

A portrait of Avi Loeb, an astrophysicist, wearing glasses and a dark shirt. The background is a dark, textured space with a bright, streaky light source. A teal horizontal band is overlaid on the image, containing the text 'ASTROPHYSICIST' and 'AVI LOEB' in yellow. The hashtag '#444' is in the bottom left in teal.

ASTROPHYSICIST
AVI LOEB

#444

1
00:01:03,670 --> 00:00:26,240

[Music]

2
00:01:06,390 --> 00:01:05,590

hello everyone i'm martin willis your

3
00:01:08,149 --> 00:01:06,400

host

4
00:01:09,590 --> 00:01:08,159

and i'm really excited about this

5
00:01:11,990 --> 00:01:09,600

evening show

6
00:01:13,590 --> 00:01:12,000

you know countless times over human

7
00:01:16,310 --> 00:01:13,600

existence

8
00:01:17,749 --> 00:01:16,320

advancements in science have been

9
00:01:21,350 --> 00:01:17,759

curtailed basically

10
00:01:24,310 --> 00:01:21,360

because of fears and egos

11
00:01:25,590 --> 00:01:24,320

and the one you know i often think of

12
00:01:29,429 --> 00:01:25,600

when it comes to

13
00:01:33,190 --> 00:01:29,439

astronomy and things like that

14

00:01:36,310 --> 00:01:33,200

is uh when galileo basically

15

00:01:39,350 --> 00:01:36,320

understood that copernicus copernicus is

16

00:01:43,350 --> 00:01:39,360

that's kind of a hard name to say

17

00:01:45,590 --> 00:01:43,360

his idea of the heliocentric theory

18

00:01:46,710 --> 00:01:45,600

that the earth is not the center of the

19

00:01:48,950 --> 00:01:46,720

universe

20

00:01:50,069 --> 00:01:48,960

um you know look what happened to him

21

00:01:54,789 --> 00:01:50,079

the

22

00:01:57,109 --> 00:01:54,799

think it was

23

00:01:58,870 --> 00:01:57,119

uh basically sentenced him to house

24

00:02:01,670 --> 00:01:58,880

arrest for the rest of his life he

25

00:02:02,389 --> 00:02:01,680

lasted 10 more years and house arrest

26

00:02:05,190 --> 00:02:02,399

and

27

00:02:06,469 --> 00:02:05,200

all along he was right uh right to think

28

00:02:08,309 --> 00:02:06,479

out of the box

29

00:02:09,990 --> 00:02:08,319

and even now there are a lot of

30

00:02:11,110 --> 00:02:10,000

scientists that kind of have the same

31

00:02:13,510 --> 00:02:11,120

attitude that

32

00:02:15,510 --> 00:02:13,520

you know they should know something um

33

00:02:16,710 --> 00:02:15,520

so if they don't know it then it can't

34

00:02:18,790 --> 00:02:16,720

be so

35

00:02:19,910 --> 00:02:18,800

and it's kind of like you know the

36

00:02:23,589 --> 00:02:19,920

universe

37

00:02:26,869 --> 00:02:23,599

evolves around us and i like when people

38

00:02:29,910 --> 00:02:26,879

can have an open mind and

39

00:02:33,670 --> 00:02:29,920

they dare to look outside of the box of

40

00:02:36,949 --> 00:02:33,680

most thinking and take take a chance

41

00:02:40,070 --> 00:02:36,959

and this is what our guest did tonight

42

00:02:42,070 --> 00:02:40,080

he is avi loeb he was the longest

43

00:02:43,350 --> 00:02:42,080

-serving chair of harvard's department of

44

00:02:47,830 --> 00:02:43,360

astronomy

45

00:02:51,430 --> 00:02:47,840

and so much more he was involved in the

46

00:02:52,869 --> 00:02:51,440

breakthrough initiative the star shot

47

00:02:54,550 --> 00:02:52,879

which i think was really interesting i

48

00:02:55,190 --> 00:02:54,560

think that might have had some influence

49

00:02:58,229 --> 00:02:55,200

on

50

00:03:00,550 --> 00:02:58,239

his thoughts about the omua muah

51
00:03:01,990 --> 00:03:00,560
the strange object that first came

52
00:03:04,630 --> 00:03:02,000
through our

53
00:03:05,990 --> 00:03:04,640
solar system back i think it was 2017. i

54
00:03:09,430 --> 00:03:06,000
read the book i

55
00:03:11,670 --> 00:03:09,440
uh really loved his book and it's called

56
00:03:14,149 --> 00:03:11,680
extraterrestrial the first sign of

57
00:03:16,949 --> 00:03:14,159
intelligent life beyond earth

58
00:03:18,630 --> 00:03:16,959
i was thinking today um i wish i was an

59
00:03:19,910 --> 00:03:18,640
astronomer so i could ask really good

60
00:03:21,830 --> 00:03:19,920
questions

61
00:03:23,670 --> 00:03:21,840
and uh all of a sudden i thought you

62
00:03:27,190 --> 00:03:23,680
know i know an astronomer

63
00:03:28,949 --> 00:03:27,200

why don't i ask him for some questions

64

00:03:31,430 --> 00:03:28,959

and then he sort of invited himself on

65

00:03:33,509 --> 00:03:31,440

the show so he'll be joining us

66

00:03:35,350 --> 00:03:33,519

mark d'antonio in the second hour of the

67

00:03:36,309 --> 00:03:35,360

show and i'm sure he'll have some great

68

00:03:38,710 --> 00:03:36,319

questions

69

00:03:40,550 --> 00:03:38,720

and i know i got a little inside that

70

00:03:43,830 --> 00:03:40,560

he's kind of on the same

71

00:03:44,710 --> 00:03:43,840

uh same track with avi on what this

72

00:03:47,350 --> 00:03:44,720

thing is

73

00:03:48,789 --> 00:03:47,360

um and so that should be interesting in

74

00:03:50,229 --> 00:03:48,799

the very last half hour of the show

75

00:03:51,110 --> 00:03:50,239

we'll be taking calls bill will be

76

00:03:54,149 --> 00:03:51,120

taking

77

00:03:55,589 --> 00:03:54,159

uh we're screening the calls and uh so

78

00:03:56,470 --> 00:03:55,599

think up some great questions if you'd

79

00:03:58,390 --> 00:03:56,480

like to call in

80

00:03:59,589 --> 00:03:58,400

and that's the last half hour we will be

81

00:04:01,270 --> 00:03:59,599

taking a break

82

00:04:02,710 --> 00:04:01,280

at the top of the hour at that time i'm

83

00:04:03,990 --> 00:04:02,720

going to bring in mark d'antonio we're

84

00:04:07,030 --> 00:04:04,000

going to talk a little bit

85

00:04:10,070 --> 00:04:07,040

and then come back again with avi

86

00:04:11,990 --> 00:04:10,080

and i've been getting pics

87

00:04:13,110 --> 00:04:12,000

from listeners all over the world thank

88

00:04:14,869 --> 00:04:13,120

you so much

89

00:04:16,310 --> 00:04:14,879

and if you want to send me one and a

90

00:04:18,949 --> 00:04:16,320

picture of yourself or the

91

00:04:20,710 --> 00:04:18,959

something that represents the location i

92

00:04:22,150 --> 00:04:20,720

created a new email address for that

93

00:04:25,030 --> 00:04:22,160

it's called gps

94

00:04:25,350 --> 00:04:25,040

at podcast ufo and there's also a page

95

00:04:28,550 --> 00:04:25,360

on

96

00:04:29,909 --> 00:04:28,560

the website uh podcast podcastufo.com

97

00:04:31,510 --> 00:04:29,919

that uh you can look at all the

98

00:04:31,990 --> 00:04:31,520

listeners pictures from all over the

99

00:04:35,270 --> 00:04:32,000

world

100

00:04:36,230 --> 00:04:35,280

uh one from um iraq actually and

101
00:04:39,270 --> 00:04:36,240
everywhere

102
00:04:40,150 --> 00:04:39,280
and uh there's another great blog this

103
00:04:42,550 --> 00:04:40,160
week by

104
00:04:44,629 --> 00:04:42,560
charles lear who creates them on in

105
00:04:45,110 --> 00:04:44,639
audio blogs for every friday afternoon

106
00:04:47,189 --> 00:04:45,120
or most

107
00:04:49,030 --> 00:04:47,199
mostly every friday afternoon this one's

108
00:04:52,070 --> 00:04:49,040
called more metal from the ufo

109
00:04:54,230 --> 00:04:52,080
the bob white object and i've seen this

110
00:04:57,189 --> 00:04:54,240
metal it's a strange cone-shaped

111
00:04:57,510 --> 00:04:57,199
piece um but uh i'm not going to say

112
00:04:59,430 --> 00:04:57,520
it's

113
00:05:00,710 --> 00:04:59,440

extraterrestrial who knows what that is

114

00:05:03,510 --> 00:05:00,720

but we'll be talking more about

115

00:05:04,790 --> 00:05:03,520

extraterrestrial objects in just a

116

00:05:06,230 --> 00:05:04,800

minute with our guest

117

00:05:07,990 --> 00:05:06,240

if you support the show i want to thank

118

00:05:11,749 --> 00:05:08,000

you so much and

119

00:05:13,189 --> 00:05:11,759

check out our facebook page and uh

120

00:05:15,029 --> 00:05:13,199

i hope you're in chat tonight if you're

121

00:05:16,469 --> 00:05:15,039

watching live on youtube

122

00:05:18,070 --> 00:05:16,479

and if you want to post questions just

123

00:05:19,110 --> 00:05:18,080

make sure you put them in all caps so i

124

00:05:20,710 --> 00:05:19,120

can see them

125

00:05:22,550 --> 00:05:20,720

and pay attention to them but i will

126

00:05:24,870 --> 00:05:22,560

only post those questions when

127

00:05:26,310 --> 00:05:24,880

they make sense at the time i may have

128

00:05:27,670 --> 00:05:26,320

to go back to them later

129

00:05:30,150 --> 00:05:27,680

but for right now i'm bringing in our

130

00:05:33,350 --> 00:05:30,160

guest welcome to the show avi

131

00:05:34,870 --> 00:05:33,360

thanks for having me thank you and i as

132

00:05:37,350 --> 00:05:34,880

you probably just heard i love you

133

00:05:38,070 --> 00:05:37,360

i loved your book i really enjoyed it

134

00:05:40,790 --> 00:05:38,080

and uh

135

00:05:41,270 --> 00:05:40,800

i like you know i'm not an astronomer

136

00:05:43,670 --> 00:05:41,280

i'm not

137

00:05:45,430 --> 00:05:43,680

someone in science but i like the that i

138

00:05:47,189 --> 00:05:45,440

could read that book and understand it

139

00:05:49,110 --> 00:05:47,199

used a lot of analogies that were really

140

00:05:51,270 --> 00:05:49,120

helpful and uh

141

00:05:52,390 --> 00:05:51,280

well i only i only explain things that i

142

00:05:55,830 --> 00:05:52,400

understand

143

00:05:59,110 --> 00:05:55,840

that's what i tell my students yeah

144

00:06:01,189 --> 00:05:59,120

yeah and i like you brought a lot of um

145

00:06:02,710 --> 00:06:01,199

the child thinking in it like what your

146

00:06:03,990 --> 00:06:02,720

daughters thought about certain things i

147

00:06:06,230 --> 00:06:04,000

love the story about

148

00:06:08,309 --> 00:06:06,240

the title uh i don't know what you call

149

00:06:10,150 --> 00:06:08,319

it when something's gravitationally in a

150

00:06:12,150 --> 00:06:10,160

title lock or whatever it is

151
00:06:13,749 --> 00:06:12,160
around the sun and your daughter said

152
00:06:14,309 --> 00:06:13,759
she wanted to get a house in the dark

153
00:06:15,990 --> 00:06:14,319
side

154
00:06:17,990 --> 00:06:16,000
so she could sleep in a house on the

155
00:06:20,309 --> 00:06:18,000
light side oh yeah that's

156
00:06:22,550 --> 00:06:20,319
actually the nearest star is proxima

157
00:06:24,950 --> 00:06:22,560
centauri it's four light years away

158
00:06:26,469 --> 00:06:24,960
and it's a dwarf star and next to it

159
00:06:28,629 --> 00:06:26,479
there is a planet which is

160
00:06:29,830 --> 00:06:28,639
20 times closer to that star than the

161
00:06:33,110 --> 00:06:29,840
earth is from the sun

162
00:06:33,990 --> 00:06:33,120
and because it's so close uh it's

163
00:06:36,150 --> 00:06:34,000

tidally locked

164

00:06:38,390 --> 00:06:36,160

just like the moon is to the earth and

165

00:06:40,230 --> 00:06:38,400

it goes the same side at all times so

166

00:06:42,870 --> 00:06:40,240

there is a permanent dayside

167

00:06:44,790 --> 00:06:42,880

and a permanent night side and actually

168

00:06:47,749 --> 00:06:44,800

it's just at the right distance

169

00:06:48,070 --> 00:06:47,759

to have room temperature on the day side

170

00:06:49,830 --> 00:06:48,080

so

171

00:06:51,189 --> 00:06:49,840

my daughter said that if we ever go

172

00:06:53,510 --> 00:06:51,199

there you know

173

00:06:54,710 --> 00:06:53,520

we should have she would like to have

174

00:06:56,390 --> 00:06:54,720

two houses

175

00:06:57,909 --> 00:06:56,400

one in the permanent night side where

176
00:07:00,150 --> 00:06:57,919
she can sleep

177
00:07:01,110 --> 00:07:00,160
and the other one in the permanent

178
00:07:03,830 --> 00:07:01,120
sunset

179
00:07:04,309 --> 00:07:03,840
strip between the night and day sides so

180
00:07:06,070 --> 00:07:04,319
that

181
00:07:07,430 --> 00:07:06,080
she can have her vacation with the

182
00:07:09,749 --> 00:07:07,440
sunset forever

183
00:07:11,430 --> 00:07:09,759
you know that yeah yeah that's great

184
00:07:12,390 --> 00:07:11,440
well if she was really thinking she'd

185
00:07:14,390 --> 00:07:12,400
build a large

186
00:07:18,070 --> 00:07:14,400
house right on the border so she'd go

187
00:07:21,990 --> 00:07:21,510
but but anyway um in a situation like

188
00:07:23,670 --> 00:07:22,000

that

189

00:07:25,430 --> 00:07:23,680

and i'm going to ask before we get into

190

00:07:26,469 --> 00:07:25,440

the topic tonight i have a couple of

191

00:07:28,469 --> 00:07:26,479

questions um

192

00:07:30,550 --> 00:07:28,479

some that i asked any astronomer that's

193

00:07:33,029 --> 00:07:30,560

on the show um

194

00:07:34,790 --> 00:07:33,039

but when it when a planet is la i mean

195

00:07:35,589 --> 00:07:34,800

when yeah when a planet is locked like

196

00:07:38,070 --> 00:07:35,599

that

197

00:07:40,230 --> 00:07:38,080

is it does it have like an it's hottest

198

00:07:43,029 --> 00:07:40,240

at the equator that type of thing

199

00:07:45,110 --> 00:07:43,039

and then uh it's it's hottest on the day

200

00:07:46,230 --> 00:07:45,120

side at the center of the day side which

201
00:07:48,390 --> 00:07:46,240
is permanent

202
00:07:50,230 --> 00:07:48,400
facing star and then it's cordless in

203
00:07:52,550 --> 00:07:50,240
the opposite direction and

204
00:07:54,710 --> 00:07:52,560
uh you should in this case by the way

205
00:07:57,589 --> 00:07:54,720
the proxima b this planet

206
00:07:58,550 --> 00:07:57,599
is moving around the star every 11 days

207
00:08:00,869 --> 00:07:58,560
so if there are any

208
00:08:02,950 --> 00:08:00,879
living creatures there they celebrate

209
00:08:05,270 --> 00:08:02,960
birthdays every 11 days

210
00:08:06,469 --> 00:08:05,280
there are lots of parties over there and

211
00:08:09,270 --> 00:08:06,479
to keep in mind is

212
00:08:10,469 --> 00:08:09,280
the star is a dwarf star 12 of the mass

213
00:08:13,029 --> 00:08:10,479

of the sun so

214

00:08:14,390 --> 00:08:13,039

it's cool it's about half the surface

215

00:08:17,189 --> 00:08:14,400

temperature of the sun

216

00:08:19,270 --> 00:08:17,199

and it emits mostly infrared radiation

217

00:08:22,309 --> 00:08:19,280

so we are used to visible light

218

00:08:24,230 --> 00:08:22,319

because our eyes were adjusted to

219

00:08:26,309 --> 00:08:24,240

the type of light that the sun produces

220

00:08:28,070 --> 00:08:26,319

it helps us when it bounces off

221

00:08:29,670 --> 00:08:28,080

predators we can escape from those

222

00:08:31,830 --> 00:08:29,680

predators if we have eyes that are

223

00:08:34,949 --> 00:08:31,840

sensitive to visible light

224

00:08:35,670 --> 00:08:34,959

and so for survival our eyes adapted to

225

00:08:38,949 --> 00:08:35,680

the light that

226

00:08:41,029 --> 00:08:38,959

our sun produces so next to proxima

227

00:08:43,670 --> 00:08:41,039

centauri the any creature would have

228

00:08:44,870 --> 00:08:43,680

infrared eyes and that may explain why

229

00:08:47,670 --> 00:08:44,880

they never visit us

230

00:08:48,870 --> 00:08:47,680

because interstellar tourist agencies

231

00:08:51,829 --> 00:08:48,880

that are looking

232

00:08:54,310 --> 00:08:51,839

uh for destinations will never find the

233

00:08:56,389 --> 00:08:54,320

earth as attractive because

234

00:08:57,350 --> 00:08:56,399

you know the visible light that we have

235

00:08:59,670 --> 00:08:57,360

here hurts

236

00:09:00,870 --> 00:08:59,680

the eyes of those creatures that have

237

00:09:03,990 --> 00:09:00,880

infrared eyes and

238

00:09:05,910 --> 00:09:04,000

also our grass is uh green

239

00:09:07,670 --> 00:09:05,920

in the vacation sites that we can offer

240

00:09:10,710 --> 00:09:07,680

whereas they're used to

241

00:09:12,310 --> 00:09:10,720

dark red grass so that may explain why

242

00:09:14,389 --> 00:09:12,320

they never visit us and

243

00:09:16,070 --> 00:09:14,399

we have to go there and entice them with

244

00:09:19,269 --> 00:09:16,080

a water-based drink

245

00:09:20,710 --> 00:09:19,279

yeah there you go now what about in a

246

00:09:22,710 --> 00:09:20,720

situation like that would it

247

00:09:24,550 --> 00:09:22,720

create strange weather patterns to have

248

00:09:27,670 --> 00:09:24,560

a locked planet like that

249

00:09:30,310 --> 00:09:27,680

oh it's cold on one side and yeah

250

00:09:30,790 --> 00:09:30,320

i wouldn't have think an atmosphere and

251
00:09:32,550 --> 00:09:30,800
yeah

252
00:09:35,350 --> 00:09:32,560
it's quite unusual because if you

253
00:09:37,269 --> 00:09:35,360
imagine life on such a planet then

254
00:09:38,949 --> 00:09:37,279
obviously the the forms of life you have

255
00:09:40,389 --> 00:09:38,959
on the permanent day side will be very

256
00:09:41,829 --> 00:09:40,399
different than those on the permanent

257
00:09:44,150 --> 00:09:41,839
night side and

258
00:09:45,430 --> 00:09:44,160
uh also the weather patterns will be

259
00:09:47,430 --> 00:09:45,440
quite different and

260
00:09:48,710 --> 00:09:47,440
now we are not at all sure that such a

261
00:09:51,030 --> 00:09:48,720
planet can

262
00:09:52,070 --> 00:09:51,040
have life on it because it's so close to

263
00:09:55,110 --> 00:09:52,080

the star that

264

00:09:58,310 --> 00:09:55,120

its atmosphere can be ripped uh

265

00:09:59,750 --> 00:09:58,320

by the stellar wind um so um

266

00:10:01,590 --> 00:09:59,760

it's not at all clear that it could

267

00:10:03,110 --> 00:10:01,600

possess an atmosphere and then of course

268

00:10:03,990 --> 00:10:03,120

if you don't have an atmosphere as we

269

00:10:06,710 --> 00:10:04,000

know from the

270

00:10:08,230 --> 00:10:06,720

example of mars then you can't have

271

00:10:09,430 --> 00:10:08,240

liquid water on the surface of the

272

00:10:13,430 --> 00:10:09,440

planet so

273

00:10:17,190 --> 00:10:13,440

uh you know we are living on a planet

274

00:10:19,670 --> 00:10:17,200

around the sunlight around the sun and

275

00:10:21,269 --> 00:10:19,680

that that kind of a star is rare in the

276

00:10:22,870 --> 00:10:21,279

milky way galaxy most stars are like

277

00:10:25,190 --> 00:10:22,880

proxima centauri and

278

00:10:27,110 --> 00:10:25,200

maybe there is a reason for that maybe

279

00:10:29,030 --> 00:10:27,120

you know if you are too close to a star

280

00:10:31,190 --> 00:10:29,040

like proxima centauri then

