether that clear some

2383
01:38:20,040 --> 01:38:15,429
secret no but by Sir two was supposed to

2384
01:38:24,180 --> 01:38:20,050
show sustainability and they had to bail

2385
01:38:26,580 --> 01:38:24,190
out because of low oxygen after a short

2386
01:38:29,520 --> 01:38:26,590
period of time because they're

2387
01:38:30,629 --> 01:38:29,530
generating co2 at a hundred times the

2388
01:38:35,820 --> 01:38:30,639

grade of

2389
01:38:38,879 --> 01:38:35,830
of the the earth is doing it okay once

2390
01:38:41,310 --> 01:38:38,889
again so you made a statement I don't

2391
01:38:45,379 --> 01:38:41,320
want to do also jesting just to correct

2392
01:38:49,830 --> 01:38:45,389
one thing the atmosphere of Mars

2393
01:38:52,950 --> 01:38:49,840
perfectly validates our ideas about co2

2394
01:38:56,609 --> 01:38:52,960
it's a very very thin atmosphere and the

2395
01:38:59,520 --> 01:38:56,619
fact that Venus and Mars have surface

2396
01:39:02,850 --> 01:38:59,530
temperatures which our climate models

2397
01:39:04,620 --> 01:39:02,860
predict very very well with our basic

2398
01:39:07,340 --> 01:39:04,630
understanding of the absorption of co2

2399
01:39:10,080 --> 01:39:07,350
and other gases actually validates our

2400
01:39:12,149 --> 01:39:10,090
understanding of the way climate works

2401
01:39:13,830 --> 01:39:12,159
now on earth and will work in the future

2402
01:39:16,020 --> 01:39:13,840
this is what I actually do for a living

2403
01:39:19,800 --> 01:39:16,030
is models of these other atmospheres in

2404
01:39:23,479 --> 01:39:19,810
and it works rather well and it's one

2405
01:39:26,580 --> 01:39:23,489
way that we know that our physics of how

2406
01:39:28,709 --> 01:39:26,590
radiation interacts with atmosphere of

2407
01:39:29,160 --> 01:39:28,719
gases is basically correct okay next

2408
01:39:31,520 --> 01:39:29,170
question

2409
01:39:34,350 --> 01:39:31,530
I take apart miss for blue marble space

2410
01:39:36,780 --> 01:39:34,360
James Lovelock the originator of the

2411
01:39:38,490 --> 01:39:36,790
Gaia hypothesis has recently articulated

2412
01:39:39,899 --> 01:39:38,500
that we don't need sustainable

2413
01:39:42,209 --> 01:39:39,909

development what we need is a

2414
01:39:44,340 --> 01:39:42,219
sustainable retreat and what this says

2415
01:39:46,890 --> 01:39:44,350
to me it's sort of the ends between

2416
01:39:48,890 --> 01:39:46,900
hubris and humility the hubris side we

2417
01:39:51,090 --> 01:39:48,900
have a strong belief in human technology

2418
01:39:52,470 --> 01:39:51,100
geoengineering or other things to be

2419
01:39:54,479 --> 01:39:52,480
able to overcome these environmental

2420
01:39:57,000 --> 01:39:54,489
problems and I'm the humility side it's

2421
01:39:58,950 --> 01:39:57,010
maybe there are a lot of uncertainties

2422
01:40:00,570 --> 01:39:58,960
and maybe we need to step back and maybe

2423
01:40:02,250 --> 01:40:00,580
we need to think about reducing our

2424
01:40:03,570 --> 01:40:02,260
lifestyle in the United States not

2425
01:40:04,979 --> 01:40:03,580
necessarily bringing everyone else up to

2426
01:40:06,300 --> 01:40:04,989
our standard but maybe we need to

2427
01:40:08,430 --> 01:40:06,310
sacrifice Oh what are your thoughts on

2428
01:40:09,149 --> 01:40:08,440
that I think you're absolutely right

2429
01:40:11,370 --> 01:40:09,159
it's both

2430
01:40:13,680 --> 01:40:11,380
we need restraint and innovation and

2431
01:40:15,930 --> 01:40:13,690
there are people that believe in only

2432
01:40:19,800 --> 01:40:15,940
one and not the other and they're both

2433
01:40:23,459 --> 01:40:19,810
wrong and and I think I think I think

2434
01:40:24,780 --> 01:40:23,469
the point so that Jane is making in what

2435
01:40:26,640 --> 01:40:24,790