281

00:10:33,509 --> 00:10:31,200

you can a planet cannot maintain its

282

00:10:35,990 --> 00:10:33,519

atmosphere you can't have life so

283

00:10:38,949 --> 00:10:36,000

we don't fully understand how easy it is

284

00:10:42,069 --> 00:10:38,959

to live around the dwarf stars

285

00:10:45,269 --> 00:10:42,079

right right um there's so many different

286

00:10:47,190 --> 00:10:45,279

variables that can make whatever rose

287

00:10:48,550 --> 00:10:47,200

if there's life there the evolution of

288

00:10:50,389 --> 00:10:48,560

that life be so different

289

00:10:51,590 --> 00:10:50,399

you know in so many ways i would think

290

00:10:54,710 --> 00:10:51,600

but i so the

291

00:10:56,470 --> 00:10:54,720

question just as a general uh you know i

292

00:10:59,190 --> 00:10:56,480

was asked many times

293

00:11:00,230 --> 00:10:59,200

how do i envision other forms of life

294

00:11:02,790 --> 00:11:00,240

and um

295

00:11:04,870 --> 00:11:02,800

you know when we meet another person

296

00:11:06,710 --> 00:11:04,880

that we've never met before

297

00:11:08,790 --> 00:11:06,720

we we can pretty much anticipate that

298

00:11:11,030 --> 00:11:08,800

the person looks like us because we

299

00:11:13,030 --> 00:11:11,040

share a common genetic heritage

300

00:11:15,430 --> 00:11:13,040

but when we meet life from another

301

00:11:17,430 --> 00:11:15,440

planet that had no contact with earth

302

00:11:18,710 --> 00:11:17,440

i'm not talking about mars that exchange

303

00:11:21,190 --> 00:11:18,720

rocks with earth but

304

00:11:23,030 --> 00:11:21,200

a planet very far away of another star

305

00:11:25,350 --> 00:11:23,040

it could be shocking for us to see

306

00:11:26,710 --> 00:11:25,360

what that life is because you know you

307

00:11:29,670 --> 00:11:26,720

can start from the same

308

00:11:30,310 --> 00:11:29,680

chemicals and then end up in a very

309

00:11:32,710 --> 00:11:30,320

different

310

00:11:34,230 --> 00:11:32,720

product you know just like when you open

311

00:11:35,910 --> 00:11:34,240

recipe books for cakes

312

00:11:37,590 --> 00:11:35,920

you can start from the same ingredients

313

00:11:40,069 --> 00:11:37,600

and depending on how you mix them

314

00:11:41,670 --> 00:11:40,079

and how much heat you apply you get very

315

00:11:44,870 --> 00:11:41,680

different cakes

316

00:11:48,230 --> 00:11:44,880

right right um you know is

317

00:11:49,590 --> 00:11:48,240

bipedal optimal in uh i don't know you

318

00:11:51,110 --> 00:11:49,600

call it binocular vision whatever you

319

00:11:53,750 --> 00:11:51,120

call it when you have two eyes

320

00:11:54,790 --> 00:11:53,760

is that optimal i don't know it again it

321

00:11:55,829 --> 00:11:54,800

depends on the

322

00:11:58,150 --> 00:11:55,839

eye because it gives you

323

00:12:00,150 --> 00:11:58,160

three-dimensional vision um

324

00:12:01,509 --> 00:12:00,160

uh but the three eyes would have been

325

00:12:03,430 --> 00:12:01,519

even better because then you can see

326

00:12:06,150 --> 00:12:03,440

back

327

00:12:07,509 --> 00:12:06,160

yeah there you go for predators um so

328

00:12:10,310 --> 00:12:07,519

the question i like to ask

329

00:12:11,670 --> 00:12:10,320

astronomers on the show is uh and i know

330

00:12:14,470 --> 00:12:11,680

you have an open mind but

331

00:12:15,110 --> 00:12:14,480

i i may be asking you to to for your

332

00:12:17,829 --> 00:12:15,120

opinion

333

00:12:19,910 --> 00:12:17,839

you may not want to give that but do you

334

00:12:20,790 --> 00:12:19,920

think it's possible that the big bang

335

00:12:24,069 --> 00:12:20,800

theory

336

00:12:26,310 --> 00:12:24,079

is something and it is flawed

337

00:12:28,150 --> 00:12:26,320

oh um well the clearly the big bang

338

00:12:29,829 --> 00:12:28,160

theory is is not complete

339

00:12:31,829 --> 00:12:29,839

because we don't know what happened

340

00:12:33,990 --> 00:12:31,839

before the big bang the big bang

341

00:12:35,269 --> 00:12:34,000

i mean is simply a point in time if we

342

00:12:37,750 --> 00:12:35,279

go back in time

343

00:12:39,910 --> 00:12:37,760

we see forward with time and we see the

344

00:12:42,310 --> 00:12:39,920

universe expanding so we go back in time

345

00:12:44,069 --> 00:12:42,320

and the universe was contracting and

346

00:12:46,230 --> 00:12:44,079

there is a point in time when the

347

00:12:47,910 --> 00:12:46,240

density of matter was infinite and that

348

00:12:49,910 --> 00:12:47,920

we call the big bang and

349

00:12:51,829 --> 00:12:49,920

the problem is that einstein's theory of

350

00:12:52,790 --> 00:12:51,839

gravity breaks down at that point in

351

00:12:55,829 --> 00:12:52,800

time because

352

00:12:57,750 --> 00:12:55,839

the the curvature of space and time

353

00:12:59,829 --> 00:12:57,760

diverges becomes infinite and the theory

354

00:13:01,190 --> 00:12:59,839

breaks down and we understand why it

355

00:13:02,949 --> 00:13:01,200

breaks down it's

356

00:13:05,030 --> 00:13:02,959

because it doesn't incorporate a very

357

00:13:07,030 --> 00:13:05,040

important pillar of modern physics which

358

00:13:09,750 --> 00:13:07,040

is called quantum mechanics

359

00:13:11,350 --> 00:13:09,760

so we can't really tell what happened

360

00:13:14,710 --> 00:13:11,360

before the big bang and

361

00:13:16,949 --> 00:13:14,720

so right now the big bang theory is

362

00:13:18,829 --> 00:13:16,959

is really incomplete and we don't know

363

00:13:21,750 --> 00:13:18,839

exactly what happened around that

364

00:13:24,069 --> 00:13:21,760

early point in time and

365

00:13:25,110 --> 00:13:24,079

uh it would have been nice to figure it

366

00:13:27,269 --> 00:13:25,120

out you know

367

00:13:29,269 --> 00:13:27,279

just as a thought experiment let me

368

00:13:31,350 --> 00:13:29,279

mention one possibility

369

00:13:32,629 --> 00:13:31,360

imagine that we had this theory of

370

00:13:35,590 --> 00:13:32,639

quantum gravity

371

00:13:37,269 --> 00:13:35,600

ourself then we could have in principle

372

00:13:38,389 --> 00:13:37,279

created the baby universe in the

373

00:13:41,910 --> 00:13:38,399

laboratory

374

00:13:43,990 --> 00:13:41,920

uh and then if we were able to do that

375

00:13:46,150 --> 00:13:44,000

you could imagine that perhaps the big

376

00:13:48,150 --> 00:13:46,160

bang started from another laboratory of

377

00:13:50,310 --> 00:13:48,160

another civilization so

378

00:13:51,990 --> 00:13:50,320

just like humans have babies that have

379

00:13:54,629 --> 00:13:52,000

babies that have babies

380

00:13:55,910 --> 00:13:54,639

you can resolve the issue of the big

381

00:13:58,389 --> 00:13:55,920

bang by

382

00:14:00,230 --> 00:13:58,399

connecting the umbilical cord of our

383

00:14:02,389 --> 00:14:00,240

universe to a laboratory of another

384

00:14:05,110 --> 00:14:02,399

civilization that existed

385

00:14:07,189 --> 00:14:05,120

before us and so forth and uh you know

386

00:14:09,590 --> 00:14:07,199

that's one possibility

387

00:14:11,509 --> 00:14:09,600

wow yeah and the other thing about time

388

00:14:13,110 --> 00:14:11,519

you know did time begin then or was

389

00:14:15,590 --> 00:14:13,120

there time before that

390

00:14:17,110 --> 00:14:15,600

the problem is as i said that our

391

00:14:18,629 --> 00:14:17,120

current theory which

392

00:14:21,189 --> 00:14:18,639

the prevailing theory is einstein's

393

00:14:23,189 --> 00:14:21,199

theory of gravity is incomplete and

394

00:14:24,710 --> 00:14:23,199

and as a result we can't really say much

395

00:14:26,550 --> 00:14:24,720

about what

396

00:14:28,550 --> 00:14:26,560

was happening around the big bang

397

00:14:31,189 --> 00:14:28,560

because we know that quantum mechanics

398

00:14:31,670 --> 00:14:31,199

quantum mechanical effects uh were

399

00:14:34,230 --> 00:14:31,680

really

400

00:14:35,829 --> 00:14:34,240

uh crucial at that time and we don't

401
00:14:37,670 --> 00:14:35,839
have a good theory of quantum gravity

402
00:14:40,470 --> 00:14:37,680
there are attempts to do that

403
00:14:42,310 --> 00:14:40,480
uh but so far they were not very

404
00:14:43,269 --> 00:14:42,320
predictive as to what happened around

405
00:14:45,189 --> 00:14:43,279
the big bang so

406
00:14:46,870 --> 00:14:45,199
you know the nice thing about science is

407
00:14:49,590 --> 00:14:46,880
that you're allowed to say

408
00:14:50,870 --> 00:14:49,600
i don't know that that's a valid answer

409
00:14:52,949 --> 00:14:50,880
if you just don't know

410
00:14:53,910 --> 00:14:52,959
you can say i don't know i mean in other

411
00:14:55,670 --> 00:14:53,920
areas

412
00:14:58,230 --> 00:14:55,680
for example in politics you know it's

413
00:15:01,030 --> 00:14:58,240

not it's not common that the politician

414

00:15:03,990 --> 00:15:01,040

would say i don't know

415

00:15:04,389 --> 00:15:04,000

that's true that's true um now you were

416

00:15:06,550 --> 00:15:04,399

on

417

00:15:08,629 --> 00:15:06,560

uh the chair of the advisory board for

418

00:15:10,150 --> 00:15:08,639

the is it called the breakthrough star

419

00:15:12,790 --> 00:15:10,160

shot is that what it was called right

420

00:15:13,509 --> 00:15:12,800

yes and uh stephen hawking was involved

421

00:15:16,470 --> 00:15:13,519

and yuri

422

00:15:17,670 --> 00:15:16,480

i i think he was involved was he uh well

423

00:15:21,670 --> 00:15:17,680

some part of it sorry

424

00:15:24,150 --> 00:15:21,680

um back in may 2015 um

425

00:15:25,910 --> 00:15:24,160

a black limousine parked in front of the

426
00:15:27,189 --> 00:15:25,920
center for astrophysics at harvard

427
00:15:30,230 --> 00:15:27,199
university and

428
00:15:32,470 --> 00:15:30,240
uh out of it came yuri milner an

429
00:15:35,269 --> 00:15:32,480
entrepreneur for silicon valley

430
00:15:36,550 --> 00:15:35,279
and he came to my office sat on the sofa

431
00:15:39,910 --> 00:15:36,560
in front of me

432
00:15:43,030 --> 00:15:39,920
and asked me am i interested in leading

433
00:15:45,350 --> 00:15:43,040
a project to visit the nearest star

434
00:15:47,350 --> 00:15:45,360
and i knew that that star is four light

435
00:15:48,230 --> 00:15:47,360
years away so it takes like four years

436
00:15:51,670 --> 00:15:48,240
to get there

437
00:15:54,949 --> 00:15:51,680
or to get from there to us uh you know

438
00:15:58,550 --> 00:15:54,959

only now there anyone there gets

439

00:15:59,590 --> 00:15:58,560

the signal about the 2016 elections in

440

00:16:03,189 --> 00:15:59,600

the us

441

00:16:06,629 --> 00:16:03,199

it's really a long time uh and then so

442

00:16:08,870 --> 00:16:06,639

i realized he wanted the travel to take

443

00:16:10,870 --> 00:16:08,880

a couple of decades within his lifetime

444

00:16:13,749 --> 00:16:10,880

which is roughly my lifetime

445

00:16:15,350 --> 00:16:13,759

we're the same age and so i realized

446

00:16:17,030 --> 00:16:15,360

that's a challenge because you need a

447

00:16:18,389 --> 00:16:17,040

spacecraft that moves at the fifth of

448

00:16:21,110 --> 00:16:18,399

the speed of light

449

00:16:23,030 --> 00:16:21,120

which is roughly a thousand times faster

450

00:16:26,870 --> 00:16:23,040

than all the rockets that we have

451
00:16:27,829 --> 00:16:26,880
sent in our history so i told him i need

452
00:16:31,030 --> 00:16:27,839
to look into that

453
00:16:31,509 --> 00:16:31,040
then came up with a recommendation to

454
00:16:34,230 --> 00:16:31,519
use

455
00:16:35,110 --> 00:16:34,240
one technology that can potentially work

456
00:16:38,790 --> 00:16:35,120
which is

457
00:16:41,269 --> 00:16:38,800
a sail pushed by light so just a very

458
00:16:45,590 --> 00:16:43,910
piece of material like a sail on a boat

459
00:16:46,470 --> 00:16:45,600
except that it's being pushed by light

460
00:16:48,310 --> 00:16:46,480
bouncing off

461
00:16:50,150 --> 00:16:48,320
it and the idea is to use a very

462
00:16:52,389 --> 00:16:50,160
powerful laser uh

463
00:16:55,749 --> 00:16:52,399

about a hundred gigawatt that is focused

464

00:16:58,790 --> 00:16:55,759

on a scale the size of a person roughly

465

00:17:00,710 --> 00:16:58,800

um that weighs about a gram and then

466

00:17:03,189 --> 00:17:00,720

this sale would reach a fifth of the

467

00:17:05,110 --> 00:17:03,199

speed of light after a few minutes

468

00:17:06,789 --> 00:17:05,120

across the distance that is five times

469

00:17:08,949 --> 00:17:06,799

the distance to the moon

470

00:17:09,829 --> 00:17:08,959

and that was the concept that we came up

471

00:17:12,710 --> 00:17:09,839

with and

472

00:17:14,630 --> 00:17:12,720

and then stephen hawking came for the

473

00:17:16,949 --> 00:17:14,640

public announcement of this project in

474

00:17:18,470 --> 00:17:16,959

new york city

475

00:17:20,069 --> 00:17:18,480

i actually i have a couple questions

476
00:17:21,750 --> 00:17:20,079
about that because i i'm just trying to

477
00:17:23,669 --> 00:17:21,760
figure out how these things work

478
00:17:25,429 --> 00:17:23,679
uh and maybe i'm picturing it totally

479
00:17:28,549 --> 00:17:25,439
wrong but i'm picturing

480
00:17:30,789 --> 00:17:28,559
that this laser has to stay on

481
00:17:33,110 --> 00:17:30,799
the sail or does it blink on and off it

482
00:17:33,669 --> 00:17:33,120
stays on well it stays on it for a few

483
00:17:36,950 --> 00:17:33,679
minutes

484
00:17:37,750 --> 00:17:36,960
and then the sail at 20 the speed of

485
00:17:40,470 --> 00:17:37,760
light will take

486
00:17:42,070 --> 00:17:40,480
20 years to reach the destination of the

487
00:17:44,470 --> 00:17:42,080
nearest star so

488
00:17:47,270 --> 00:17:44,480

so it's a very short period of time

489

00:17:49,110 --> 00:17:47,280

during which the sail is pushing

490

00:17:51,190 --> 00:17:49,120

is being pushed by the laser and then

491

00:17:54,549 --> 00:17:51,200

after that it just coasts

492

00:17:55,270 --> 00:17:54,559

so okay so it's only one time that the

493

00:17:57,350 --> 00:17:55,280

laser

494

00:17:58,950 --> 00:17:57,360

yes hits this okay because i was

495

00:17:59,990 --> 00:17:58,960

wondering how you could possibly hit it

496

00:18:02,310 --> 00:18:00,000

once it started

497

00:18:03,190 --> 00:18:02,320

traveling only when it starts because

498

00:18:05,350 --> 00:18:03,200

the point is

499

00:18:07,430 --> 00:18:05,360

it's difficult it's impossible to focus

500

00:18:10,070 --> 00:18:07,440

the laser at great distances

501
00:18:11,750 --> 00:18:10,080
you can't really focus it on the sky or

502
00:18:13,510 --> 00:18:11,760
you can do it on the sail

503
00:18:15,270 --> 00:18:13,520
only within a limited distance and

504
00:18:15,830 --> 00:18:15,280
that's what dictates the power of the

505
00:18:19,510 --> 00:18:15,840
laser

506
00:18:20,470 --> 00:18:19,520
forever then you will need very powerful

507
00:18:23,029 --> 00:18:20,480
laser you could still

508
00:18:24,789 --> 00:18:23,039
continue to push it for 20 years right

509
00:18:26,950 --> 00:18:24,799
instead you need to push it only across

510
00:18:28,710 --> 00:18:26,960
a certain distance

511
00:18:30,870 --> 00:18:28,720
and that distance is the distance over

512
00:18:32,549 --> 00:18:30,880
which you can focus the laser

513
00:18:34,070 --> 00:18:32,559

another question i had about this

514

00:18:34,549 --> 00:18:34,080

because i i did a little bit of reading

515

00:18:37,990 --> 00:18:34,559

when

516

00:18:38,549 --> 00:18:38,000

the idea first came out and how many of

517

00:18:41,110 --> 00:18:38,559

these

518

00:18:42,150 --> 00:18:41,120

solar sails would be sent approximately

519

00:18:45,270 --> 00:18:42,160

one day

520

00:18:47,990 --> 00:18:45,280

because the actual actual sale is

521

00:18:48,630 --> 00:18:48,000

is really cheap i mean it's the cost of

522

00:18:50,789 --> 00:18:48,640

a phone

523

00:18:52,150 --> 00:18:50,799

a cell phone but the most of the

524

00:18:54,390 --> 00:18:52,160

investment of funds is in the

525

00:18:57,430 --> 00:18:54,400

infrastructure of the laser

526

00:19:00,390 --> 00:18:57,440

and the you know and and the

527

00:19:01,909 --> 00:19:00,400

spacecraft that releases those uh sales

528

00:19:04,230 --> 00:19:01,919

but each sail is really

529

00:19:06,070 --> 00:19:04,240

cheap so it's a changing concept that

530

00:19:07,270 --> 00:19:06,080

each mission that you send each

531

00:19:10,310 --> 00:19:07,280

spacecraft

532

00:19:12,710 --> 00:19:10,320

is very you know it is it does not cost

533

00:19:15,830 --> 00:19:12,720

much and you can do it once a day

534

00:19:19,430 --> 00:19:15,840

and so say in 20 years

535

00:19:22,789 --> 00:19:19,440

these reach um that that star

536

00:19:24,390 --> 00:19:22,799

system how do they signal back i mean it

537

00:19:25,029 --> 00:19:24,400

would take doesn't it take that long to

538

00:19:27,190 --> 00:19:25,039

come back

539

00:19:28,150 --> 00:19:27,200

i mean well it takes four years for the

540

00:19:31,750 --> 00:19:28,160

signal to come back

541

00:19:33,669 --> 00:19:31,760

i see that's the speed of light and

542

00:19:35,510 --> 00:19:33,679

but you are right that it's a great

543

00:19:37,190 --> 00:19:35,520

challenge the communication across such

544

00:19:39,510 --> 00:19:37,200

a vast distance

545

00:19:41,909 --> 00:19:39,520

is not simple and you need a big

546

00:19:42,870 --> 00:19:41,919

telescope on earth to collect the signal

547

00:19:45,909 --> 00:19:42,880

that comes back

548

00:19:47,029 --> 00:19:45,919

and to read it and the idea is to take a

549

00:19:49,990 --> 00:19:47,039

photograph

550

00:19:51,270 --> 00:19:50,000

of that planet and see what's on it now

551
00:19:53,190 --> 00:19:51,280
of course the same

552
00:19:54,310 --> 00:19:53,200
spacecraft can be used also within the

553
00:19:56,870 --> 00:19:54,320
solar system much

554
00:19:58,549 --> 00:19:56,880
shorter distances we could get we could

555
00:20:01,350 --> 00:19:58,559
visit the pluto

556
00:20:02,789 --> 00:20:01,360
within a few days uh instead of nine and

557
00:20:05,270 --> 00:20:02,799
a half years that it

558
00:20:07,350 --> 00:20:05,280
horizon to do it yeah and so you can

559
00:20:09,029 --> 00:20:07,360
imagine a lot of other targets once this

560
00:20:11,750 --> 00:20:09,039