President Obama used to say which is

2436
01:40:28,320 --> 01:40:26,650
true which is that restraint doesn't

2437
01:40:31,200 --> 01:40:28,330
mean a worse quality of life you can

2438
01:40:32,729 --> 01:40:31,210

just you can find better ways to create

2439
01:40:35,220 --> 01:40:32,739
new technologies that allow you to live

2440
01:40:37,169 --> 01:40:35,230
better with less and so it isn't always

2441
01:40:39,330 --> 01:40:37,179
just a matter of doing without it's a

2442
01:40:41,399 --> 01:40:39,340
matter of finding way ways to do with

2443
01:40:41,930 --> 01:40:41,409
less and do more with less often I think

2444
01:40:43,790 --> 01:40:41,940
that's

2445
01:40:46,729 --> 01:40:43,800
an important thing that and technology

2446
01:40:48,500 --> 01:40:46,739
is the key I think I think you could get

2447
01:40:50,510 --> 01:40:48,510
down another layer in some of this that

2448
01:40:53,479 --> 01:40:50,520
we haven't done there's bang for the

2449
01:40:55,790 --> 01:40:53,489
buck on efficiency for example in we

2450
01:40:58,370 --> 01:40:55,800
have no really replacement for gasoline

2451
01:41:01,209 --> 01:40:58,380
and mobile transportation for the most

2452
01:41:05,240 --> 01:41:01,219
part I mean while biofuel might become

2453
01:41:07,100 --> 01:41:05,250
carbon neutral it's not now and there is

2454
01:41:09,140 --> 01:41:07,110
it's going to be limited by biomass so

2455
01:41:10,970 --> 01:41:09,150
this is where efficiency and

2456
01:41:12,590 --> 01:41:10,980
conservation really make a huge

2457
01:41:14,840 --> 01:41:12,600
difference because we don't have a

2458
01:41:17,510 --> 01:41:14,850
technology to replace it could we

2459
01:41:21,830 --> 01:41:17,520
theoretically decarbonize electricity

2460
01:41:26,660 --> 01:41:21,840
yes we can we know how to do it so there

2461
01:41:28,400 --> 01:41:26,670
uses of electricity might expand and if

2462
01:41:30,709 --> 01:41:28,410
we can still create enough electricity

2463
01:41:32,900 --> 01:41:30,719

without carbon dioxide we'll be fine it

2464
01:41:34,670 --> 01:41:32,910
doesn't matter but if you don't have the

2465
01:41:35,720 --> 01:41:34,680
technology then efficiency becomes

2466
01:41:37,790 --> 01:41:35,730
important and I don't think we've

2467
01:41:39,170 --> 01:41:37,800
thought that way you know you know we

2468
01:41:40,189 --> 01:41:39,180
haven't parsed the problem like that'd

2469
01:41:41,720 --> 01:41:40,199
be enough

2470
01:41:44,120 --> 01:41:41,730
I have one other thing to add to this

2471
01:41:46,280 --> 01:41:44,130
idea and I think it's important to

2472
01:41:49,700 --> 01:41:46,290
remember at the risk of sounding like a

2473
01:41:51,470 --> 01:41:49,710
chemist time and human evolution is a

2474
01:41:53,930 --> 01:41:51,480
one-way reaction we don't get to go

2475
01:41:56,930 --> 01:41:53,940
backwards we can make the forward

2476
01:41:58,280 --> 01:41:56,940
reaction different but we can't turn it

2477
01:42:00,950 --> 01:41:58,290
around and put the genie back in the

2478
01:42:03,380 --> 01:42:00,960
bottle on this and so we have to look

2479
01:42:07,820 --> 01:42:03,390
forwards and not think about it as

2480
01:42:10,130 --> 01:42:07,830
retreat excellent okay a few more yep I

2481
01:42:11,840 --> 01:42:10,140
like to end by nine which is about 15

2482
01:42:13,790 --> 01:42:11,850
minutes longer than I planned just so

2483
01:42:14,660 --> 01:42:13,800
you know if you're here I don't make it

2484
01:42:17,180 --> 01:42:14,670
quick

2485
01:42:19,160 --> 01:42:17,190
so I'm now more aware than ever the

2486
01:42:21,110 --> 01:42:19,170
current unsustainable trajectory of our

2487
01:42:23,180 --> 01:42:21,120
society and through that I sort of feel

2488
01:42:24,800 --> 01:42:23,190