technology is available

561
00:20:12,950 --> 00:20:11,760
we could have chased omuamua and taken a

562
00:20:16,070 --> 00:20:12,960
photograph of it

563
00:20:17,909 --> 00:20:16,080

easily uh but with current rockets we

564

00:20:21,270 --> 00:20:17,919

could not do that

565

00:20:23,990 --> 00:20:21,280

right right and oh muammu is still

566

00:20:26,549 --> 00:20:24,000

in our solar system but heading out it

567

00:20:28,470 --> 00:20:26,559

takes it about 10 000 years to traverse

568

00:20:30,310 --> 00:20:28,480

the entire solar system so

569

00:20:31,830 --> 00:20:30,320

coming in was 10 000 years now it's

570

00:20:35,510 --> 00:20:31,840

going out

571

00:20:37,669 --> 00:20:35,520

wow but it is far enough for it to be

572

00:20:40,149 --> 00:20:37,679

extremely dim it's now

573

00:20:41,590 --> 00:20:40,159

uh a million times fainter than it was

574

00:20:44,070 --> 00:20:41,600

close to the sun

575

00:20:45,190 --> 00:20:44,080

so we cannot really observe it with any

576

00:20:47,990 --> 00:20:45,200

telescope

577

00:20:49,510 --> 00:20:48,000

uh we had our chance but we shouldn't

578

00:20:51,190 --> 00:20:49,520

worry about it too much

579

00:20:53,029 --> 00:20:51,200

because you know when i go to the

580

00:20:54,870 --> 00:20:53,039

kitchen and i see an ant

581

00:20:57,270 --> 00:20:54,880

i get alarmed because i know that there

582

00:21:00,549 --> 00:20:57,280

must be many more ants out there

583

00:21:03,350 --> 00:21:00,559

and the same with we found it

584

00:21:05,750 --> 00:21:03,360

over a few years with the pan stars

585

00:21:08,070 --> 00:21:05,760

survey telescope and

586

00:21:09,830 --> 00:21:08,080

we should find a similar object every

587

00:21:12,070 --> 00:21:09,840

few years with pan stars but

588

00:21:14,310 --> 00:21:12,080

in fact in less than three years the

589

00:21:16,630 --> 00:21:14,320

vera rubin observatory in chile

590

00:21:18,470 --> 00:21:16,640

will become operational and then it will

591

00:21:19,350 --> 00:21:18,480

be much more sensitive than pan stars

592

00:21:22,789 --> 00:21:19,360

and we could find an

593

00:21:23,350 --> 00:21:22,799

um like object every month and my point

594

00:21:26,470 --> 00:21:23,360

is

595

00:21:28,630 --> 00:21:26,480

uh if we find weird objects as weird as

596

00:21:31,190 --> 00:21:28,640

um

597

00:21:32,789 --> 00:21:31,200

we should contemplate sending a

598

00:21:35,430 --> 00:21:32,799

spacecraft with a camera

599

00:21:37,029 --> 00:21:35,440

that will intercept its trajectory and

600

00:21:39,669 --> 00:21:37,039

come very close to it

601
00:21:41,750 --> 00:21:39,679
and take a photograph because they say a

602
00:21:43,990 --> 00:21:41,760
picture is worth a thousand words

603
00:21:44,789 --> 00:21:44,000
actually in my case a picture is worth

604
00:21:48,870 --> 00:21:44,799
66

605
00:21:52,070 --> 00:21:48,880
000 words the number of words in my book

606
00:21:54,710 --> 00:21:52,080
i got it if if

607
00:21:55,990 --> 00:21:54,720
this has been this could possibly just

608
00:21:57,750 --> 00:21:56,000
be happening but we didn't have the

609
00:22:01,110 --> 00:21:57,760
technology to see it

610
00:22:03,029 --> 00:22:01,120
until recently yes

611
00:22:04,630 --> 00:22:03,039
so in fact there should be a lot of

612
00:22:08,310 --> 00:22:04,640
these objects in the milk

613
00:22:10,630 --> 00:22:08,320

in the in the solar system right now

614

00:22:11,590 --> 00:22:10,640

about a quadrillion of them 10 to the

615

00:22:13,270 --> 00:22:11,600

power 15

616

00:22:15,350 --> 00:22:13,280

there should be one such object for

617

00:22:16,230 --> 00:22:15,360

every volume associated with the orbit

618

00:22:19,510 --> 00:22:16,240

of the earth

619

00:22:21,270 --> 00:22:19,520

around the sun roughly speaking so um

620

00:22:22,950 --> 00:22:21,280

you know there there should be a lot of

621

00:22:26,149 --> 00:22:22,960

them and we didn't have

622

00:22:29,350 --> 00:22:26,159

a survey telescope like pan stars

623

00:22:32,470 --> 00:22:29,360

until it started operating panstas was

624

00:22:35,750 --> 00:22:32,480

initiated because congress gave

625

00:22:38,390 --> 00:22:35,760

a task to nasa to find 90 percent of all

626

00:22:41,990 --> 00:22:38,400

the near-earth objects objects

627

00:22:42,549 --> 00:22:42,000

bigger than 140 meters roughly the size

628

00:22:46,950 --> 00:22:42,559

of a

629

00:22:49,510 --> 00:22:46,960

mu that are coming close to earth

630

00:22:50,630 --> 00:22:49,520

because we know that you know 66 million

631

00:22:53,190 --> 00:22:50,640

years ago

632

00:22:55,830 --> 00:22:53,200

you know the there was a giant rock

633

00:22:58,230 --> 00:22:55,840

roughly the size of manhattan island

634

00:22:59,669 --> 00:22:58,240

that got bigger and bigger on the sky

635

00:23:02,390 --> 00:22:59,679

and the dinosaurs

636

00:23:04,390 --> 00:23:02,400

saw it coming but they couldn't do much

637

00:23:07,430 --> 00:23:04,400

even though they had huge bodies

638

00:23:08,630 --> 00:23:07,440

uh and then once it hit the ground the

639

00:23:11,510 --> 00:23:08,640

fun stopped

640

00:23:11,990 --> 00:23:11,520

and the three-quarters of all life forms

641

00:23:13,750 --> 00:23:12,000

uh

642

00:23:15,510 --> 00:23:13,760

perished at that point where it went

643

00:23:17,190 --> 00:23:15,520

extinct uh

644

00:23:18,950 --> 00:23:17,200

and we came to the scene afterwards so

645

00:23:21,510 --> 00:23:18,960

perhaps we owe our

646

00:23:23,510 --> 00:23:21,520

thanks to our gratitude to this giant

647

00:23:25,270 --> 00:23:23,520

rock that killed the dinosaurs and other

648

00:23:26,149 --> 00:23:25,280

forms of life so that we can come into

649

00:23:27,990 --> 00:23:26,159

the scene

650

00:23:29,190 --> 00:23:28,000

but at any event we don't want it to

651
00:23:31,350 --> 00:23:29,200
happen to us

652
00:23:33,190 --> 00:23:31,360
so that's why congress the us congress

653
00:23:35,909 --> 00:23:33,200
tasked nasa to find

654
00:23:37,190 --> 00:23:35,919
uh actually objects down to one percent

655
00:23:39,830 --> 00:23:37,200
of the size of

656
00:23:40,870 --> 00:23:39,840
the chick-fil-a impactors that kill the

657
00:23:43,990 --> 00:23:40,880
dinosaurs

658
00:23:45,990 --> 00:23:44,000
uh and then panstas was

659
00:23:47,110 --> 00:23:46,000
designed to survey the sky and look for

660
00:23:49,590 --> 00:23:47,120
such objects and

661
00:23:52,310 --> 00:23:49,600
it's doing part of this task but then

662
00:23:54,950 --> 00:23:52,320
the vera rubin observatory will find 60

663
00:23:56,390 --> 00:23:54,960

of those objects bigger than 140 meters

664

00:23:58,149 --> 00:23:56,400

that will come close to earth

665

00:23:59,909 --> 00:23:58,159

so it will go two thirds of the way

666

00:24:03,029 --> 00:23:59,919

towards fulfilling

667

00:24:05,750 --> 00:24:03,039

uh the congress the congressional task

668

00:24:06,149 --> 00:24:05,760

i think that's great i mean we need i i

669

00:24:07,750 --> 00:24:06,159

mean

670

00:24:09,590 --> 00:24:07,760

i don't know if there was nothing we

671

00:24:11,990 --> 00:24:09,600

could do if something was coming at us

672

00:24:13,750 --> 00:24:12,000

hopefully we'll have technology to do

673

00:24:15,830 --> 00:24:13,760

that or hopefully we'll get off planet

674

00:24:17,590 --> 00:24:15,840

and be able to not be completely wiped

675

00:24:19,510 --> 00:24:17,600

out of something like this yeah

676
00:24:21,510 --> 00:24:19,520
the remarkable thing is the human brain

677
00:24:22,549 --> 00:24:21,520
is so small compared to the size of a

678
00:24:24,789 --> 00:24:22,559
dinosaur

679
00:24:26,149 --> 00:24:24,799
nevertheless it's much more important

680
00:24:28,070 --> 00:24:26,159
for survival

681
00:24:29,510 --> 00:24:28,080
and that's why intelligence is so

682
00:24:32,870 --> 00:24:29,520
crucial that's why

683
00:24:35,029 --> 00:24:32,880
science is really our best protector

684
00:24:37,110 --> 00:24:35,039
because it allows us to design

685
00:24:38,390 --> 00:24:37,120
telescopes that will alert us about an

686
00:24:40,310 --> 00:24:38,400
incoming rock

687
00:24:42,710 --> 00:24:40,320
and so that we can deflect it the

688
00:24:45,990 --> 00:24:42,720

dinosaurs didn't have that capability

689

00:24:49,830 --> 00:24:46,000

yeah one thing this uh i heard you

690

00:24:50,710 --> 00:24:49,840

say that um with our current telescopes

691

00:24:54,630 --> 00:24:50,720

right now

692

00:24:57,029 --> 00:24:54,640

we could probably see a uh city the size

693

00:24:59,110 --> 00:24:57,039

the lights in the city the size of tokyo

694

00:25:00,710 --> 00:24:59,120

in our solar system

695

00:25:03,190 --> 00:25:00,720

the the question i have for you the

696

00:25:06,070 --> 00:25:03,200

james webb is going to be launched

697

00:25:07,909 --> 00:25:06,080

on in october coming and i actually had

698

00:25:11,269 --> 00:25:07,919

the pleasure of actually seeing that um

699

00:25:12,710 --> 00:25:11,279

on site down there um in in baltimore

700

00:25:15,350 --> 00:25:12,720

but i just wondered

701
00:25:17,510 --> 00:25:15,360
if you knew if the james webb will have

702
00:25:20,950 --> 00:25:17,520
the capability to see

703
00:25:22,870 --> 00:25:20,960
um possible i mean can we see out of uh

704
00:25:25,909 --> 00:25:22,880
can we see lights out of our solar

705
00:25:29,190 --> 00:25:25,919
system well

706
00:25:31,190 --> 00:25:29,200
a city like like tokyo we

707
00:25:33,269 --> 00:25:31,200
could be seen three times farther with

708
00:25:34,310 --> 00:25:33,279
the james webb space telescope it has a

709
00:25:36,630 --> 00:25:34,320
larger

710
00:25:38,310 --> 00:25:36,640
mirror than the hubble space telescope

711
00:25:41,110 --> 00:25:38,320
by by a factor of a few

712
00:25:42,390 --> 00:25:41,120
and uh so all together it can see

713
00:25:44,950 --> 00:25:42,400

something that is

714

00:25:47,269 --> 00:25:44,960

fainter by about a factor of 10. and

715

00:25:50,950 --> 00:25:49,510

i did this calculation about the city of

716

00:25:54,070 --> 00:25:50,960

tokyo because we

717

00:25:56,549 --> 00:25:54,080

i attended the a conference in abu dhabi

718

00:25:57,990 --> 00:25:56,559

and the tour guide was bragging that you

719

00:26:01,190 --> 00:25:58,000

can see

720

00:26:03,909 --> 00:26:01,200

uh the lights over there from the moon

721

00:26:05,430 --> 00:26:03,919

and it was just a fun calculation to

722

00:26:08,470 --> 00:26:05,440

figure out how far away

723

00:26:10,549 --> 00:26:08,480

one can see tokyo um

724

00:26:12,149 --> 00:26:10,559

you know from earth with the best

725

00:26:14,630 --> 00:26:12,159

telescopes we have and

726

00:26:15,269 --> 00:26:14,640

turns out you can see it on pluto for

727

00:26:19,190 --> 00:26:15,279

example the

728

00:26:21,350 --> 00:26:19,200

the at the edge of the planetary uh

729

00:26:22,470 --> 00:26:21,360

array of you know within the solar

730

00:26:26,230 --> 00:26:22,480

system and

731

00:26:28,149 --> 00:26:26,240

um so of course if you have many cities

732

00:26:31,669 --> 00:26:28,159

then you can see further out so

733

00:26:34,710 --> 00:26:31,679

for example if proxima b uh on its

734

00:26:37,029 --> 00:26:34,720

dark side has a lot of city lights

735

00:26:39,590 --> 00:26:37,039

uh that are illuminated by electricity

736

00:26:40,230 --> 00:26:39,600

produced by photovoltaic cells that are

737

00:26:42,630 --> 00:26:40,240

on the day

738

00:26:44,149 --> 00:26:42,640

side you can imagine transferring

739

00:26:45,750 --> 00:26:44,159
electricity to the night side and

740

00:26:47,669 --> 00:26:45,760
illuminating it

741

00:26:49,590 --> 00:26:47,679
then we could if the illumination is

742

00:26:51,350 --> 00:26:49,600
more than a few percent

743

00:26:53,269 --> 00:26:51,360
this is actually a paper that i'm

744

00:26:54,149 --> 00:26:53,279
writing right now with an undergraduate

745

00:26:55,750 --> 00:26:54,159
student

746

00:26:57,909 --> 00:26:55,760
then you could potentially see it with

747

00:26:59,990 --> 00:26:57,919
the james webb space telescope

748

00:27:01,669 --> 00:27:00,000
so your question is very timely because

749

00:27:02,390 --> 00:27:01,679
we are working on a paper related to

750

00:27:06,149 --> 00:27:02,400
that

751
00:27:09,669 --> 00:27:06,159
wow wow no the work you did with the

752
00:27:13,029 --> 00:27:09,679
starshire or doing it did that

753
00:27:14,710 --> 00:27:13,039
influence your thoughts on this

754
00:27:16,630 --> 00:27:14,720
well obviously it expanded my

755
00:27:17,510 --> 00:27:16,640
imagination you know we can imagine only

756
00:27:20,870 --> 00:27:17,520
things that we

757
00:27:24,630 --> 00:27:20,880
know about um then in

758
00:27:27,510 --> 00:27:24,640
you can see throughout the search for uh

759
00:27:28,230 --> 00:27:27,520
intelligence in the universe because we

760
00:27:31,029 --> 00:27:28,240
started

761
00:27:33,190 --> 00:27:31,039
searching for radio signals as soon as

762
00:27:34,149 --> 00:27:33,200
radio communication was developed here

763
00:27:37,110 --> 00:27:34,159

on earth and

764

00:27:37,590 --> 00:27:37,120

radio telescopes were developed um and

765

00:27:41,669 --> 00:27:37,600

so

766

00:27:44,230 --> 00:27:41,679

and and we started searching for laser

767

00:27:45,190 --> 00:27:44,240

signals once the laser was invented and

768

00:27:47,110 --> 00:27:45,200

so forth and

769

00:27:49,110 --> 00:27:47,120

obviously the fact that i had some

770

00:27:50,070 --> 00:27:49,120

experience and knowledge about the light

771

00:27:51,909 --> 00:27:50,080

sales

772

00:27:53,430 --> 00:27:51,919

expanded my imagination so actually at

773

00:27:56,549 --> 00:27:53,440

the same time that

774

00:27:57,430 --> 00:27:56,559

i worked on the starshot concept for

775

00:28:00,630 --> 00:27:57,440

yuri

776

00:28:02,630 --> 00:28:00,640

uh i also wrote a paper about uh with a

777

00:28:05,830 --> 00:28:02,640

postdoc of mine about the fact that

778

00:28:07,990 --> 00:28:05,840

if there happens to be a beam of light

779

00:28:10,230 --> 00:28:08,000

propelling a light sail in another

780

00:28:11,510 --> 00:28:10,240

planetary system let's say in an analog

781

00:28:13,750 --> 00:28:11,520

of the earth mars

782

00:28:15,430 --> 00:28:13,760

system and we happen to be along the

783

00:28:18,149 --> 00:28:15,440

line of sight of that beam

784

00:28:18,950 --> 00:28:18,159

then as it sweeps across the sky we

785

00:28:21,830 --> 00:28:18,960

would see

786

00:28:22,149 --> 00:28:21,840

a flash of light uh because of leakage

787

00:28:27,669 --> 00:28:22,159

of

788

00:28:28,789 --> 00:28:27,679

so if you imagine a cell being propelled

789

00:28:31,190 --> 00:28:28,799

from an earth

790

00:28:31,830 --> 00:28:31,200

like planet to a mars-like planet you

791

00:28:36,230 --> 00:28:31,840

can tell

792

00:28:39,350 --> 00:28:36,240

when those two planets line up with our

793

00:28:41,029 --> 00:28:39,360

view with our line of sight and

794

00:28:43,350 --> 00:28:41,039

if you see a flash of light at that

795

00:28:45,350 --> 00:28:43,360

point in time then you know

796

00:28:47,110 --> 00:28:45,360

what it may be used for and that's a

797

00:28:50,870 --> 00:28:47,120

paper that we wrote when we were

798

00:28:53,590 --> 00:28:50,880

preparing the concept for yuri ah i see

799

00:28:55,430 --> 00:28:53,600

well i remember when i i very first

800

00:28:57,830 --> 00:28:55,440

heard of umu and i had a hard time

801
00:29:01,430 --> 00:28:57,840
saying the names sometimes i still

802
00:29:03,750 --> 00:29:01,440
mess it up but um all the depictions and

803
00:29:05,669 --> 00:29:03,760
um i did put it in your thumbnail too

804
00:29:09,510 --> 00:29:05,679
because i couldn't really find

805
00:29:09,990 --> 00:29:09,520
um the the uh what what i want to talk

806
00:29:14,549 --> 00:29:10,000
about

807
00:29:17,029 --> 00:29:14,559
and this is your thumbnail right here um

808
00:29:18,310 --> 00:29:17,039
all everything you find online is a

809
00:29:20,149 --> 00:29:18,320
cigar shape

810
00:29:21,430 --> 00:29:20,159
that's right when i'm reading your book

811
00:29:25,269 --> 00:29:21,440
i find out that

812
00:29:28,630 --> 00:29:25,279
it's 90 of a chance that it's uh

813
00:29:31,350 --> 00:29:28,640

more like a flat shape possibly a disc

814

00:29:33,110 --> 00:29:31,360

shape yes i mean the reason for the

815

00:29:35,269 --> 00:29:33,120

confusion is simple

816

00:29:37,029 --> 00:29:35,279

just imagine a piece of paper tumbling

817

00:29:40,549 --> 00:29:37,039

in the wind

818

00:29:43,510 --> 00:29:40,559

and so um

819

00:29:45,029 --> 00:29:43,520

was tumbling over eight hours and then

820

00:29:46,310 --> 00:29:45,039

when you look at the piece of paper

821

00:29:49,430 --> 00:29:46,320

projected

822

00:29:49,830 --> 00:29:49,440

uh you see something elongated uh and

823

00:29:55,190 --> 00:29:49,840

that

824

00:29:57,029 --> 00:29:55,200

10 times longer than it is wide when

825

00:29:58,630 --> 00:29:57,039

projected because the amount of light

826

00:30:01,029 --> 00:29:58,640

that was reflected from it

827

00:30:01,909 --> 00:30:01,039

was varying by a factor of 10 as it was

828

00:30:03,830 --> 00:30:01,919

tumbling

829

00:30:05,430 --> 00:30:03,840

but that's just projected on the sky it

830

00:30:08,470 --> 00:30:05,440

was 10 times longer than

831

00:30:10,230 --> 00:30:08,480

than white intrinsically it was just

832

00:30:12,549 --> 00:30:10,240

like this piece of paper

833

00:30:14,870 --> 00:30:12,559

and and you can figure it out by

834

00:30:16,789 --> 00:30:14,880

modeling the variation in the light

835

00:30:20,070 --> 00:30:16,799

so that was done in a paper that was

836

00:30:22,310 --> 00:30:20,080

published only in 2019

837

00:30:23,669 --> 00:30:22,320

and before that even the discovery paper

838

00:30:26,710 --> 00:30:23,679

of

839

00:30:28,070 --> 00:30:26,720

was pointing out that the flat shape is

840

00:30:31,750 --> 00:30:28,080

more likely

841

00:30:33,430 --> 00:30:31,760

based on what they saw but that was just

842

00:30:35,110 --> 00:30:33,440

preliminary analysis

843

00:30:36,549 --> 00:30:35,120

and then you know the person that made

844

00:30:39,190 --> 00:30:36,559

this cartoon

845

00:30:40,149 --> 00:30:39,200

uh didn't really pay attention to the

846

00:30:43,269 --> 00:30:40,159

details

847

00:30:46,789 --> 00:30:43,279

i'm not sure exactly why but made it

848

00:30:49,110 --> 00:30:46,799

look like a cigar but the reality of the

849

00:30:51,029 --> 00:30:49,120

situation is that already the

850

00:30:53,190 --> 00:30:51,039

discovery paper pointed this out and

851
00:30:55,909 --> 00:30:53,200
then there was a detailed analysis

852
00:30:59,190 --> 00:30:55,919
published in 2019 that showed that it

853
00:31:00,789 --> 00:30:59,200
is at the 90 confidence level uh pancake

854
00:31:03,990 --> 00:31:00,799
shape

855
00:31:06,310 --> 00:31:04,000
right right and it it uh

856
00:31:07,190 --> 00:31:06,320
it has i know you said it has something

857
00:31:09,830 --> 00:31:07,200
like six

858
00:31:11,029 --> 00:31:09,840
very strange properties right so i want

859
00:31:13,669 --> 00:31:11,039
to get to all of them

860
00:31:15,110 --> 00:31:13,679
and and but before we do i just want to

861
00:31:18,310 --> 00:31:15,120
take a little jag here and just

862
00:31:20,710 --> 00:31:18,320
ask you um summon

863
00:31:21,750 --> 00:31:20,720

at your level what type of ridicule are

864

00:31:23,990 --> 00:31:21,760

you getting from your

865

00:31:25,750 --> 00:31:24,000

colleagues and people in the science

866

00:31:28,789 --> 00:31:25,760

world well i should say it's

867

00:31:31,190 --> 00:31:28,799

uh significantly muted by the fact that

868

00:31:32,950 --> 00:31:31,200

you know i had a lot of leadership

869

00:31:35,750 --> 00:31:32,960

positions and

870

00:31:36,870 --> 00:31:35,760

know me and and that i worked on topics

871

00:31:40,230 --> 00:31:36,880

ranging from

872

00:31:41,990 --> 00:31:40,240

the early universe to black holes and uh

873

00:31:43,990 --> 00:31:42,000

you know i applied exactly the same

874

00:31:46,549 --> 00:31:44,000

approach to this subject as i did to

875

00:31:49,110 --> 00:31:46,559

other anomalies in other contexts

876
00:31:50,230 --> 00:31:49,120
and so you know i keep my eyes on the

877
00:31:52,789 --> 00:31:50,240
ball just like

878
00:31:55,350 --> 00:31:52,799
basketball coaches advise the players to

879
00:31:57,590 --> 00:31:55,360
do i don't care about the audience and

880
00:32:00,070 --> 00:31:57,600
i'm just talking about the evidence and

881
00:32:01,990 --> 00:32:00,080
i highly respect the scientists that try

882
00:32:03,430 --> 00:32:02,000
to explain the same evidence which is

883
00:32:05,509 --> 00:32:03,440
anomalous

884
00:32:06,789 --> 00:32:05,519
in terms of a natural origin i have no

885
00:32:08,549 --> 00:32:06,799
problem with that as

886
00:32:10,230 --> 00:32:08,559
they put some possibilities on the table

887
00:32:12,310 --> 00:32:10,240
and we can discuss them

888
00:32:14,710 --> 00:32:12,320

uh unfortunately all the possibilities

889

00:32:17,430 --> 00:32:14,720

that were put on the table uh as

890

00:32:19,029 --> 00:32:17,440

a naturally occurring object all of them

891

00:32:20,389 --> 00:32:19,039

involved something that we have never

892

00:32:22,870 --> 00:32:20,399

seen before

893

00:32:24,389 --> 00:32:22,880

and all of these possibilities uh have

894

00:32:26,630 --> 00:32:24,399

major flows

895

00:32:28,470 --> 00:32:26,640

um you know i can give you some examples

896

00:32:31,909 --> 00:32:28,480

one was that

897

00:32:34,230 --> 00:32:31,919

uh maybe it's a hydrogen iceberg

898

00:32:35,830 --> 00:32:34,240

a chunk of frozen hydrogen the size of a

899

00:32:38,230 --> 00:32:35,840

football field

900

00:32:40,149 --> 00:32:38,240

because we haven't seen a cometary tail

901
00:32:43,509 --> 00:32:40,159
and no no

902
00:32:45,830 --> 00:32:43,519
tale of gas or or dust

903
00:32:47,590 --> 00:32:45,840
was found around this object even with a

904
00:32:48,389 --> 00:32:47,600
special space telescope that looked very

905
00:32:50,789 --> 00:32:48,399
deeply

906
00:32:51,990 --> 00:32:50,799
couldn't find any carbon-based molecules

907
00:32:53,909 --> 00:32:52,000
and uh

908
00:32:55,430 --> 00:32:53,919
the idea of the hydrogen iceberg was

909
00:32:56,310 --> 00:32:55,440
that you know the hydrogen is

910
00:32:58,310 --> 00:32:56,320
transparent

911
00:33:00,070 --> 00:32:58,320
so you might get a cometary tail without

912
00:33:02,070 --> 00:33:00,080
seeing it

913
00:33:03,669 --> 00:33:02,080

but then we showed in a paper after that

914

00:33:06,070 --> 00:33:03,679

that uh in fact the

915

00:33:07,509 --> 00:33:06,080

hydrogen hydrogen iceberg would

916

00:33:08,950 --> 00:33:07,519

evaporate very quickly it wouldn't

917

00:33:11,830 --> 00:33:08,960

survive the journey

918

00:33:13,350 --> 00:33:11,840

because it will absorb starlight so that

919

00:33:15,190 --> 00:33:13,360

doesn't really work

920

00:33:16,870 --> 00:33:15,200

uh and then there was a suggestion maybe

921

00:33:19,830 --> 00:33:16,880

it's a cloud of dust particles

922

00:33:21,669 --> 00:33:19,840

um you know sort of a very fluffy cloud

923

00:33:24,549 --> 00:33:21,679

of dust that is a hundred times

924

00:33:26,470 --> 00:33:24,559

less dense than air on average like a

925

00:33:28,310 --> 00:33:26,480

dust bunny

926
00:33:29,590 --> 00:33:28,320
and the problem of that is when it gets

927
00:33:32,149 --> 00:33:29,600
close to the sun

928
00:33:33,110 --> 00:33:32,159
it will be heated by hundreds of degrees

929
00:33:35,190 --> 00:33:33,120
and then

930
00:33:37,029 --> 00:33:35,200
it will lose its integrity because it

931
00:33:40,630 --> 00:33:37,039
doesn't have the material strength

932
00:33:42,950 --> 00:33:40,640
to survive uh so and then there was

933
00:33:45,909 --> 00:33:42,960
another idea that maybe it's shrapnel

934
00:33:47,750 --> 00:33:45,919
uh you know some some fragments from uh

935
00:33:48,389 --> 00:33:47,760
the disruption of a bigger object by a

936
00:33:50,470 --> 00:33:48,399
star

937
00:33:52,789 --> 00:33:50,480
and the problem with that is that a

938
00:33:55,990 --> 00:33:52,799

tidal disruption of an object results in

939

00:33:57,830 --> 00:33:56,000

elongated pieces and the most likely

940

00:34:01,269 --> 00:33:57,840

model for umuah was

941

00:34:02,630 --> 00:34:01,279

flat a pancake shape so uh all of these

942

00:34:04,310 --> 00:34:02,640

suggestions i mean and these are the

943

00:34:05,750 --> 00:34:04,320

only suggestions put on the table to

944

00:34:07,430 --> 00:34:05,760

explain the anomalies

945

00:34:09,190 --> 00:34:07,440

and all of them involved something that

946

00:34:12,149 --> 00:34:09,200

we've never seen before

947

00:34:12,790 --> 00:34:12,159

and all of them had flows and i said

948

00:34:15,990 --> 00:34:12,800

that

949

00:34:17,750 --> 00:34:16,000

alternatives we have

950

00:34:19,750 --> 00:34:17,760

we should definitely seriously

951
00:34:21,829 --> 00:34:19,760
contemplate the possibility of

952
00:34:23,430 --> 00:34:21,839
an artificial origin and of course there

953
00:34:25,909 --> 00:34:23,440
was a huge backlash

954
00:34:26,710 --> 00:34:25,919
against that possibility most people did

955
00:34:28,710 --> 00:34:26,720
not attend

956
00:34:30,310 --> 00:34:28,720
to the anomalies they just didn't want

957
00:34:32,550 --> 00:34:30,320
it to be on the table

958
00:34:34,470 --> 00:34:32,560
uh because it takes them out of their

959
00:34:36,710 --> 00:34:34,480
comfort zone you know and

960
00:34:38,310 --> 00:34:36,720
there was there was a seminar at harvard

961
00:34:39,829 --> 00:34:38,320
about the mua muai and when i left the

962
00:34:41,829 --> 00:34:39,839
room with a colleague of mine that

963
00:34:44,869 --> 00:34:41,839

worked on rocks for decades

964

00:34:48,069 --> 00:34:44,879

he said this object is so weird

965

00:34:49,750 --> 00:34:48,079

i wish it never existed and to me that

966

00:34:51,990 --> 00:34:49,760

was appalling because when

967

00:34:54,310 --> 00:34:52,000

nature gives you evidence that is not

968

00:34:55,990 --> 00:34:54,320

lining up with what you expected

969

00:34:57,750 --> 00:34:56,000

that's actually an opportunity to learn

970

00:34:59,750 --> 00:34:57,760

something new

971

00:35:00,870 --> 00:34:59,760

and you should actually be thrilled at

972

00:35:03,430 --> 00:35:00,880

such but

973

00:35:04,950 --> 00:35:03,440

somehow many of my colleagues prefer

974

00:35:07,829 --> 00:35:04,960

science to be boring

975

00:35:09,190 --> 00:35:07,839

not to be exciting and i don't i don't

976
00:35:11,430 --> 00:35:09,200
fully understand that

977
00:35:13,030 --> 00:35:11,440
and you know one possible reason is they

978
00:35:14,310 --> 00:35:13,040
worry about their reputation they don't

979
00:35:16,069 --> 00:35:14,320
want to take risks

980
00:35:18,470 --> 00:35:16,079
they don't want to put any skin in the

981
00:35:21,109 --> 00:35:18,480
game but that goes contrary to

982
00:35:23,109 --> 00:35:21,119
innovation in science because

983
00:35:24,870 --> 00:35:23,119
you know just like kids you have to put

984
00:35:26,710 --> 00:35:24,880
skin in the game because

985
00:35:29,109 --> 00:35:26,720
otherwise you don't learn anything new i

986
00:35:31,430 --> 00:35:29,119
mean einstein was wrong three times

987
00:35:32,790 --> 00:35:31,440
in the last decade of his career he said

988
00:35:34,550 --> 00:35:32,800

that black holes don't exist

989

00:35:36,470 --> 00:35:34,560

gravitational waves don't exist

990

00:35:38,310 --> 00:35:36,480

and quantum mechanics doesn't have a

991

00:35:40,790 --> 00:35:38,320

spooky action at the distance and

992

00:35:42,630 --> 00:35:40,800

all three were proven wrong by

993

00:35:44,790 --> 00:35:42,640

experiments that took place later

994

00:35:47,190 --> 00:35:44,800

but that's fine i mean when you work at

995

00:35:49,510 --> 00:35:47,200

the frontier you make mistakes sometimes

996

00:35:51,109 --> 00:35:49,520

uh however if your objective is to

997

00:35:53,270 --> 00:35:51,119

always be right

998

00:35:55,190 --> 00:35:53,280

then obviously you would retreat to a

999

00:35:55,670 --> 00:35:55,200

place where you never put skin in the

1000

00:35:59,030 --> 00:35:55,680

game

1001
00:36:02,069 --> 00:35:59,040
you never take any risks you always sit

1002
00:36:02,390 --> 00:36:02,079
in your comfort zone and i mean you can

1003
00:36:04,470 --> 00:36:02,400
get

1004
00:36:06,150 --> 00:36:04,480
awards and honors and and belong to

1005
00:36:08,710 --> 00:36:06,160
honor societies but

1006
00:36:09,990 --> 00:36:08,720
frankly i would hate to be in that

1007
00:36:11,990 --> 00:36:10,000
position because that's

1008
00:36:13,109 --> 00:36:12,000
boring you know and science is supposed

1009
00:36:15,829 --> 00:36:13,119
to be exciting

1010
00:36:16,390 --> 00:36:15,839
uh why should we retreat to a place that

1011
00:36:18,870 --> 00:36:16,400
is

1012
00:36:19,589 --> 00:36:18,880
uh so boring and especially given that

1013
00:36:22,470 --> 00:36:19,599

the public

1014

00:36:23,030 --> 00:36:22,480

is excited about this question of are we

1015

00:36:25,190 --> 00:36:23,040

alone

1016

00:36:26,790 --> 00:36:25,200

are we the smartest kid on the block so

1017

00:36:28,710 --> 00:36:26,800

and the public funds

1018

00:36:30,630 --> 00:36:28,720

uh science and i think science

1019

00:36:31,990 --> 00:36:30,640

scientists have an obligation to address

1020

00:36:32,630 --> 00:36:32,000

this question if they have the ability

1021

00:36:35,109 --> 00:36:32,640

to do so

1022

00:36:35,910 --> 00:36:35,119

and we suddenly have the telescopes it's

1023

00:36:38,470 --> 00:36:35,920

just that

1024

00:36:39,109 --> 00:36:38,480

this kind of research is not funded uh

1025

00:36:42,069 --> 00:36:39,119

much and

1026

00:36:44,069 --> 00:36:42,079

and then there is this ridicule uh of

1027

00:36:45,510 --> 00:36:44,079

any suggestion in this direction that i

1028

00:36:47,589 --> 00:36:45,520

find inappropriate

1029

00:36:49,510 --> 00:36:47,599

uh you know some scientists say well

1030

00:36:51,430 --> 00:36:49,520

it's a controversial subject

1031

00:36:52,550 --> 00:36:51,440

my answer to that is if you go to

1032

00:36:53,910 --> 00:36:52,560

ancient times

1033

00:36:55,750 --> 00:36:53,920

you know there was a controversial

1034

00:36:56,630 --> 00:36:55,760

suggestion that the human body has a

1035

00:37:00,069 --> 00:36:56,640

soul

1036

00:37:03,430 --> 00:37:00,079

and imagine if scientists would say

1037

00:37:05,190 --> 00:37:03,440

oh you know there is this controversy

1038

00:37:05,750 --> 00:37:05,200

about whether the human body has a soul

1039

00:37:07,270 --> 00:37:05,760

and

1040

00:37:09,510 --> 00:37:07,280

therefore we don't want to pursue

1041

00:37:11,109 --> 00:37:09,520

anatomy because

1042

00:37:13,109 --> 00:37:11,119

you know that there are some views that

1043

00:37:14,390 --> 00:37:13,119

say that it should be forbidden and

1044

00:37:16,310 --> 00:37:14,400

other way

1045

00:37:18,069 --> 00:37:16,320

views that say no you should actually

1046

00:37:18,870 --> 00:37:18,079

dissect the human body to find what's

1047

00:37:21,510 --> 00:37:18,880

inside

1048

00:37:22,069 --> 00:37:21,520

and imagine where modern science modern

1049

00:37:24,150 --> 00:37:22,079

medicine

1050

00:37:26,150 --> 00:37:24,160

would be if we were to avoid this

1051
00:37:29,270 --> 00:37:26,160
subject just because it's controversial

1052
00:37:30,790 --> 00:37:29,280
i think there is an obligation for

1053
00:37:33,430 --> 00:37:30,800
science to address

1054
00:37:34,390 --> 00:37:33,440
to clear up questions of great interest

1055
00:37:37,589 --> 00:37:34,400
to the public

1056
00:37:38,870 --> 00:37:37,599
using the scientific method you know as

1057
00:37:42,069 --> 00:37:38,880
i said in the

1058
00:37:43,030 --> 00:37:42,079
uh beginning um i think since human

1059
00:37:46,230 --> 00:37:43,040
existence

1060
00:37:48,390 --> 00:37:46,240
there's been pushback on something new

1061
00:37:49,510 --> 00:37:48,400
and it it's it's got to be fear-based i

1062
00:37:55,750 --> 00:37:49,520
don't

1063
00:37:57,430 --> 00:37:55,760

like i should know about it that type of

1064

00:37:59,270 --> 00:37:57,440

thing we're having uh we're having a

1065

00:38:01,990 --> 00:37:59,280

number of things come into the

1066

00:38:03,510 --> 00:38:02,000

uh chat as far as questions um i'll just

1067

00:38:07,030 --> 00:38:03,520

pull one up here

1068

00:38:10,230 --> 00:38:07,040

because i think you can address it

1069

00:38:12,630 --> 00:38:10,240

don is asking if um scout ship how much

1070

00:38:13,589 --> 00:38:12,640

information could they have collected

1071

00:38:17,109 --> 00:38:13,599

about earth

1072

00:38:19,270 --> 00:38:17,119

or i'll just add to that a little bit

1073

00:38:21,910 --> 00:38:19,280

was it if it was i mean would they even

1074

00:38:23,990 --> 00:38:21,920

want to i mean are we that special

1075

00:38:25,510 --> 00:38:24,000

well that's exactly my point i don't

1076

00:38:27,510 --> 00:38:25,520

think that we are sufficiently

1077

00:38:30,310 --> 00:38:27,520

interesting for anyone to worry about

1078

00:38:30,790 --> 00:38:30,320

us we had our technologies only for 100

1079

00:38:34,470 --> 00:38:30,800

years

1080

00:38:36,790 --> 00:38:34,480

about a century and omomo started its

1081

00:38:37,510 --> 00:38:36,800

trip into the solar system 10 000 years

1082

00:38:39,349 --> 00:38:37,520

ago when

1083

00:38:41,109 --> 00:38:39,359

we weren't very interesting back then

1084

00:38:43,750 --> 00:38:41,119

technologically speaking and

1085

00:38:45,750 --> 00:38:43,760

therefore i don't think that it is

1086

00:38:47,990 --> 00:38:45,760

likely to be spying on us

1087

00:38:49,670 --> 00:38:48,000

the more likely situation is it's a

1088

00:38:51,510 --> 00:38:49,680

piece of equipment that

1089

00:38:53,589 --> 00:38:51,520

you know was produced billions of years

1090

00:38:56,150 --> 00:38:53,599

ago because most of the stars

1091

00:38:58,230 --> 00:38:56,160

in the milky way galaxy form billions of

1092

00:38:59,030 --> 00:38:58,240

years before the sun the sun is the late

1093

00:39:01,510 --> 00:38:59,040

camera

1094

00:39:02,550 --> 00:39:01,520

and so if those stars had civilizations

1095

00:39:05,750 --> 00:39:02,560

like ours

1096

00:39:07,030 --> 00:39:05,760

that sent probes into space like voyager

1097

00:39:10,069 --> 00:39:07,040

1 voyager 2

1098

00:39:11,589 --> 00:39:10,079

new horizons you know these probes

1099

00:39:14,230 --> 00:39:11,599

billions of years later

1100

00:39:15,990 --> 00:39:14,240

are not operational anymore but you know

1101

00:39:16,790 --> 00:39:16,000

they are just like plastic bottles on

1102

00:39:19,910 --> 00:39:16,800

the beach

1103

00:39:22,310 --> 00:39:19,920

they may have punctures in them and

1104

00:39:24,230 --> 00:39:22,320

they are not really functional but they

1105

00:39:25,349 --> 00:39:24,240

tell us a story about the civilization

1106

00:39:27,589 --> 00:39:25,359

that made them

1107

00:39:29,510 --> 00:39:27,599

and then you know the best way to tell

1108

00:39:30,069 --> 00:39:29,520

that it's not a natural object not a

1109

00:39:32,150 --> 00:39:30,079

rock

1110

00:39:34,310 --> 00:39:32,160

is to take a close-up photograph and

1111

00:39:34,710 --> 00:39:34,320

then decide whether we want to land on

1112

00:39:36,390 --> 00:39:34,720

it

1113

00:39:38,390 --> 00:39:36,400

and put our hands on this piece of

1114

00:39:40,310 --> 00:39:38,400

technology because perhaps it's

1115

00:39:41,510 --> 00:39:40,320

a million years more advanced than the

1116

00:39:44,390 --> 00:39:41,520

technologies we have

1117

00:39:45,430 --> 00:39:44,400

right here right now yeah and you

1118

00:39:48,310 --> 00:39:45,440

mentioned in your book and i

1119

00:39:50,069 --> 00:39:48,320

i sent you an email about this too that

1120

00:39:53,109 --> 00:39:50,079

i had an astronomer on my

1121

00:39:54,390 --> 00:39:53,119

um on this show before who basically

1122

00:39:57,829 --> 00:39:54,400

said that

1123

00:40:01,030 --> 00:39:57,839

his fellows at nasa agreed

1124

00:40:02,630 --> 00:40:01,040

with him that if uh if a civilization

1125

00:40:05,030 --> 00:40:02,640

can get through the bottleneck of

1126