like a responsibility to do something

2489
01:42:26,840 --> 01:42:24,810
about it because if I'm going to be

2490
01:42:29,600 --> 01:42:26,850
doing work on this planet I'd like to

2491
01:42:32,510 --> 01:42:29,610
help make the planet work so I'm just

2492
01:42:36,770 --> 01:42:32,520
curious how do I sign up for this

2493
01:42:43,189 --> 01:42:36,780
program and become a steward in the near

2494
01:42:45,709 --> 01:42:43,199
term send me an email all right well in

2495
01:42:47,660 --> 01:42:45,719
tactics yeah there we go you know let me

2496
01:42:49,160 --> 01:42:47,670
say as an individual I mean I'll talk

2497
01:42:50,930 --> 01:42:49,170
about some of the things that I've done

2498
01:42:53,180 --> 01:42:50,940
I mean there are a lot of individual

2499
01:42:54,700 --> 01:42:53,190
choices you can make and I'll you know

2500
01:42:56,470 --> 01:42:54,710
alone your choices are not going to

2501
01:42:59,110 --> 01:42:56,480
big impact on the planet only when we

2502
01:43:00,880 --> 01:42:59,120
are collectively but really for at all

2503
01:43:03,729 --> 01:43:00,890
levels about decisions you make every

2504
01:43:05,860 --> 01:43:03,739
day about decisions that our elected

2505
01:43:07,900 --> 01:43:05,870
officials make about decisions the UN

2506
01:43:10,240 --> 01:43:07,910
tries to make collectively that other

2507
01:43:12,970 --> 01:43:10,250
nations make those decisions that make a

2508
01:43:14,950 --> 01:43:12,980
difference so when you you know let's

2509
01:43:16,750 --> 01:43:14,960
say you decide to go buy a car you go

2510
01:43:18,880 --> 01:43:16,760
into the dealer and at about the same

2511
01:43:21,430 --> 01:43:18,890
price you know you can get an f250

2512
01:43:23,680 --> 01:43:21,440
double-wide or you can buy an electric

2513
01:43:25,810 --> 01:43:23,690

car and you know you get to make a

2514
01:43:27,670 --> 01:43:25,820
choice and you know the good thing is to

2515
01:43:30,250 --> 01:43:27,680
try and educate yourself and make a wise

2516
01:43:31,660 --> 01:43:30,260
decision with whatever criteria you have

2517
01:43:33,220 --> 01:43:31,670
if you're going to haul manure you're

2518
01:43:35,320 --> 01:43:33,230
probably going to get the truck if you

2519
01:43:37,120 --> 01:43:35,330
want to try and get basic transportation

2520
01:43:39,250 --> 01:43:37,130
and have the least impact on the planet

2521
01:43:41,440 --> 01:43:39,260
you know it's the electric car when you

2522
01:43:43,630 --> 01:43:41,450
eat there's a huge energy difference

2523
01:43:46,240 --> 01:43:43,640
between eating vegetables chicken and

2524
01:43:48,520 --> 01:43:46,250
beef for instance and so you can decide

2525
01:43:51,310 --> 01:43:48,530
how often you eat what of webs you and

2526
01:43:53,530 --> 01:43:51,320
where it comes from that has you know a

2527
01:43:54,940 --> 01:43:53,540
large energy difference now it's going

2528
01:43:57,520 --> 01:43:54,950
to make you feel better that you're

2529
01:43:59,320 --> 01:43:57,530
helping yours and if you're if you make

2530
01:44:01,240 --> 01:43:59,330
educated decisions and then also

2531
01:44:03,070 --> 01:44:01,250
influence your friends and neighbors and

2532
01:44:04,540 --> 01:44:03,080
maybe become you know an elected

2533
01:44:07,420 --> 01:44:04,550
official you can have more and never

2534
01:44:09,910 --> 01:44:07,430
increase in influence and we and I that

2535
01:44:11,050 --> 01:44:09,920
well what is it yeah I think one thing I

2536
01:44:13,120 --> 01:44:11,060
think is really important that people

2537
01:44:14,890 --> 01:44:13,130
don't talk about too much or people you

2538
01:44:17,590 --> 01:44:14,900

need to talk about is avoiding

2539
01:44:19,090 --> 01:44:17,600
groupthink I think one of the things

2540