00:40:07,109 --> 00:40:05,040
technology without blowing themselves up

1127
00:40:08,950 --> 00:40:07,119
they'd be traveling the stars but along

1128
00:40:10,390 --> 00:40:08,960
that same line and you kind of touched

1129
00:40:13,430 --> 00:40:10,400
on that in your book

1130
00:40:15,510 --> 00:40:13,440
along that same line it's possible that

1131
00:40:18,790 --> 00:40:15,520
these billions of year-old

1132
00:40:20,390 --> 00:40:18,800
planets have had multiple civilizations

1133
00:40:21,829 --> 00:40:20,400
that might have wiped themselves out and

1134
00:40:22,870 --> 00:40:21,839
started over again i mean these things

1135
00:40:25,750 --> 00:40:22,880
are all possible

1136
00:40:26,630 --> 00:40:25,760
definitely we had a lot of cultures on

1137
00:40:27,910 --> 00:40:26,640
earth and

1138
00:40:30,150 --> 00:40:27,920

you know we can't have a phone

1139

00:40:31,670 --> 00:40:30,160

conversation with the mayans the mayan

1140

00:40:33,750 --> 00:40:31,680

culture is gone

1141

00:40:36,870 --> 00:40:33,760

and but we can find about them by

1142

00:40:39,670 --> 00:40:36,880

looking at the relics they left behind

1143

00:40:40,150 --> 00:40:39,680

through archaeological sites and the

1144

00:40:43,750 --> 00:40:40,160

that's

1145

00:40:47,030 --> 00:40:43,760

why i think the biggest message of

1146

00:40:49,430 --> 00:40:47,040

space archaeology because it allows us

1147

00:40:50,150 --> 00:40:49,440

you know to search for relics left

1148

00:40:53,670 --> 00:40:50,160

behind by

1149

00:40:55,589 --> 00:40:53,680

dead civilizations in space um and

1150

00:40:57,750 --> 00:40:55,599

in the past in the past 70 years we've

1151

00:41:00,309 --> 00:40:57,760

been looking for radio signals

1152

00:41:03,030 --> 00:41:00,319

but it's just like a phone conversation

1153

00:41:05,190 --> 00:41:03,040

you need the counterpart to be alive and

1154

00:41:07,270 --> 00:41:05,200

if most counterparts are not alive

1155

00:41:08,630 --> 00:41:07,280

anymore because they predated us by

1156

00:41:10,710 --> 00:41:08,640

billions of years

1157

00:41:12,790 --> 00:41:10,720

then searching for relics that they left

1158

00:41:15,990 --> 00:41:12,800

behind is a much better approach

1159

00:41:17,109 --> 00:41:16,000

and then what if i had funding what i

1160

00:41:19,589 --> 00:41:17,119

would fund first

1161

00:41:20,710 --> 00:41:19,599

is placing cameras within the orbit of

1162

00:41:23,510 --> 00:41:20,720

the earth around the sun

1163

00:41:25,349 --> 00:41:23,520

so that they could look up close at

1164

00:41:28,790 --> 00:41:25,359

interstellar objects that

1165

00:41:29,910 --> 00:41:28,800

come into the our neighborhood and see

1166

00:41:31,910 --> 00:41:29,920

whether there are rocks

1167

00:41:34,309 --> 00:41:31,920

natural objects or plastic bottles you

1168

00:41:36,870 --> 00:41:34,319

know artificial objects

1169

00:41:38,390 --> 00:41:36,880

and then this i would call it space

1170

00:41:40,150 --> 00:41:38,400

archaeology and

1171

00:41:41,829 --> 00:41:40,160

i think it's a new frontier that should

1172

00:41:44,230 --> 00:41:41,839

be mainstream just like

1173

00:41:46,150 --> 00:41:44,240

archaeology on earth is mainstream and

1174

00:41:47,510 --> 00:41:46,160

on every campus there should be space

1175

00:41:49,670 --> 00:41:47,520

archaeologists

1176

00:41:50,870 --> 00:41:49,680

wow how about that that's really that's

1177

00:41:53,270 --> 00:41:50,880

a great thought

1178

00:41:55,270 --> 00:41:53,280

um the one thing that i when i first

1179

00:41:57,829 --> 00:41:55,280

read about umuah

1180

00:41:59,430 --> 00:41:57,839

um the first question i had is how do we

1181

00:42:00,069 --> 00:41:59,440

know it's from another solar system and

1182

00:42:01,990 --> 00:42:00,079

i know it's

1183

00:42:04,069 --> 00:42:02,000

i do know this now but i want you to

1184

00:42:06,069 --> 00:42:04,079

explain that for the person that may not

1185

00:42:07,349 --> 00:42:06,079

right so that that is uh relatively

1186

00:42:10,710 --> 00:42:07,359

straightforward because

1187

00:42:13,670 --> 00:42:10,720

the object was moving very fast and

1188

00:42:15,430 --> 00:42:13,680

uh it could not be bound to the sun like

1189

00:42:16,470 --> 00:42:15,440

the planets are you know the earth is

1190

00:42:18,870 --> 00:42:16,480

bound to the sun

1191

00:42:21,030 --> 00:42:18,880

so when we launch a rocket away from

1192

00:42:23,190 --> 00:42:21,040

earth if we give it a high enough speed

1193

00:42:24,069 --> 00:42:23,200

it will escape the gravitational pull of

1194

00:42:27,750 --> 00:42:24,079

the earth

1195

00:42:29,990 --> 00:42:27,760

if if we throw a stone up it comes back

1196

00:42:32,470 --> 00:42:30,000

to us because we we don't throw it

1197

00:42:34,710 --> 00:42:32,480

fast enough so clearly the speed of an

1198

00:42:37,190 --> 00:42:34,720

object can tell you whether it's bound

1199

00:42:38,230 --> 00:42:37,200

by the gravitational force to earth or

1200

00:42:41,349 --> 00:42:38,240

to the sun

1201
00:42:41,910 --> 00:42:41,359
and the um was moving too fast to be

1202
00:42:45,109 --> 00:42:41,920
bound

1203
00:42:46,950 --> 00:42:45,119
to the sun now that's another weird

1204
00:42:50,710 --> 00:42:46,960
property of

1205
00:42:52,790 --> 00:42:50,720
that when you ask what where was it

1206
00:42:55,109 --> 00:42:52,800
before it arrived to the solar system

1207
00:42:55,990 --> 00:42:55,119
turns out that it was at a special frame

1208
00:42:58,630 --> 00:42:56,000
of reference

1209
00:43:00,230 --> 00:42:58,640
called the local standard of rest which

1210
00:43:01,109 --> 00:43:00,240
is the frame that you get to when you

1211
00:43:02,950 --> 00:43:01,119
average over the

1212
00:43:04,790 --> 00:43:02,960
random motions of all the stars in the

1213
00:43:08,230 --> 00:43:04,800

neighborhood of the sun

1214

00:43:10,390 --> 00:43:08,240

and then it was at rest in that frame

1215

00:43:11,349 --> 00:43:10,400

so it was sort of parked in the local

1216

00:43:13,750 --> 00:43:11,359

parking lot

1217

00:43:14,870 --> 00:43:13,760

not moving like a buoy on the surface of

1218

00:43:16,790 --> 00:43:14,880

the ocean

1219

00:43:18,950 --> 00:43:16,800

and then the solar system like a giant

1220

00:43:20,630 --> 00:43:18,960

ship bumped into it

1221

00:43:22,309 --> 00:43:20,640

because the sun moves relative to the

1222

00:43:25,349 --> 00:43:22,319

local standalone fresh

1223

00:43:26,069 --> 00:43:25,359

and only one in 500 stars is so much at

1224

00:43:29,750 --> 00:43:26,079

rest

1225

00:43:31,589 --> 00:43:29,760

in the local standard of res as um was

1226

00:43:32,950 --> 00:43:31,599

so the question is whether that tells us

1227

00:43:36,390 --> 00:43:32,960

something about

1228

00:43:38,550 --> 00:43:36,400

the purpose of umuamua perhaps it's a

1229

00:43:41,270 --> 00:43:38,560

member of a grid of objects

1230

00:43:41,750 --> 00:43:41,280

that are filling up interstellar space

1231

00:43:45,030 --> 00:43:41,760

and

1232

00:43:47,750 --> 00:43:45,040

just like a coordinate uh

1233

00:43:49,109 --> 00:43:47,760

posts and so that when you travel

1234

00:43:49,829 --> 00:43:49,119

through interstellar space you know

1235

00:43:51,750 --> 00:43:49,839

where you are

1236

00:43:53,430 --> 00:43:51,760

relative to these objects that are at

1237

00:43:56,069 --> 00:43:53,440

the local standard frames

1238

00:43:57,910 --> 00:43:56,079

or maybe it's a member of an array of

1239

00:44:00,309 --> 00:43:57,920

objects that are used for

1240

00:44:01,670 --> 00:44:00,319

uh really s relay stations for

1241

00:44:03,589 --> 00:44:01,680

communication

1242

00:44:04,790 --> 00:44:03,599

um you know that could be two

1243

00:44:06,630 --> 00:44:04,800

possibilities

1244

00:44:09,190 --> 00:44:06,640

given the fact that it's so weird in

1245

00:44:12,470 --> 00:44:09,200

terms of where it started from

1246

00:44:13,430 --> 00:44:12,480

now the speed thing i'm still stuck on

1247

00:44:15,349 --> 00:44:13,440

that just a little bit

1248

00:44:17,270 --> 00:44:15,359

because a lot of times you hear like uh

1249

00:44:19,349 --> 00:44:17,280

an asteroid's moving like 40

1250

00:44:20,309 --> 00:44:19,359

000 miles an hour or something like that

1251
00:44:22,150 --> 00:44:20,319
i think

1252
00:44:23,510 --> 00:44:22,160
did i hear this was 60 or something like

1253
00:44:26,470 --> 00:44:23,520
that i'm i'm not sure

1254
00:44:28,870 --> 00:44:26,480
but but my question is does our because

1255
00:44:30,870 --> 00:44:28,880
of our solar system do we have a speed

1256
00:44:33,349 --> 00:44:30,880
limit in our solar system

1257
00:44:34,710 --> 00:44:33,359
yeah no i mean so uh an object that

1258
00:44:37,750 --> 00:44:34,720
comes from

1259
00:44:39,349 --> 00:44:37,760
almost at rest uh bound to the sun like

1260
00:44:39,829 --> 00:44:39,359
at the edge the periphery of the solar

1261
00:44:41,510 --> 00:44:39,839
system

1262
00:44:43,030 --> 00:44:41,520
in fact there is this ore cloud of

1263
00:44:45,270 --> 00:44:43,040

objects where they

1264

00:44:46,309 --> 00:44:45,280

hardly move relative to the sun and if

1265

00:44:48,950 --> 00:44:46,319

one of these objects

1266

00:44:51,270 --> 00:44:48,960

just falls towards the sun that will

1267

00:44:53,270 --> 00:44:51,280

give you the highest speed

1268

00:44:55,589 --> 00:44:53,280

that a bound object an object that

1269

00:44:58,230 --> 00:44:55,599

belongs to the solar system can move

1270

00:44:59,030 --> 00:44:58,240

uh relative to the sun and or more more

1271

00:45:00,630 --> 00:44:59,040

was moving

1272

00:45:02,550 --> 00:45:00,640

faster than that because the solar

1273

00:45:04,069 --> 00:45:02,560

system was actually moving relative to

1274

00:45:07,990 --> 00:45:04,079

the local standard of rest

1275

00:45:10,710 --> 00:45:08,000

and bumping into it uh so think about

1276

00:45:12,390 --> 00:45:10,720

this object being at rest like a beauty

1277

00:45:13,030 --> 00:45:12,400

on the surface of the ocean and then the

1278

00:45:15,750 --> 00:45:13,040

sun

1279

00:45:16,470 --> 00:45:15,760

just like a giant ship running into it

1280

00:45:18,950 --> 00:45:16,480

at

1281

00:45:19,910 --> 00:45:18,960

20 kilometers per second or you know

1282

00:45:23,430 --> 00:45:19,920

like about

1283

00:45:24,069 --> 00:45:23,440

15 miles per second uh just bumping into

1284

00:45:39,030 --> 00:45:24,079

it

1285

00:45:39,910 --> 00:45:39,040

and so um that's from the point of view

1286

00:45:43,109 --> 00:45:39,920

of

1287

00:45:45,109 --> 00:45:43,119

seeing the sun approaching it

1288

00:45:47,270 --> 00:45:45,119

but from the point of view of the sun or

1289

00:45:49,670 --> 00:45:47,280

muammua is approaching it

1290

00:45:51,349 --> 00:45:49,680

so it doesn't really matter which frame

1291

00:45:54,390 --> 00:45:51,359

you're sitting it

1292

00:45:56,630 --> 00:45:54,400

in you just see the the same motion but

1293

00:45:58,150 --> 00:45:56,640

the reflex of the same motion in the two

1294

00:46:01,190 --> 00:45:58,160

frames

1295

00:46:03,589 --> 00:46:01,200

now when this thing went by the sun

1296

00:46:04,630 --> 00:46:03,599

there was no apparent outgassing which

1297

00:46:07,030 --> 00:46:04,640

was another

1298

00:46:08,390 --> 00:46:07,040

odd thing right so then it meant that

1299

00:46:12,069 --> 00:46:08,400

it's not a comment

1300

00:46:14,470 --> 00:46:12,079

because the comets show very clearly

1301
00:46:16,150 --> 00:46:14,480
uh evaporation of gases and in fact the

1302
00:46:17,270 --> 00:46:16,160
second interstellar object that was

1303
00:46:20,230 --> 00:46:17,280
discovered

1304
00:46:21,510 --> 00:46:20,240
by gennady borisov a russian amateur

1305
00:46:24,710 --> 00:46:21,520
astronomer

1306
00:46:27,750 --> 00:46:24,720
um which is called borisov after him

1307
00:46:31,190 --> 00:46:27,760
uh did look just like a comet and

1308
00:46:34,309 --> 00:46:31,200
so people ask me oh obviously borisov is

1309
00:46:36,950 --> 00:46:34,319
a natural interstellar object and

1310
00:46:38,870 --> 00:46:36,960
i agree with that uh and then they said

1311
00:46:41,430 --> 00:46:38,880
doesn't it convince you that

1312
00:46:43,270 --> 00:46:41,440
was also natural to which i replied you

1313
00:46:43,990 --> 00:46:43,280

know if you find a plastic bottle on the

1314

00:46:46,150 --> 00:46:44,000

beach

1315

00:46:48,390 --> 00:46:46,160

and after that you find rocks it doesn't

1316

00:46:50,550 --> 00:46:48,400

make the plastic bottle a rock

1317

00:46:52,069 --> 00:46:50,560

or another way to put it when i met my

1318

00:46:54,150 --> 00:46:52,079

wife on the first date

1319

00:46:55,829 --> 00:46:54,160

she looked special to me the fact that i

1320

00:46:58,069 --> 00:46:55,839

met many other

1321

00:46:59,670 --> 00:46:58,079

people afterwards didn't change this

1322

00:47:03,109 --> 00:46:59,680

perception so

1323

00:47:06,630 --> 00:47:03,119

in fact since uh borisov

1324

00:47:10,630 --> 00:47:06,640

looks natural then it makes um even more

1325

00:47:14,390 --> 00:47:10,640

strange right and also

1326

00:47:17,109 --> 00:47:14,400

it uh did it picked up speed like i mean

1327

00:47:18,309 --> 00:47:17,119

as if like the sail theory again right

1328

00:47:20,870 --> 00:47:18,319

after it went by the side

1329

00:47:23,589 --> 00:47:20,880

so there was an extra push uh away from

1330

00:47:26,710 --> 00:47:23,599

the sun and um

1331

00:47:27,750 --> 00:47:26,720

so that the the only plausible

1332

00:47:29,910 --> 00:47:27,760

interpretation

1333

00:47:30,790 --> 00:47:29,920

as far as i'm concerned was that it

1334

00:47:33,270 --> 00:47:30,800

reflects

1335

00:47:34,230 --> 00:47:33,280

sunlight and as a result it it's getting

1336

00:47:36,230 --> 00:47:34,240

pushed and

1337

00:47:37,910 --> 00:47:36,240

for that to be effective it had to be

1338

00:47:40,710 --> 00:47:37,920

very thin

1339

00:47:42,309 --> 00:47:40,720

like a light sail and so that it has

1340

00:47:44,230 --> 00:47:42,319

enough area

1341

00:47:45,510 --> 00:47:44,240

for its weight to be pushed by

1342

00:47:48,870 --> 00:47:45,520

reflecting sunlight

1343

00:47:51,190 --> 00:47:48,880

and in september 2020 there was another

1344

00:47:53,990 --> 00:47:51,200

object discovered

1345

00:47:55,349 --> 00:47:54,000

that also exhibited the nexra push by

1346

00:47:57,589 --> 00:47:55,359

reflecting sunlight

1347

00:47:59,510 --> 00:47:57,599

and didn't show any commentary tale it

1348

00:48:03,430 --> 00:47:59,520

was given the name 2020

1349

00:48:03,829 --> 00:48:03,440

so by the organization that gives names

1350

00:48:05,990 --> 00:48:03,839

to

1351
00:48:07,030 --> 00:48:06,000
celestial objects the minor planet

1352
00:48:10,870 --> 00:48:07,040
center

1353
00:48:12,710 --> 00:48:10,880
and then then it was discovered by pan

1354
00:48:14,630 --> 00:48:12,720
stars the same telescope and the

1355
00:48:18,230 --> 00:48:14,640
astronomers figured out that

1356
00:48:21,829 --> 00:48:18,240
actually it originated from the earth

1357
00:48:24,230 --> 00:48:21,839
in 1966 it was a rocket booster

1358
00:48:25,670 --> 00:48:24,240
of a lunar lander mission that was

1359
00:48:27,750 --> 00:48:25,680
kicked into space and

1360
00:48:29,430 --> 00:48:27,760
obviously we know that it was hollow and

1361
00:48:32,549 --> 00:48:29,440
had very thin walls

1362
00:48:33,670 --> 00:48:32,559
and that's why it was pushed by sunlight

1363
00:48:36,470 --> 00:48:33,680

because it had a lot

1364

00:48:37,670 --> 00:48:36,480

it had a lot of area for its weight and

1365

00:48:39,750 --> 00:48:37,680

so we know that's

1366

00:48:41,670 --> 00:48:39,760

that this object was definitely

1367

00:48:45,349 --> 00:48:41,680

artificial because we made it

1368

00:48:45,670 --> 00:48:45,359

uh we don't know who made um now as far

1369

00:48:49,510 --> 00:48:45,680

as

1370

00:48:51,190 --> 00:48:49,520

this thing you said it's

1371

00:48:52,790 --> 00:48:51,200

it's just under eight hours i guess it's

1372

00:48:54,790 --> 00:48:52,800

rotating um

1373

00:48:57,910 --> 00:48:54,800

but this is this is all theory there's

1374

00:49:01,030 --> 00:48:57,920

no real way to tell an aspect ratio of

1375

00:49:03,430 --> 00:49:01,040

oh no so what you can

1376

00:49:05,109 --> 00:49:03,440

argue is that the amount of light that

1377

00:49:08,790 --> 00:49:05,119

we receive is simply the

1378

00:49:10,790 --> 00:49:08,800

area that the uh object projects on the

1379

00:49:11,670 --> 00:49:10,800

sky because we see reflected sunlight

1380

00:49:13,589 --> 00:49:11,680

and so

1381

00:49:15,589 --> 00:49:13,599

variation by a factor of 10 means that

1382

00:49:16,230 --> 00:49:15,599

the mark the area of the object

1383

00:49:18,710 --> 00:49:16,240

projected

1384

00:49:20,309 --> 00:49:18,720

on the sky changes by a factor of 10 as

1385

00:49:24,309 --> 00:49:20,319

it's stumbling

1386

00:49:24,950 --> 00:49:24,319

uh unless of course the reflectivity of

1387

00:49:26,710 --> 00:49:24,960

the object

1388

00:49:28,549 --> 00:49:26,720

also changes but if you assume roughly

1389

00:49:31,829 --> 00:49:28,559

the same reflectance

1390

00:49:33,349 --> 00:49:31,839

across the uh the entire object then

1391

00:49:35,190 --> 00:49:33,359

it means that the area of the object

1392

00:49:37,270 --> 00:49:35,200

changes by a factor of them projected on

1393

00:49:40,390 --> 00:49:37,280

the sky just like a tumbling

1394

00:49:42,549 --> 00:49:40,400

piece of paper in the wind and that

1395

00:49:43,510 --> 00:49:42,559

implied that it has an extreme geometry

1396

00:49:47,349 --> 00:49:43,520

we don't see that

1397

00:49:48,470 --> 00:49:47,359

often for rocks at most they show a

1398

00:49:51,589 --> 00:49:48,480

factor of three

1399

00:49:54,470 --> 00:49:51,599

variation and um and then

1400

00:49:56,790 --> 00:49:54,480

of course there was this uh fitting to

1401
00:50:00,790 --> 00:49:56,800
the light curve that implied that

1402
00:50:02,150 --> 00:50:00,800
it's probably pancake shape flat

1403
00:50:03,550 --> 00:50:02,160
now i'm i'm going to ask you an

1404
00:50:05,270 --> 00:50:03,560
uncomfortable question

1405
00:50:08,790 --> 00:50:05,280
[Music]