01:44:21,880 --> 01:44:19,100
that people are beginning to show is

2541
01:44:23,740 --> 01:44:21,890
that they that people tend to believe

2542
01:44:26,229 --> 01:44:23,750
information from people they think are

2543
01:44:28,030 --> 01:44:26,239
part of their tribe or their group and I

2544
01:44:29,920 --> 01:44:28,040
think what we what we're doing is

2545
01:44:31,780 --> 01:44:29,930
propagating a lot of information on all

2546
01:44:36,660 --> 01:44:31,790
sides of this problem that are not that

2547
01:44:38,950 --> 01:44:36,670
that isn't really true you know the the

2548
01:44:42,280 --> 01:44:38,960
that what was the big pipeline the

2549
01:44:44,590 --> 01:44:42,290
Keystone pipeline you know was going to

2550
01:44:46,690 --> 01:44:44,600
be game over and everybody blond on to

2551
01:44:48,310 --> 01:44:46,700
get Keystone pipeline Keystone pipeline

2552
01:44:49,870 --> 01:44:48,320
a year of emissions from Keystone

2553
01:44:52,660 --> 01:44:49,880
pipeline associated without a ten

2554
01:44:54,700 --> 01:44:52,670
minutes of carbon dioxide from China's

2555
01:44:56,650 --> 01:44:54,710
coal-fired plants you've got to be able

2556
01:44:59,260 --> 01:44:56,660
to put things in the right context and

2557
01:45:01,540 --> 01:44:59,270
understand that and so I think we have

2558
01:45:03,250 --> 01:45:01,550
as a society as an individual you have

2559
01:45:05,229 --> 01:45:03,260
an obligation to go beyond what

2560
01:45:07,300 --> 01:45:05,239
everybody's telling you and figure it

2561
01:45:08,390 --> 01:45:07,310
out figure out what the right way to

2562
01:45:10,580 --> 01:45:08,400
think about this is

2563
01:45:13,760 --> 01:45:10,590

but as scientist me I think as Hillary

2564
01:45:15,380 --> 01:45:13,770
saying I think that it may be it's not

2565
01:45:18,110 --> 01:45:15,390
advocacy but what we need to do is

2566
01:45:20,120 --> 01:45:18,120
translate in an effective way so the

2567
01:45:20,450 --> 01:45:20,130
cover so the public can figure things

2568
01:45:21,740 --> 01:45:20,460
out

2569
01:45:24,350 --> 01:45:21,750
so they do have access to information

2570
01:45:27,709 --> 01:45:24,360
that's understandable and clear I mean

2571
01:45:29,959 --> 01:45:27,719
yeah here's one example it takes 703

2572
01:45:32,600 --> 01:45:29,969
tons of water to prove the feed for a

2573
01:45:34,160 --> 01:45:32,610
car that produces one hamburger for

2574
01:45:36,740 --> 01:45:34,170
example is the kind of kind of

2575
01:45:41,060 --> 01:45:36,750
information that is digestible literally

2576
01:45:43,280 --> 01:45:41,070
if not metaphorically and and and and I

2577
01:45:46,520 --> 01:45:43,290
bet bet but but I didn't plan that that

2578
01:45:48,380 --> 01:45:46,530
just came but um but no the point is so

2579
01:45:49,700 --> 01:45:48,390
that we I think the real thing that if

2580
01:45:51,680 --> 01:45:49,710
the public is going to be able to act

2581
01:45:53,720 --> 01:45:51,690
they have to have access to information

2582
01:45:55,669 --> 01:45:53,730
and not just raw information but

2583
01:45:58,970 --> 01:45:55,679
information that it's comprehensible

2584
01:46:01,490 --> 01:45:58,980
clear and complete and and then we can

2585
01:46:04,370 --> 01:46:01,500
expect people to act responsibly another

2586
01:46:06,320 --> 01:46:04,380
thing I would say is I don't you know

2587
01:46:08,180 --> 01:46:06,330
don't give up don't assume we're on an

2588
01:46:10,310 --> 01:46:08,190

unsustainable path history is very

2589
01:46:11,870 --> 01:46:10,320
nonlinear in the future will be - I

2590
01:46:13,340 --> 01:46:11,880
recently did a project where I spent a

2591
01:46:14,930 --> 01:46:13,350
lot of time reading predictions of the

2592
01:46:17,750 --> 01:46:14,940
future written a couple hundred years

2593
01:46:20,090 --> 01:46:17,760
ago read about now and all these smart

2594
01:46:22,370 --> 01:46:20,100
people got to come nobody gets it right

2595
01:46:24,709 --> 01:46:22,380
nobody and I'm very confident that none

2596
01:46:26,090 --> 01:46:24,719
of us can really predict the world of a

2597
01:46:28,820 --> 01:46:26,100
hundred or two hundred years from now

2598
01:46:30,200 --> 01:46:28,830
not climate models not modelers not

2599
01:46:32,270 --> 01:46:30,210
economists because there are

2600
01:46:35,419 --> 01:46:32,280
game-changers not just technical

2601
01:46:37,970 --> 01:46:35,429
breakthroughs but human beings also go

2602
01:46:39,680 --> 01:46:37,980
through nonlinearities and phase changes

2603
01:46:43,310 --> 01:46:39,690
in the way we think and history shows

2604
01:46:45,080 --> 01:46:43,320
this as well so yeah that make your you

2605
01:46:46,610 --> 01:46:45,090
know it's about your personal choices of

2606
01:46:48,790 --> 01:46:46,620
the kind that John mentioned it's about

2607
01:46:51,200 --> 01:46:48,800
communicating with your representatives

2608
01:46:53,390 --> 01:46:51,210
because at some level they still do

2609
01:46:56,890 --> 01:46:53,400
represent us and they they they listen

2610
01:46:59,120 --> 01:46:56,900
they succumb and but also communicate

2611
01:47:01,130 --> 01:46:59,130
communicate with your fellow humans you

2612
01:47:03,200 --> 01:47:01,140
know education communicators that

2613
01:47:04,490 --> 01:47:03,210

representatives and personal choices and

2614
01:47:07,370 --> 01:47:04,500
it does add up and make a real

2615
01:47:09,140 --> 01:47:07,380
difference yeah we're gonna add one of

2616
01:47:10,790 --> 01:47:09,150
those you know big nonlinearities that

2617
01:47:12,020 --> 01:47:10,800
we can't predict where we have a

2618
01:47:13,430 --> 01:47:12,030
congress that works together and

2619
01:47:15,080 --> 01:47:13,440
actually gets yeah yeah I know that's

2620
01:47:17,720 --> 01:47:15,090
why I admit that I think that's too

2621
01:47:19,650 --> 01:47:17,730
science fiction I would put it just one

2622
01:47:21,240 --> 01:47:19,660
thing I would put it in these terms a

2623
01:47:24,390 --> 01:47:21,250
serious send me an email we can talk

2624
01:47:26,160 --> 01:47:24,400
more but have the conversation and the

2625
01:47:28,620 --> 01:47:26,170
conversations not always all that easy

2626
01:47:30,540 --> 01:47:28,630
but find some piece of the conversation

2627
01:47:32,850 --> 01:47:30,550
that you can that you can align with

2628
01:47:35,550 --> 01:47:32,860
someone on and talk about it we don't

2629
01:47:37,020 --> 01:47:35,560
we've gotten bad at having these

2630
01:47:39,210 --> 01:47:37,030
conversations because they're really

2631
01:47:41,220 --> 01:47:39,220
their conversations about values what do

2632
01:47:43,590 --> 01:47:41,230
we care about those conversations are

2633
01:47:45,180 --> 01:47:43,600
challenging but they're very much a part

2634
01:47:47,640 --> 01:47:45,190
of how we're going to change this we

2635
01:47:48,930 --> 01:47:47,650
exactly we need to do that and and not

2636
01:47:52,770 --> 01:47:48,940
trust anyone who calls themselves with

2637
01:47:53,880 --> 01:47:52,780
futures too but now the person that the

2638
01:47:55,800 --> 01:47:53,890

microphone is going to really hate me

2639
01:47:58,260 --> 01:47:55,810
right now because what I'm going to say

2640
01:47:59,700 --> 01:47:58,270
to you is I want to ask the woman in the

2641
01:48:01,080 --> 01:47:59,710
back to be able to ask questions we

2642
01:48:02,790 --> 01:48:01,090
haven't had a single question from a

2643
01:48:04,140 --> 01:48:02,800
woman and there's only one woman here

2644
01:48:06,800 --> 01:48:04,150
and the line so if you'd asked the