1406
00:50:09,270 --> 00:50:08,800
this is a show about ufos and there has

1407
00:50:12,309 --> 00:50:09,280
been

1408
00:50:13,030 --> 00:50:12,319
a lot of people including you know the

1409
00:50:15,910 --> 00:50:13,040
navy and

1410
00:50:16,870 --> 00:50:15,920
and um pilots and things like that that

1411
00:50:19,109 --> 00:50:16,880
have ufo

1412
00:50:20,630 --> 00:50:19,119
sightings do you think it's out of the

1413
00:50:23,430 --> 00:50:20,640

possibility

1414

00:50:24,870 --> 00:50:23,440

that perhaps they have figured out how

1415

00:50:26,710 --> 00:50:24,880

to get here

1416

00:50:28,150 --> 00:50:26,720

no i don't think it's uh i don't think

1417

00:50:30,950 --> 00:50:28,160

we should have prejudice and

1418

00:50:33,109 --> 00:50:30,960

in fact i have a scientific american

1419

00:50:36,549 --> 00:50:33,119

essay on this subject

1420

00:50:40,150 --> 00:50:36,559

uh from yesterday uh so check it out

1421

00:50:42,470 --> 00:50:40,160

oh wow um and then my point about the

1422

00:50:44,390 --> 00:50:42,480

ufo reports is as follows i mean that

1423

00:50:45,109 --> 00:50:44,400

there is also everyone is anticipating

1424

00:50:48,230 --> 00:50:45,119

for

1425

00:50:51,349 --> 00:50:48,240

the declassification of the pentagon

1426
00:50:53,270 --> 00:50:51,359
documents but i'm not that obsessed with

1427
00:50:56,230 --> 00:50:53,280
old reports because

1428
00:50:58,150 --> 00:50:56,240
they rely on eyewitness testimonies and

1429
00:51:01,750 --> 00:50:58,160
on equipment that used to exist

1430
00:51:03,990 --> 00:51:01,760
decades ago and not was not optimized

1431
00:51:05,349 --> 00:51:04,000
uh for that purpose and i would much

1432
00:51:08,950 --> 00:51:05,359
rather see

1433
00:51:10,230 --> 00:51:08,960
funding of a scientific experiment

1434
00:51:12,790 --> 00:51:10,240
basically of using

1435
00:51:14,069 --> 00:51:12,800
state-of-the-art cameras and audio

1436
00:51:17,190 --> 00:51:14,079
sensor

1437
00:51:18,870 --> 00:51:17,200
and placing them in

1438
00:51:21,190 --> 00:51:18,880

the same locations where the reports

1439

00:51:23,270 --> 00:51:21,200

came from the most credible reports

1440

00:51:25,270 --> 00:51:23,280

and just recording everything out there

1441

00:51:27,589 --> 00:51:25,280

and looking for anything unusual and

1442

00:51:29,190 --> 00:51:27,599

i think that would be the best way

1443

00:51:31,349 --> 00:51:29,200

forward because

1444

00:51:32,950 --> 00:51:31,359

you never know whether you know what

1445

00:51:35,430 --> 00:51:32,960

happened decades ago and

1446

00:51:36,270 --> 00:51:35,440

why should we obsess with that the

1447

00:51:39,109 --> 00:51:36,280

science is about

1448

00:51:41,270 --> 00:51:39,119

reproducibility and if we place

1449

00:51:42,549 --> 00:51:41,280

state-of-the-art cameras and audio

1450

00:51:44,790 --> 00:51:42,559

sensors

1451

00:51:47,030 --> 00:51:44,800

we will get much better data and then

1452

00:51:48,790 --> 00:51:47,040

people will be convinced about it so

1453

00:51:50,470 --> 00:51:48,800

that that's my hope that such an

1454

00:51:53,030 --> 00:51:50,480

experiment will be funded

1455

00:51:54,710 --> 00:51:53,040

and i always give this example of you

1456

00:51:58,069 --> 00:51:54,720

know the biblical story of

1457

00:51:59,190 --> 00:51:58,079

abraham that says that abraham heard the

1458

00:52:02,549 --> 00:51:59,200

voice of god

1459

00:52:03,190 --> 00:52:02,559

and that told him to sacrifice his only

1460

00:52:06,390 --> 00:52:03,200

son

1461

00:52:07,750 --> 00:52:06,400

isaac and if abraham had a cell phone

1462

00:52:10,150 --> 00:52:07,760

with a voice memo

1463

00:52:12,150 --> 00:52:10,160

up he could have pressed the button and

1464

00:52:13,750 --> 00:52:12,160

recorded the voice of god

1465

00:52:16,150 --> 00:52:13,760

and then everyone would believe his

1466

00:52:17,430 --> 00:52:16,160

story but since he didn't have a cell

1467

00:52:19,109 --> 00:52:17,440

phone back then

1468

00:52:21,829 --> 00:52:19,119

we have to decide whether we believe

1469

00:52:25,030 --> 00:52:21,839

abraham so my point is

1470

00:52:28,470 --> 00:52:25,040

that scientific instruments remove

1471

00:52:31,109 --> 00:52:28,480

the concerns that some scientists would

1472

00:52:33,030 --> 00:52:31,119

have with eyewitness testimonies and

1473

00:52:34,390 --> 00:52:33,040

we should deploy the very best

1474

00:52:36,150 --> 00:52:34,400

instruments we have right now

1475

00:52:37,990 --> 00:52:36,160

at those locations and see what they

1476

00:52:39,750 --> 00:52:38,000

record that's all i

1477

00:52:41,109 --> 00:52:39,760

love that i love that answer that's

1478

00:52:44,870 --> 00:52:41,119

that's a great

1479

00:52:46,470 --> 00:52:44,880

open-minded answer and uh mark d'antonio

1480

00:52:48,470 --> 00:52:46,480

has actually been involved in something

1481

00:52:50,150 --> 00:52:48,480

we'll bring him on in a little while to

1482

00:52:50,790 --> 00:52:50,160

talk about that but along those lines

1483

00:52:53,430 --> 00:52:50,800

with uh

1484

00:52:54,870 --> 00:52:53,440

you know sophisticated equipment and um

1485

00:52:57,990 --> 00:52:54,880

his partner on that

1486

00:52:59,829 --> 00:52:58,000

is very well funded and but i think it

1487

00:53:01,510 --> 00:52:59,839

you know i mean there are there are

1488

00:53:04,630 --> 00:53:01,520

countries that are taking

1489

00:53:05,430 --> 00:53:04,640

this serious chile for one they they do

1490

00:53:08,710 --> 00:53:05,440

and i know there's

1491

00:53:09,349 --> 00:53:08,720

great telescopes in in in chile um but

1492

00:53:11,510 --> 00:53:09,359

their whole

1493

00:53:12,710 --> 00:53:11,520

entire government is involved even the

1494

00:53:15,829 --> 00:53:12,720

police and

1495

00:53:17,430 --> 00:53:15,839

every you know military everything is in

1496

00:53:19,990 --> 00:53:17,440

looking at it seriously which

1497

00:53:21,670 --> 00:53:20,000

well one reason for governments to be

1498

00:53:22,549 --> 00:53:21,680

concerned about such reports is of

1499

00:53:24,950 --> 00:53:22,559

course um

1500

00:53:27,109 --> 00:53:24,960

national security you might want to know

1501
00:53:29,349 --> 00:53:27,119
if other nations have technologies that

1502
00:53:30,870 --> 00:53:29,359
you're not aware of and they're used for

1503
00:53:33,190 --> 00:53:30,880
espionage

1504
00:53:33,990 --> 00:53:33,200
so that's why governments are interested

1505
00:53:35,829 --> 00:53:34,000
but it's

1506
00:53:37,270 --> 00:53:35,839
a completely different reason than the

1507
00:53:38,790 --> 00:53:37,280
scientific reason of

1508
00:53:40,390 --> 00:53:38,800
trying to find evidence for alien

1509
00:53:43,430 --> 00:53:40,400
civilizations yeah

1510
00:53:44,309 --> 00:53:43,440
yeah that's great um we are going into

1511
00:53:46,230 --> 00:53:44,319
break in just

1512
00:53:48,390 --> 00:53:46,240
just a minute um i did have another

1513
00:53:51,829 --> 00:53:48,400

question for you here before we go in

1514

00:53:55,430 --> 00:53:51,839

and uh karen meeche professor meeche

1515

00:53:55,990 --> 00:53:55,440

um she she kind of disagrees with you or

1516

00:54:01,829 --> 00:53:56,000

or

1517

00:54:02,470 --> 00:54:01,839

i did see her name come up well i think

1518

00:54:07,270 --> 00:54:02,480

she

1519

00:54:09,589 --> 00:54:07,280

mainstream approach saying that

1520

00:54:11,109 --> 00:54:09,599

extraordinary evidence require

1521

00:54:13,349 --> 00:54:11,119

extraordinary claims require

1522

00:54:16,069 --> 00:54:13,359

extraordinary evidence and

1523

00:54:18,230 --> 00:54:16,079

my answer to that is that extraordinary

1524

00:54:22,710 --> 00:54:18,240

conservatism

1525

00:54:27,109 --> 00:54:24,390

the point is that we should be

1526

00:54:28,950 --> 00:54:27,119

open-minded and when there is anomalies

1527

00:54:30,390 --> 00:54:28,960

we should invest in getting more

1528

00:54:32,870 --> 00:54:30,400

evidence to find out

1529

00:54:34,230 --> 00:54:32,880

what their origin is and the

1530

00:54:37,430 --> 00:54:34,240

alternatives to my

1531

00:54:39,109 --> 00:54:37,440

artificial origin invoke something that

1532

00:54:40,950 --> 00:54:39,119

we have never seen before so

1533

00:54:42,549 --> 00:54:40,960

obviously we will learn something new

1534

00:54:43,349 --> 00:54:42,559

irrespective whether it's a natural

1535

00:54:47,670 --> 00:54:43,359

object

1536

00:54:49,910 --> 00:54:47,680

we will not learn anything new

1537

00:54:51,270 --> 00:54:49,920

is if we believe everyone that says it's

1538

00:54:54,789 --> 00:54:51,280

just rocks it's never

1539

00:54:57,030 --> 00:54:54,799

aliens okay if we adapt that approach

1540

00:54:58,789 --> 00:54:57,040

it's we are we will be very similar to

1541

00:55:00,950 --> 00:54:58,799

those philosophers that refuse to look

1542

00:55:03,190 --> 00:55:00,960

through galileo's telescope

1543

00:55:04,150 --> 00:55:03,200

that's right and and how we stand still

1544

00:55:07,829 --> 00:55:04,160

so many times

1545

00:55:11,030 --> 00:55:07,839

you know uh that that phrase from sagan

1546

00:55:15,430 --> 00:55:11,040

was originated all the way back in 1814

1547

00:55:18,230 --> 00:55:15,440

and then reinvented in 1899

1548

00:55:19,190 --> 00:55:18,240

um as this the weight of evidence for

1549

00:55:20,870 --> 00:55:19,200

extraordinary

1550

00:55:23,109 --> 00:55:20,880

claim must be proportioned to its

1551
00:55:23,829 --> 00:55:23,119
strangeness and that was by theodore

1552
00:55:27,270 --> 00:55:23,839
flourny

1553
00:55:29,510 --> 00:55:27,280
in 1899. so it was carl sagan kind of

1554
00:55:30,950 --> 00:55:29,520
remade that saying but it holds true all

1555
00:55:33,190 --> 00:55:30,960
the way through

1556
00:55:34,309 --> 00:55:33,200
yeah i should also say that you know the

1557
00:55:36,069 --> 00:55:34,319
existence of

1558
00:55:37,510 --> 00:55:36,079
aliens i don't regard it as

1559
00:55:38,870 --> 00:55:37,520
extraordinary because

1560
00:55:40,870 --> 00:55:38,880
we know that we exist we know the

1561
00:55:42,630 --> 00:55:40,880
conditions on earth are reproduced

1562
00:55:44,230 --> 00:55:42,640
in billions of earth sun systems

1563
00:55:45,990 --> 00:55:44,240

throughout the milky way galaxy

1564

00:55:47,430 --> 00:55:46,000

why should we believe that we are unique

1565

00:55:48,230 --> 00:55:47,440

and special you know that would be

1566

00:55:51,270 --> 00:55:48,240

arrogant

1567

00:55:54,150 --> 00:55:51,280

and i think the mainstream conservative

1568

00:55:54,630 --> 00:55:54,160

view that is also a matter of common

1569

00:55:57,430 --> 00:55:54,640

sense

1570

00:55:58,630 --> 00:55:57,440

would be to say that things like us are

1571

00:56:00,309 --> 00:55:58,640

very common

1572

00:56:02,309 --> 00:56:00,319

and we should just search for them that

1573

00:56:04,950 --> 00:56:02,319

should be the the mainstream view

1574

00:56:05,750 --> 00:56:04,960

so i wouldn't call it extraordinary

1575

00:56:12,069 --> 00:56:05,760

right

1576

00:56:13,190 --> 00:56:12,079

and uh we'll be back in about three

1577

00:56:15,430 --> 00:56:13,200

minutes or so

1578

00:56:16,549 --> 00:56:15,440

so everyone hang in there i'm going to

1579

00:56:19,030 --> 00:56:16,559

be right back

1580

00:56:20,150 --> 00:56:19,040

with uh mark d'antonio we're going to

1581

00:56:22,309 --> 00:56:20,160

talk during the break

1582

00:56:23,349 --> 00:56:22,319

and bring our guests back in right after

1583

00:56:35,190 --> 00:56:23,359

the three-minute

1584

00:56:35,200 --> 00:56:39,190

hello mark

1585

00:56:44,710 --> 00:56:41,190

there you go on mu i know it means

1586

00:56:47,430 --> 00:56:44,720

exactly but you know what i never know

1587

00:56:48,150 --> 00:56:47,440

well all right i can always mute you if

1588

00:56:50,470 --> 00:56:48,160

i want to

1589

00:56:52,230 --> 00:56:50,480

this is good i mean i i rephrase some of

1590

00:56:53,829 --> 00:56:52,240

my questions because he answered some

1591

00:56:56,870 --> 00:56:53,839

and i wanted to uh

1592

00:56:57,990 --> 00:56:56,880

you know i think that he and i meet in a

1593

00:57:00,950 --> 00:56:58,000

lot of ways

1594

00:57:03,109 --> 00:57:00,960

on this i'm really really uh excited to

1595

00:57:06,549 --> 00:57:03,119

uh hear what he had to say

1596

00:57:08,950 --> 00:57:06,559

oh good good um he did a

1597

00:57:10,150 --> 00:57:08,960

he and i did an abc special with the abc

1598

00:57:13,430 --> 00:57:10,160

affiliate in boston

1599

00:57:13,829 --> 00:57:13,440

okay it was chronicle and we didn't meet

1600

00:57:16,630 --> 00:57:13,839

on

1601
00:57:17,190 --> 00:57:16,640
that shoot but he did his from where he

1602
00:57:19,750 --> 00:57:17,200
was

1603
00:57:20,950 --> 00:57:19,760
and doug and i did ours from doug's

1604
00:57:24,150 --> 00:57:20,960
studio

1605
00:57:27,349 --> 00:57:24,160
and we talked about the prospects of

1606
00:57:30,470 --> 00:57:27,359
alien life being here um

1607
00:57:32,150 --> 00:57:30,480
and i think it's important to maybe we

1608
00:57:34,630 --> 00:57:32,160
can talk about this too

1609
00:57:35,910 --> 00:57:34,640
bring up the fact that i think that if

1610
00:57:37,190 --> 00:57:35,920
they're here they're not going to be

1611
00:57:38,950 --> 00:57:37,200
hiding on the moon they're not going to

1612
00:57:39,589 --> 00:57:38,960
be watching us from some lagrange point

1613
00:57:40,710 --> 00:57:39,599

somewhere

1614

00:57:42,710 --> 00:57:40,720

i think they're going to be in our

1615

00:57:43,990 --> 00:57:42,720

oceans you know they're going to be deep

1616

00:57:46,470 --> 00:57:44,000

in the oceans because they can because

1617

00:57:48,549 --> 00:57:46,480

we're not there they go where we are not

1618

00:57:50,069 --> 00:57:48,559

basically kind of a thing if they're

1619

00:57:51,670 --> 00:57:50,079

here i mean

1620

00:57:53,430 --> 00:57:51,680

and you can't just say something with

1621

00:57:55,430 --> 00:57:53,440

absolute like that like like oh they're

1622

00:57:58,470 --> 00:57:55,440

here no we don't know that you know

1623

00:58:00,549 --> 00:57:58,480

they may be here there's a possibility

1624

00:58:02,309 --> 00:58:00,559

and as he said mainstream science can't

1625

00:58:04,230 --> 00:58:02,319

deny the possibilities

1626
00:58:05,910 --> 00:58:04,240
and main street science mainstream

1627
00:58:08,549 --> 00:58:05,920
science shouldn't

1628
00:58:09,670 --> 00:58:08,559
close their minds because as he said you

1629
00:58:12,950 --> 00:58:09,680
know extraordinary

1630
00:58:14,470 --> 00:58:12,960
you know proof uh might be required but

1631
00:58:17,190 --> 00:58:14,480
you can't exhibit extraordinary

1632
00:58:19,510 --> 00:58:17,200
ignorance by ignoring other things

1633
00:58:21,109 --> 00:58:19,520
yeah and that's very true and that's how

1634
00:58:23,270 --> 00:58:21,119
i live my life that's how i do things

1635
00:58:25,990 --> 00:58:23,280
that's why i'm open-minded

1636
00:58:27,190 --> 00:58:26,000
well yeah what you said about the ocean

1637
00:58:30,390 --> 00:58:27,200
think about

1638
00:58:33,109 --> 00:58:30,400

how much of the ocean covers this earth

1639

00:58:34,710 --> 00:58:33,119

you know and and we we know less about

1640

00:58:36,150 --> 00:58:34,720

the ocean floor than we do about the

1641

00:58:37,430 --> 00:58:36,160

surface of the moon you know from what

1642

00:58:38,950 --> 00:58:37,440

i've heard i don't know

1643

00:58:40,950 --> 00:58:38,960

you go into google earth and you think

1644

00:58:42,630 --> 00:58:40,960

wow look you see the whole ocean floor

1645

00:58:44,230 --> 00:58:42,640

mapped out with that bathymetry you see

1646

00:58:44,870 --> 00:58:44,240

all the ups and downs all the levels

1647

00:58:46,309 --> 00:58:44,880

changes all

1648

00:58:48,470 --> 00:58:46,319

you see all that but you know what you

1649

00:58:49,030 --> 00:58:48,480

don't see you don't see a snapshot of

1650

00:58:51,510 --> 00:58:49,040

what it is

1651
00:58:53,349 --> 00:58:51,520
right this second you see the bathymetry

1652
00:58:53,910 --> 00:58:53,359
of where that toad sled went over the

1653
00:58:56,309 --> 00:58:53,920
bottom

1654
00:58:57,270 --> 00:58:56,319
to show you that ocean floor at that

1655
00:59:00,390 --> 00:58:57,280
time when they did it

1656
00:59:01,670 --> 00:59:00,400
seven years ago say you know it didn't

1657
00:59:04,710 --> 00:59:01,680
happen all at once it took

1658
00:59:06,630 --> 00:59:04,720
years to map the ocean floor like that

1659
00:59:08,789 --> 00:59:06,640
so when they did that you know that's

1660
00:59:10,870 --> 00:59:08,799
just a snapshot

1661
00:59:11,910 --> 00:59:10,880
and you can be sure that certain areas

1662
00:59:15,270 --> 00:59:11,920
look very different

1663
00:59:16,789 --> 00:59:15,280

now than they did then and even within

1664

00:59:18,390 --> 00:59:16,799

the range of all that data

1665

00:59:20,309 --> 00:59:18,400

certain parts of the ocean floor are

1666

00:59:24,230 --> 00:59:20,319

going to look very different

1667

00:59:28,230 --> 00:59:24,240

from the ocean floor now you know

1668

00:59:30,870 --> 00:59:28,240

so it's a constant change so we kind of

1669

00:59:32,710 --> 00:59:30,880

we have to be careful not to accept

1670

00:59:34,630 --> 00:59:32,720

everything we see as

1671

00:59:35,829 --> 00:59:34,640

this is absolute truth right now because

1672

00:59:37,349 --> 00:59:35,839

it's not

1673

00:59:42,950 --> 00:59:37,359

all right gentlemen we are coming back

1674

00:59:49,430 --> 00:59:46,950

in three two one go

1675

00:59:50,789 --> 00:59:49,440

all right welcome back uh just brought

1676

00:59:54,069 --> 00:59:50,799

in mark d'antonio

1677

00:59:57,510 --> 00:59:54,079

and bringing back on our guest avi loeb

1678

00:59:59,910 --> 00:59:57,520

we're all three here together and uh so

1679

01:00:00,870 --> 00:59:59,920

mark um you you just mentioned during

1680

01:00:03,190 --> 01:00:00,880

the break that you were

1681

01:00:04,789 --> 01:00:03,200

in the same location on a shoot at the

1682

01:00:07,910 --> 01:00:04,799

same time as avi was

1683

01:00:10,069 --> 01:00:07,920

yeah sorry yeah you remember the i don't

1684

01:00:13,430 --> 01:00:10,079

know if you remember this aubry we did a

1685

01:00:16,390 --> 01:00:13,440

abc affiliate show chronicle oh yeah

1686

01:00:16,789 --> 01:00:16,400

yeah you did your part we did our part

1687

01:00:18,789 --> 01:00:16,799

okay

1688

01:00:19,910 --> 01:00:18,799

we are in western massachusetts and you

1689

01:00:22,470 --> 01:00:19,920

were in in

1690

01:00:23,510 --> 01:00:22,480

over in harvard which i thought was

1691

01:00:25,750 --> 01:00:23,520

pretty funny

1692

01:00:26,549 --> 01:00:25,760

um it's very close and i remember that

1693

01:00:29,349 --> 01:00:26,559

show yeah

1694

01:00:30,549 --> 01:00:29,359

yeah and it was a very good shoot and um

1695

01:00:31,349 --> 01:00:30,559

you know one of the things i thought

1696

01:00:35,109 --> 01:00:31,359

about

1697

01:00:38,870 --> 01:00:35,119

and congratulations on the book

1698

01:00:39,589 --> 01:00:38,880

excellent okay um i think more of it is

1699

01:00:43,109 --> 01:00:39,599

needed

1700

01:00:46,069 --> 01:00:43,119

you know frankly and uh and

1701

01:00:48,470 --> 01:00:46,079

what happens is when we uh when we look

1702

01:00:51,589 --> 01:00:48,480

in there our vast oceans right

1703

01:00:53,589 --> 01:00:51,599

my feeling is that if and i say if

1704

01:00:55,270 --> 01:00:53,599

okay because i'm a science guy you say

1705

01:00:57,190 --> 01:00:55,280

if right you don't say definitely you

1706

01:01:00,150 --> 01:00:57,200

can't use authority we know that

1707

01:01:00,870 --> 01:01:00,160

you know but the thing is if they're

1708

01:01:03,910 --> 01:01:00,880

here

1709

01:01:05,109 --> 01:01:03,920

all right well then i have a feeling

1710

01:01:07,109 --> 01:01:05,119

that they're observing not

1711

01:01:09,109 --> 01:01:07,119

from the moon not from some lagrange

1712

01:01:11,109 --> 01:01:09,119

point with a cloaked spacecraft

1713

01:01:12,789 --> 01:01:11,119

not via the soho you know and looking at

1714

01:01:15,990 --> 01:01:12,799

all those cosmic ray

1715

01:01:18,150 --> 01:01:16,000

flashes on those photos okay but perhaps

1716

01:01:19,750 --> 01:01:18,160

from within our own oceans where we are

1717

01:01:22,230 --> 01:01:19,760

not they go where we're not

1718

01:01:23,030 --> 01:01:22,240

if they're here right i mean is that

1719

01:01:25,670 --> 01:01:23,040

does that seem

1720

01:01:26,870 --> 01:01:25,680

like a logical approach i think we

1721

01:01:28,630 --> 01:01:26,880

should contemplate

1722

01:01:30,069 --> 01:01:28,640

all possibilities this is one of them

1723

01:01:32,710 --> 01:01:30,079

definitely worth what

1724

01:01:33,589 --> 01:01:32,720

the question is can we um do experiments

1725

01:01:37,349 --> 01:01:33,599

that will

1726

01:01:38,549 --> 01:01:37,359

let us know about them yes we can

1727

01:01:39,829 --> 01:01:38,559

and that's something that we've been

1728

01:01:40,630 --> 01:01:39,839

working on actually we've been working

1729

01:01:43,430 --> 01:01:40,640

on the

1730

01:01:43,829 --> 01:01:43,440

very type of technology to allow us to

1731

01:01:47,190 --> 01:01:43,839

look

1732

01:01:49,670 --> 01:01:47,200

not up but down in the ocean

1733

01:01:51,190 --> 01:01:49,680

using technology to see what might be

1734

01:01:53,270 --> 01:01:51,200

under the water

1735

01:01:55,190 --> 01:01:53,280

and maybe some hot spots that people say

1736

01:01:56,549 --> 01:01:55,200

oh we see all these famous these funny

1737

01:01:58,549 --> 01:01:56,559

lights coming out of the ocean over here

1738

01:02:00,710 --> 01:01:58,559

well let's deploy something

1739

01:02:02,470 --> 01:02:00,720

you know i came up with a system that we

1740

01:02:04,789 --> 01:02:02,480

haven't built it yet but it's actually

1741

01:02:07,190 --> 01:02:04,799

uh it sits in the tide it sits in the in

1742

01:02:08,390 --> 01:02:07,200

the waves and it uses the wave action to

1743

01:02:09,910 --> 01:02:08,400

charge its batteries

1744

01:02:11,510 --> 01:02:09,920

you know it's a it's one of these little

1745

01:02:13,270 --> 01:02:11,520

dipping things that actually

1746

01:02:14,549 --> 01:02:13,280

starts to do the cell recharge as it

1747

01:02:17,430 --> 01:02:14,559

dips it's a

1748

01:02:19,430 --> 01:02:17,440

not an uncommon thought and so but it

1749

01:02:20,950 --> 01:02:19,440

would look down with instrumentation

1750

01:02:23,029 --> 01:02:20,960

uh with instruments that can actually

1751

01:02:25,109 --> 01:02:23,039

penetrate through the water obviously

1752

01:02:26,309 --> 01:02:25,119

you know we know sonar can do it we

1753

01:02:29,190 --> 01:02:26,319

certainly yeah

1754

01:02:29,910 --> 01:02:29,200

there's certain light we can't use by

1755

01:02:31,829 --> 01:02:29,920

the way uh

1756

01:02:33,190 --> 01:02:31,839

i mean whatever you find would be

1757

01:02:35,190 --> 01:02:33,200

interesting

1758

01:02:36,230 --> 01:02:35,200

irrespective you know because you will

1759

01:02:40,309 --> 01:02:36,240

do the first

1760

01:02:41,750 --> 01:02:40,319

observations of such yeah that's right

1761

01:02:43,510 --> 01:02:41,760

yeah margaret you would tell them what

1762

01:02:46,710 --> 01:02:43,520

you and doug uh

1763

01:02:50,230 --> 01:02:46,720

were putting together yeah well

1764

01:02:52,069 --> 01:02:50,240

for ufo technology observation

1765

01:02:54,230 --> 01:02:52,079

right you know and one of the things

1766

01:02:55,270 --> 01:02:54,240

that i feel is very important is trying

1767

01:02:58,549 --> 01:02:55,280

to

1768

01:03:00,630 --> 01:02:58,559

they're here

1769

01:03:02,710 --> 01:03:00,640

let's get the answer let's figure this

1770

01:03:04,470 --> 01:03:02,720

out there should be a way right

1771

01:03:06,230 --> 01:03:04,480

you're looking at you're saying it's a

1772

01:03:06,870 --> 01:03:06,240

pancake shaped object this might be a

1773

01:03:09,430 --> 01:03:06,880

very very

1774

01:03:11,349 --> 01:03:09,440

thin light sail technology which by the

1775

01:03:12,630 --> 01:03:11,359

way douglas trumbull is a big fan of

1776

01:03:16,470 --> 01:03:12,640

just so you know

1777

01:03:18,150 --> 01:03:16,480

okay and this light cell technology

1778

01:03:20,309 --> 01:03:18,160

is something that you've identified as a

1779

01:03:23,430 --> 01:03:20,319

very strong possibility

1780

01:03:25,349 --> 01:03:23,440

but here on earth how can how can

1781

01:03:27,029 --> 01:03:25,359

everyone participate in finding such

1782

01:03:28,870 --> 01:03:27,039

things well the way they can

1783

01:03:31,109 --> 01:03:28,880

is if we can make these what we call

1784

01:03:32,950 --> 01:03:31,119

platters of instrumentation that are

1785

01:03:35,750 --> 01:03:32,960

always looking up and observing the sky

1786

01:03:37,190 --> 01:03:35,760

but not with just regular cameras they

1787

01:03:38,950 --> 01:03:37,200

have to look in the wavelengths that our

1788

01:03:41,029 --> 01:03:38,960

eyes don't use obviously

1789

01:03:42,549 --> 01:03:41,039

you know they have to look at other

1790

01:03:45,349 --> 01:03:42,559

energies that are being

1791

01:03:47,829 --> 01:03:45,359

uh you know given off by potential

1792

01:03:49,430 --> 01:03:47,839

interlopers into our space or whatever

1793

01:03:51,190 --> 01:03:49,440

and you know you you quickly start

1794

01:03:53,109 --> 01:03:51,200

sounding like some kind of a ufo now

1795

01:03:56,069 --> 01:03:53,119

when you start talking about this stuff

1796

01:03:57,349 --> 01:03:56,079

but it's just science trying to find out

1797

01:03:59,670 --> 01:03:57,359

what other

1798

01:04:00,710 --> 01:03:59,680

things are in play in our atmosphere so

1799

01:04:03,510 --> 01:04:00,720

did you did you

1800

01:04:05,109 --> 01:04:03,520

deploy instruments of that type not yet

1801
01:04:07,430 --> 01:04:05,119
actually there was a prototype that was

1802
01:04:10,470 --> 01:04:07,440
made yes and but there was only one

1803
01:04:12,390 --> 01:04:10,480
okay and we actually cannibalized that

1804
01:04:14,630 --> 01:04:12,400
and we're making our others our other

1805
01:04:16,309 --> 01:04:14,640
platters that's exactly the approach

1806
01:04:18,710 --> 01:04:16,319
that i'm advocating for and i

1807
01:04:19,829 --> 01:04:18,720
i wrote about it in scientific american

1808
01:04:21,829 --> 01:04:19,839
basically making it

1809
01:04:24,150 --> 01:04:21,839
a part of science and trying to figure

1810
01:04:26,230 --> 01:04:24,160
out you know try to collect the data and

1811
01:04:28,390 --> 01:04:26,240
see what we get

1812
01:04:30,710 --> 01:04:28,400
and i think it's a much much healthier

1813
01:04:33,829 --> 01:04:30,720

approach than relying on all documents

1814

01:04:37,109 --> 01:04:33,839

because we can design the experiment to

1815

01:04:37,750 --> 01:04:37,119

to be optimized for this purpose yeah i

1816

01:04:38,950 --> 01:04:37,760

agree that

1817

01:04:40,870 --> 01:04:38,960

and you know the other thing too that

1818

01:04:44,789 --> 01:04:40,880

i've thought of and said many times is

1819

01:04:48,150 --> 01:04:44,799

and and you probably will agree is that

1820

01:04:51,190 --> 01:04:48,160

um and you actually do agree i know um

1821

01:04:54,630 --> 01:04:51,200

i don't really care about historical

1822

01:04:56,069 --> 01:04:54,640

ufo cases okay as you said and he points

1823

01:04:59,029 --> 01:04:56,079

out very eloquently

1824

01:04:59,670 --> 01:04:59,039

it was taken with old instrumentation

1825

01:05:03,270 --> 01:04:59,680

that

1826

01:05:05,589 --> 01:05:03,280

we would

1827

01:05:06,789 --> 01:05:05,599

put it under and therefore it's not

1828

01:05:10,150 --> 01:05:06,799

going to be valid to me

1829

01:05:11,829 --> 01:05:10,160

i only focus on now in the future right

1830

01:05:13,430 --> 01:05:11,839

because now in the future we have the

1831

01:05:15,829 --> 01:05:13,440

best technology to

1832

01:05:17,190 --> 01:05:15,839

to use to look at that's exactly you're

1833

01:05:21,990 --> 01:05:17,200

saying exactly what i said

1834

01:05:23,750 --> 01:05:22,000

yeah excellent yeah

1835

01:05:25,109 --> 01:05:23,760

yeah mark you're gonna have to turn your

1836

01:05:26,230 --> 01:05:25,119

your headset down a little bit more

1837

01:05:27,510 --> 01:05:26,240

again

1838

01:05:30,150 --> 01:05:27,520

unfortunately it's feeding back a little

1839

01:05:30,950 --> 01:05:30,160

bit okay i sent you a message but you

1840

01:05:34,549 --> 01:05:30,960

didn't see it

1841

01:05:37,510 --> 01:05:34,559

i did yeah yeah um

1842

01:05:38,309 --> 01:05:37,520

maybe like this that should be better

1843

01:05:41,910 --> 01:05:38,319

okay

1844

01:05:43,029 --> 01:05:41,920

yeah um so mark uh what is a really good

1845

01:05:45,510 --> 01:05:43,039

question to ask

1846

01:05:46,309 --> 01:05:45,520

avi now that you have this opportunity

1847

01:05:47,430 --> 01:05:46,319

uh you know i

1848

01:05:49,270 --> 01:05:47,440

it's something i've actually wanted to

1849

01:05:50,549 --> 01:05:49,280

ask you i actually want to ask you this

1850

01:05:51,910 --> 01:05:50,559

when we were doing the shoot and i was

1851
01:05:53,190 --> 01:05:51,920
hoping that we were going to be in each

1852
01:05:54,230 --> 01:05:53,200
other's presence so i could talk to you

1853
01:05:56,230 --> 01:05:54,240
about this stuff

1854
01:05:57,990 --> 01:05:56,240
go ahead but no they didn't do it that

1855
01:06:00,470 --> 01:05:58,000
the way it worked out

1856
01:06:01,990 --> 01:06:00,480
i was really interested in the fact that

1857
01:06:03,829 --> 01:06:02,000
omumua shows us this

1858
01:06:06,069 --> 01:06:03,839
this dichotomy of two different

1859
01:06:08,069 --> 01:06:06,079
potential objects

1860
01:06:09,349 --> 01:06:08,079
on one hand it looks like it's a comet

1861
01:06:10,789 --> 01:06:09,359
on the other hand it appears like it's

1862
01:06:12,950 --> 01:06:10,799
an asteroid

1863
01:06:14,230 --> 01:06:12,960

how does how do people of science

1864

01:06:16,390 --> 01:06:14,240

actually sit there

1865

01:06:18,630 --> 01:06:16,400

look at this thing and say well it's

1866

01:06:20,230 --> 01:06:18,640

just a strange asteroid

1867

01:06:22,789 --> 01:06:20,240

i don't understand that that's a very

1868

01:06:24,549 --> 01:06:22,799

good question because it did exhibit all

1869

01:06:27,510 --> 01:06:24,559

these anomalies and people just

1870

01:06:27,990 --> 01:06:27,520

i think people just want to dismiss that

1871

01:06:30,470 --> 01:06:28,000

it's

1872

01:06:31,190 --> 01:06:30,480

strange and and they just say that and

1873

01:06:33,589 --> 01:06:31,200

and ignore

1874

01:06:35,589 --> 01:06:33,599

the facts and unfortunately that's an

1875

01:06:37,430 --> 01:06:35,599

acceptable behavior these days

1876

01:06:39,109 --> 01:06:37,440

even though you know very often it's

1877

01:06:41,430 --> 01:06:39,119

argued against politicians that

1878

01:06:42,710 --> 01:06:41,440

politicians that are ignoring evidence

1879

01:06:45,670 --> 01:06:42,720

ignoring facts that

1880

01:06:47,109 --> 01:06:45,680

you know how dare they do that but if if

1881

01:06:50,230 --> 01:06:47,119

scientists can do it

1882

01:06:51,910 --> 01:06:50,240

what why would we hold our politicians

1883

01:06:53,750 --> 01:06:51,920

to a higher standard you know

1884

01:06:55,029 --> 01:06:53,760

and but i should say it's not all

1885

01:06:57,589 --> 01:06:55,039

scientists um

1886

01:06:58,549 --> 01:06:57,599

those that take seriously the anomalies

1887

01:07:00,789 --> 01:06:58,559

and the facts that

1888

01:07:02,630 --> 01:07:00,799

trying to explain them uh and of course

1889

01:07:03,589 --> 01:07:02,640

there are some like that and they came

1890

01:07:05,430 --> 01:07:03,599

up with

1891

01:07:07,190 --> 01:07:05,440

uh all these scenarios that i mentioned

1892

01:07:08,789 --> 01:07:07,200

that involve

1893

01:07:10,230 --> 01:07:08,799

something that we've never seen before

1894

01:07:12,950 --> 01:07:10,240

so that i

1895

01:07:13,990 --> 01:07:12,960

actually regard with respect and you

1896

01:07:15,670 --> 01:07:14,000

know it's just like

1897

01:07:17,190 --> 01:07:15,680

the scientific process where you put all

1898

01:07:18,470 --> 01:07:17,200

possibilities on the table and you

1899

01:07:20,789 --> 01:07:18,480

collect more evidence

1900

01:07:22,470 --> 01:07:20,799

and that's completely legitimate but you

1901

01:07:24,630 --> 01:07:22,480

know there are people

1902

01:07:26,069 --> 01:07:24,640

that didn't write even a single paper

1903

01:07:29,109 --> 01:07:26,079

over the past decade

1904

01:07:31,510 --> 01:07:29,119

that would criticize my paper

1905

01:07:32,710 --> 01:07:31,520

uh without a good reason just because

1906

01:07:35,990 --> 01:07:32,720

they don't like the

1907

01:07:39,270 --> 01:07:36,000

this notion you know and um

1908

01:07:41,829 --> 01:07:39,280

it's um unfortunate the an unfortunate

1909

01:07:43,109 --> 01:07:41,839

symptom of social media these days that

1910

01:07:45,109 --> 01:07:43,119

you know there is a lot of

1911

01:07:46,309 --> 01:07:45,119

group thing and the people encourage

1912

01:07:47,910 --> 01:07:46,319

each other by

1913

01:07:49,670 --> 01:07:47,920

making false statements that are not

1914

01:07:51,349 --> 01:07:49,680

attending to the facts

1915

01:07:52,789 --> 01:07:51,359

i i don't disagree with that at all i

1916

01:07:55,750 --> 01:07:52,799

think that's that's a

1917

01:07:56,950 --> 01:07:55,760

marvelous problem yeah you know i i look

1918

01:07:58,870 --> 01:07:56,960

at life on earth

1919

01:08:01,589 --> 01:07:58,880

uh we're bipedal we have our binocular

1920

01:08:03,430 --> 01:08:01,599

vision where every life form has dna

1921

01:08:05,190 --> 01:08:03,440

okay to me that's a template that the

1922

01:08:06,870 --> 01:08:05,200

universe provides

1923

01:08:08,630 --> 01:08:06,880

because there's so many variations of

1924

01:08:10,549 --> 01:08:08,640

life on the planet that