2645
01:48:10,320 --> 01:48:06,810
question it would be the last question

2646
01:48:12,150 --> 01:48:10,330
okay I just want to say this is kind of

2647
01:48:15,180 --> 01:48:12,160
a follow up to what the young man was

2648
01:48:17,490 --> 01:48:15,190
just talking about I I think what's

2649
01:48:19,830 --> 01:48:17,500
really encouraging because I'm an

2650
01:48:21,840 --> 01:48:19,840
eternal optimist my background is in

2651
01:48:24,990 --> 01:48:21,850
political science and environmental

2652
01:48:28,350 --> 01:48:25,000
planning and that I think what we need

2653
01:48:30,690 --> 01:48:28,360
is leadership and I think what happened

2654
01:48:33,930 --> 01:48:30,700
with the science March this last weekend

2655
01:48:38,000 --> 01:48:33,940
shows that a lot of the public are ready

2656
01:48:41,880 --> 01:48:38,010
to support scientist and to marry and

2657
01:48:43,050 --> 01:48:41,890
somehow on many issues and move forward

2658
01:48:46,590 --> 01:48:43,060
and so I just want to encourage

2659
01:48:48,300 --> 01:48:46,600
everybody here to kind of engage in that

2660
01:48:50,790 --> 01:48:48,310
manner I'm sure there are many people

2661
01:48:53,450 --> 01:48:50,800
that were at least interested if not

2662
01:48:56,010 --> 01:48:53,460
we're there and so I would ask I guess

2663
01:48:58,410 --> 01:48:56,020

again with the planet works that you're

2664
01:49:00,000 --> 01:48:58,420
trying to kind of have a prototype and

2665
01:49:03,600 --> 01:49:00,010
maybe take it to other states and other

2666
01:49:04,890 --> 01:49:03,610
universities I think that the greatest

2667
01:49:07,350 --> 01:49:04,900
thing that we can do even though we're

2668
01:49:10,260 --> 01:49:07,360
not scientists is to back you up because

2669
01:49:12,870 --> 01:49:10,270
you have some of the knowledge and we

2670
01:49:14,940 --> 01:49:12,880
can maybe help explore other avenues as

2671
01:49:17,040 --> 01:49:14,950
well so I want to thank you all for your

2672
01:49:17,460 --> 01:49:17,050
voices and the dialogue that's what we

2673
01:49:20,130 --> 01:49:17,470
need

2674
01:49:23,730 --> 01:49:20,140
well thank you for that and and I think

2675
01:49:25,470 --> 01:49:23,740
I think yeah that is a is a great way

2676
01:49:26,730 --> 01:49:25,480
that was a great last question and even

2677
01:49:28,110 --> 01:49:26,740
though is it not a question it was a

2678
01:49:30,390 --> 01:49:28,120
great a great way to put this in

2679
01:49:31,360 --> 01:49:30,400
perspective and we have to thank you for

2680
01:49:33,190 --> 01:49:31,370
support support

2681
01:49:35,290 --> 01:49:33,200
but I will say one of the reasons that

2682
01:49:38,050 --> 01:49:35,300
we that you know planet works as

2683
01:49:39,550 --> 01:49:38,060
interested in managing things and that

2684
01:49:42,760 --> 01:49:39,560
we in origins are interested in this is

2685
01:49:44,620 --> 01:49:42,770
this is being broadcast around the world

2686
01:49:47,200 --> 01:49:44,630
right now at the Internet and it will be

2687
01:49:48,970 --> 01:49:47,210
recorded and online and the purpose of

2688
01:49:51,040 --> 01:49:48,980

this is to provide the information so

2689
01:49:54,160 --> 01:49:51,050
that you and the public can then act on

2690
01:49:55,270 --> 01:49:54,170
it because the leadership we can as

2691
01:49:58,030 --> 01:49:55,280
scientists can provide is really

2692
01:49:59,650 --> 01:49:58,040
providing you the information the public

2693
01:50:01,690 --> 01:49:59,660
has to take the lead in all of this and

2694
01:50:03,220 --> 01:50:01,700
we'll never do it alone and so that's

2695
01:50:04,930 --> 01:50:03,230
why we do what we do and I want to thank

2696
01:50:06,360 --> 01:50:04,940
all of you for supporting it thank you