1925

01:08:13,109 --> 01:08:10,559

they had a chance to have developed you

1926

01:08:15,190 --> 01:08:13,119

know other types of life here

1927

01:08:17,349 --> 01:08:15,200

maybe we can find other types of life

1928

01:08:19,269 --> 01:08:17,359

that are very hardy microbes on mars

1929

01:08:20,470 --> 01:08:19,279

i'm looking forward to that actually you

1930

01:08:21,669 --> 01:08:20,480

know under the south pole of mars

1931

01:08:22,309 --> 01:08:21,679

there's a reservoir maybe we'll find

1932

01:08:24,550 --> 01:08:22,319

life there

1933

01:08:25,669 --> 01:08:24,560

that will be very interesting and on

1934

01:08:27,990 --> 01:08:25,679

mars of course the

1935

01:08:29,910 --> 01:08:28,000

fundamental question if we find life is

1936

01:08:30,550 --> 01:08:29,920

it similar to life on earth or not

1937

01:08:34,070 --> 01:08:30,560

because

1938

01:08:36,229 --> 01:08:34,080

if it resembles the dna we have on earth

1939

01:08:37,349 --> 01:08:36,239

then it may mean that life was

1940

01:08:38,709 --> 01:08:37,359

transported

1941

01:08:40,470 --> 01:08:38,719

with rock you know we know that there

1942

01:08:41,910 --> 01:08:40,480

are martian rocks that arrive to earth

1943

01:08:44,309 --> 01:08:41,920

and vice versa and

1944

01:08:45,990 --> 01:08:44,319

it's quite possible that life was

1945

01:08:48,149 --> 01:08:46,000

exchanged between the planets we might

1946

01:08:50,070 --> 01:08:48,159

be all martians for example

1947

01:08:51,590 --> 01:08:50,080

exactly but there is the second

1948

01:08:52,630 --> 01:08:51,600

possibility that it's it will be

1949

01:08:54,870 --> 01:08:52,640

completely different

1950

01:08:56,789 --> 01:08:54,880

and that would illustrate that not only

1951

01:08:58,789 --> 01:08:56,799

there was no exchange of life but also

1952

01:09:00,630 --> 01:08:58,799

that there are multiple paths for having

1953

01:09:02,630 --> 01:09:00,640

life and

1954

01:09:03,910 --> 01:09:02,640

either way it would be very exciting to

1955

01:09:05,749 --> 01:09:03,920

see evidence

1956

01:09:07,189 --> 01:09:05,759

because it would be a second data point

1957

01:09:08,789 --> 01:09:07,199

even though this is the nearest

1958

01:09:10,470 --> 01:09:08,799

one of you know the second nearest

1959

01:09:13,510 --> 01:09:10,480

planet to us uh

1960

01:09:15,990 --> 01:09:13,520

after venus um uh that

1961

01:09:17,510 --> 01:09:16,000

nevertheless it's the second place where

1962

01:09:19,749 --> 01:09:17,520

we might find life

1963

01:09:21,829 --> 01:09:19,759

yeah i'm gonna i'm gonna ask kind of a

1964

01:09:26,149 --> 01:09:21,839

philosophical question

1965

01:09:28,070 --> 01:09:26,159

the first spark of life um

1966

01:09:30,950 --> 01:09:28,080

you think it'll could ever be created in

1967

01:09:33,590 --> 01:09:30,960

a lab oh yeah i mean

1968

01:09:34,390 --> 01:09:33,600

at harvard the one of my colleagues jack

1969

01:09:36,470 --> 01:09:34,400

shostak

1970

01:09:38,470 --> 01:09:36,480

who is a nobel laureate is working on

1971

01:09:42,309 --> 01:09:38,480

making synthetic life

1972

01:09:44,870 --> 01:09:42,319

uh basically a living cell out of

1973

01:09:45,829 --> 01:09:44,880

scratch you know and wow he's getting

1974

01:09:48,149 --> 01:09:45,839

close to that

1975

01:09:50,229 --> 01:09:48,159

uh he said that when he started to work

1976

01:09:52,950 --> 01:09:50,239

on it about a decade ago

1977

01:09:53,669 --> 01:09:52,960

he was quite pessimistic and said that

1978

01:09:56,630 --> 01:09:53,679

he

1979

01:09:57,430 --> 01:09:56,640

cannot see how life formed spontaneously

1980

01:09:59,350 --> 01:09:57,440

on earth

1981

01:10:00,950 --> 01:09:59,360

but now he changed his view he thinks

1982

01:10:02,870 --> 01:10:00,960

that it's uh

1983

01:10:04,390 --> 01:10:02,880

you know once once he started

1984

01:10:07,270 --> 01:10:04,400

experimenting that

1985

01:10:08,630 --> 01:10:07,280

it is reasonable to expect to have

1986

01:10:10,390 --> 01:10:08,640

expected the earth

1987

01:10:11,669 --> 01:10:10,400

to produce the conditions that lead to

1988

01:10:14,630 --> 01:10:11,679

life and uh

1989

01:10:15,110 --> 01:10:14,640

he's almost there i mean he's getting

1990

01:10:18,870 --> 01:10:15,120

there

1991

01:10:21,990 --> 01:10:18,880

uh and he doesn't see any uh

1992

01:10:23,430 --> 01:10:22,000

major roadblocks so he's getting close

1993

01:10:24,229 --> 01:10:23,440

to making synthetic life in the

1994

01:10:26,790 --> 01:10:24,239

laboratory

1995

01:10:27,669 --> 01:10:26,800

it's not that it's not the same as the

1996

01:10:29,750 --> 01:10:27,679

life that

1997

01:10:31,590 --> 01:10:29,760

you know that form naturally but but

1998

01:10:33,590 --> 01:10:31,600

it's the first step you know if if we

1999

01:10:34,709 --> 01:10:33,600

are able to create a living organism in

2000

01:10:37,430 --> 01:10:34,719

the lab

2001

01:10:38,390 --> 01:10:37,440

then after that we might design

2002

01:10:40,310 --> 01:10:38,400

organisms that

2003

01:10:42,870 --> 01:10:40,320

are not very different from what we

2004

01:10:45,189 --> 01:10:42,880

found in early earth

2005

01:10:46,229 --> 01:10:45,199

wow what kind of award would someone get

2006

01:10:49,110 --> 01:10:46,239

for that

2007

01:10:49,830 --> 01:10:49,120

and nobody yes i would think so he's

2008

01:10:51,750 --> 01:10:49,840

second

2009

01:10:53,669 --> 01:10:51,760

if he's successful yeah yeah yeah it

2010

01:10:54,550 --> 01:10:53,679

would be such an amazing development

2011

01:10:56,550 --> 01:10:54,560

really

2012

01:10:58,550 --> 01:10:56,560

i mean that question to ask if i could

2013

01:11:00,630 --> 01:10:58,560

martin oh yeah yeah yeah my picture is

2014

01:11:01,990 --> 01:11:00,640

here i feel i i have a little

2015

01:11:04,229 --> 01:11:02,000

you know a little bit of time to ask him

2016

01:11:07,110 --> 01:11:04,239

a question or so oh yeah yeah yeah

2017

01:11:09,510 --> 01:11:07,120

um i mean i wanted to ask you you know

2018

01:11:12,229 --> 01:11:09,520

um had a really strange

2019

01:11:13,590 --> 01:11:12,239

uh change in its albedo as it was moving

2020

01:11:15,350 --> 01:11:13,600

through and so the question i had

2021

01:11:17,910 --> 01:11:15,360

regarded that to that brightness change

2022

01:11:22,470 --> 01:11:20,950

does that spin rate that it had say

2023

01:11:24,470 --> 01:11:22,480

anything about its composition

2024

01:11:26,630 --> 01:11:24,480

in terms of flying apart or being held

2025

01:11:27,270 --> 01:11:26,640

together whether it was metallic or not

2026

01:11:29,270 --> 01:11:27,280

i mean

2027

01:11:30,630 --> 01:11:29,280

i i don't have good enough information

2028

01:11:31,430 --> 01:11:30,640

about that well regarding the

2029

01:11:33,430 --> 01:11:31,440

composition

2030

01:11:35,510 --> 01:11:33,440

there are two ways you can go at it one

2031

01:11:38,149 --> 01:11:35,520

is if you have a good spectrum of

2032

01:11:38,950 --> 01:11:38,159

the reflected light from from the object

2033

01:11:40,950 --> 01:11:38,960

then

2034

01:11:41,990 --> 01:11:40,960

you might be able to infer what it's

2035

01:11:44,950 --> 01:11:42,000

made of but

2036

01:11:46,550 --> 01:11:44,960

unfortunately the spectrum was not high

2037

01:11:50,149 --> 01:11:46,560

enough quality and

2038

01:11:53,510 --> 01:11:50,159

it just looked red kind of reddish um

2039

01:11:55,110 --> 01:11:53,520

and then you couldn't tell whether there

2040

01:11:58,149 --> 01:11:55,120

are specific elements

2041

01:11:58,630 --> 01:11:58,159

on on the surface of this object uh and

2042

01:12:00,870 --> 01:11:58,640

then

2043

01:12:02,390 --> 01:12:00,880

with respect to material strength that

2044

01:12:04,950 --> 01:12:02,400

really depends on

2045

01:12:07,110 --> 01:12:04,960

uh its shape which i mean we don't have

2046

01:12:09,270 --> 01:12:07,120

an image of it we just have

2047

01:12:11,350 --> 01:12:09,280

it just appeared as a point of light and

2048

01:12:14,310 --> 01:12:11,360

we know that it was stumbling

2049

01:12:15,430 --> 01:12:14,320

uh over eight hours and you know any

2050

01:12:18,550 --> 01:12:15,440

solid

2051

01:12:19,350 --> 01:12:18,560

could potentially do that that is not a

2052

01:12:21,110 --> 01:12:19,360

challenge

2053

01:12:22,950 --> 01:12:21,120

for an object the size of a football

2054

01:12:27,350 --> 01:12:22,960

field to spin around

2055

01:12:31,189 --> 01:12:27,360

uh every eight hours so you can't i mean

2056

01:12:32,790 --> 01:12:31,199

even for a cloud of dust it's possible i

2057

01:12:34,229 --> 01:12:32,800

checked the numbers so

2058

01:12:36,950 --> 01:12:34,239

so that doesn't say much about the

2059

01:12:38,709 --> 01:12:36,960

material composition so obviously we

2060

01:12:41,189 --> 01:12:38,719

the next time around when we find

2061

01:12:44,229 --> 01:12:41,199

another strange object of this type

2062

01:12:44,709 --> 01:12:44,239

we want to get much more data on it yeah

2063

01:12:47,910 --> 01:12:44,719

and that's

2064

01:12:50,310 --> 01:12:47,920

early detection exactly and the

2065

01:12:51,830 --> 01:12:50,320

lsst on the vera rubin observatory this

2066

01:12:53,990 --> 01:12:51,840

survey of the sky

2067

01:12:55,669 --> 01:12:54,000

uh would be much more sensitive than pan

2068

01:12:56,790 --> 01:12:55,679

stars and could find objects much

2069

01:12:59,110 --> 01:12:56,800

farther away

2070

01:13:00,229 --> 01:12:59,120

so it could give us an advanced warning

2071

01:13:03,430 --> 01:13:00,239

of a year

2072

01:13:05,270 --> 01:13:03,440

or more of objects like

2073

01:13:07,189 --> 01:13:05,280

then we can plan a mission that would

2074

01:13:08,709 --> 01:13:07,199

intercept their trajectory so that we

2075

01:13:09,990 --> 01:13:08,719

can get a photograph i think that would

2076

01:13:12,310 --> 01:13:10,000

be fantastic

2077

01:13:15,510 --> 01:13:12,320

yeah yeah i i think that's wonderful

2078

01:13:18,870 --> 01:13:17,110

i know the answer you see that's the

2079

01:13:22,870 --> 01:13:18,880

thing that it's not the

2080

01:13:26,070 --> 01:13:24,709

a question that came in and mark you're

2081

01:13:26,550 --> 01:13:26,080

you're welcome to ask him right after

2082

01:13:28,630 --> 01:13:26,560

this

2083

01:13:30,630 --> 01:13:28,640

but a question that came into chat was

2084

01:13:32,709 --> 01:13:30,640

is it possible the surface of whatever

2085

01:13:36,229 --> 01:13:32,719

it was could have been it like

2086

01:13:38,229 --> 01:13:36,239

a painted surface so to speak

2087

01:13:40,470 --> 01:13:38,239

well it's it's possible it's artificial

2088

01:13:42,229 --> 01:13:40,480

you have to realize that

2089

01:13:43,750 --> 01:13:42,239

when an object is interested in

2090

01:13:46,550 --> 01:13:43,760

interstellar space it gets

2091

01:13:47,189 --> 01:13:46,560

bombarded by dust particles and and by

2092

01:13:49,669 --> 01:13:47,199

gas

2093

01:13:51,750 --> 01:13:49,679

and actually the objects that we find in

2094

01:13:53,030 --> 01:13:51,760

the ore cloud in the outer part of the

2095

01:13:56,310 --> 01:13:53,040

solar system

2096

01:13:58,390 --> 01:13:56,320

are also exposed to the same

2097

01:13:59,990 --> 01:13:58,400

environment as interstellar space

2098

01:14:01,830 --> 01:14:00,000

because the solar wind is

2099

01:14:03,430 --> 01:14:01,840

being stopped at a hundred times the

2100

01:14:05,350 --> 01:14:03,440

earth sun separation and

2101
01:14:07,270 --> 01:14:05,360
the ultra goes to a hundred thousand

2102
01:14:09,430 --> 01:14:07,280
times the earth sun separation so

2103
01:14:11,430 --> 01:14:09,440
most of the volume of the solar system

2104
01:14:14,070 --> 01:14:11,440
is exposed to interstellar space

2105
01:14:15,110 --> 01:14:14,080
in much the same way as an interstellar

2106
01:14:18,149 --> 01:14:15,120
object is

2107
01:14:20,310 --> 01:14:18,159
and then there would be damage to the

2108
01:14:21,830 --> 01:14:20,320
surface of any object traveling for

2109
01:14:24,630 --> 01:14:21,840
millions of years you know

2110
01:14:25,510 --> 01:14:24,640
just like the damage that is encountered

2111
01:14:27,510 --> 01:14:25,520
by

2112
01:14:29,510 --> 01:14:27,520
you know the comets or asteroids that

2113
01:14:30,790 --> 01:14:29,520

are out there in the outer parts of the

2114

01:14:33,590 --> 01:14:30,800

solar system so

2115

01:14:34,470 --> 01:14:33,600

i think uh if you were to take a

2116

01:14:36,870 --> 01:14:34,480

close-up

2117

01:14:39,590 --> 01:14:36,880

look at the surface you know unless it's

2118

01:14:43,030 --> 01:14:39,600

metal that is very resilient

2119

01:14:46,709 --> 01:14:43,040

to damage it would look pretty much like

2120

01:14:49,990 --> 01:14:46,719

any rock uh in terms of being

2121

01:14:52,310 --> 01:14:50,000

you know bombarded by dust particles and

2122

01:14:53,030 --> 01:14:52,320

having some small craters on it so it

2123

01:14:55,750 --> 01:14:53,040

will be rough

2124

01:14:56,070 --> 01:14:55,760

a rough surface and that's probably why

2125

01:14:59,189 --> 01:14:56,080

uh

2126

01:15:01,669 --> 01:14:59,199

it was reddish similar to the colors of

2127

01:15:03,669 --> 01:15:01,679

of objects from the outlaw but but

2128

01:15:06,390 --> 01:15:03,679

whether it's artificial or natural

2129

01:15:08,310 --> 01:15:06,400

you know you can tell that by having a

2130

01:15:10,550 --> 01:15:08,320

resolved image because

2131

01:15:12,870 --> 01:15:10,560

you can tell the shape of it and and you

2132

01:15:15,270 --> 01:15:12,880

know the thickness of it and

2133

01:15:18,310 --> 01:15:15,280

you know rock it does not resemble a

2134

01:15:23,350 --> 01:15:21,430

doesn't radiation also redden surfaces

2135

01:15:24,870 --> 01:15:23,360

or after billions of years certain types

2136

01:15:27,669 --> 01:15:24,880

of radiation right i mean

2137

01:15:28,950 --> 01:15:27,679

yes so that's another possibility right

2138

01:15:31,830 --> 01:15:28,960

for why that could be

2139

01:15:33,750 --> 01:15:31,840

reddish yeah yeah it's a radiation it's

2140

01:15:38,870 --> 01:15:33,760

also cosmic rays and and

2141

01:15:41,590 --> 01:15:38,880

bombardment by dust particles yes

2142

01:15:42,950 --> 01:15:41,600

mark yeah i i actually you know i this

2143

01:15:43,270 --> 01:15:42,960

is another one i thought of too abby

2144

01:15:45,270 --> 01:15:43,280

which

2145

01:15:46,630 --> 01:15:45,280

you know this is good stuff what can i

2146

01:15:48,310 --> 01:15:46,640

tell you i mean i i really

2147

01:15:50,229 --> 01:15:48,320

enjoy this it's a i could talk about

2148

01:15:53,110 --> 01:15:50,239

this all night unfortunately which uh

2149

01:15:54,630 --> 01:15:53,120

unfortunately for you i'm actually

2150

01:15:58,470 --> 01:15:54,640

enjoying it as well

2151

01:16:00,550 --> 01:15:58,480

excellent um i felt that um

2152

01:16:02,229 --> 01:16:00,560

you know in our solar system you know

2153

01:16:03,830 --> 01:16:02,239

there were dynamical instabilities way

2154

01:16:05,030 --> 01:16:03,840

in the beginning that ejected lots and

2155

01:16:07,189 --> 01:16:05,040

lots of things

2156

01:16:08,790 --> 01:16:07,199

and they became interstellar right

2157

01:16:11,910 --> 01:16:08,800

perhaps at some point they

2158

01:16:13,590 --> 01:16:11,920

may end up at you know the

2159

01:16:15,590 --> 01:16:13,600

local standard of rest at some point and

2160

01:16:18,229 --> 01:16:15,600

make their way into some other

2161

01:16:19,430 --> 01:16:18,239

star system at some point so we actually

2162

01:16:22,229 --> 01:16:19,440

we actually

2163

01:16:24,709 --> 01:16:22,239

wrote the paper a decade before um was

2164

01:16:28,229 --> 01:16:24,719

discovered in 2007

2165

01:16:31,270 --> 01:16:28,239

with amaya more martin and ed turner

2166

01:16:32,870 --> 01:16:31,280

that was the first paper to forecast how

2167

01:16:33,990 --> 01:16:32,880

many interstellar objects you might

2168

01:16:37,430 --> 01:16:34,000

expect as a function

2169

01:16:40,229 --> 01:16:37,440

of size based on the ejected rocks from

2170

01:16:42,950 --> 01:16:40,239

the solar system

2171

01:16:44,310 --> 01:16:42,960

we found that the population that you

2172

01:16:47,189 --> 01:16:44,320

will end up with

2173

01:16:50,229 --> 01:16:47,199

will not be detectable with pan stars it

2174

01:16:53,350 --> 01:16:50,239

was a hundred to a hundred million times

2175

01:16:54,390 --> 01:16:53,360

uh smaller than the population needed to

2176
01:16:57,189 --> 01:16:54,400
explain

2177
01:16:58,310 --> 01:16:57,199
omua moa is a member of a random set of

2178
01:17:01,430 --> 01:16:58,320
objects and

2179
01:17:05,910 --> 01:17:01,440
um so the answer is even if

2180
01:17:07,350 --> 01:17:05,920
is natural uh the factories that make or

2181
01:17:10,870 --> 01:17:07,360
more more like objects

2182
01:17:13,189 --> 01:17:10,880
uh must be unusual they cannot just be

2183
01:17:14,229 --> 01:17:13,199
you know planetary systems like the

2184
01:17:15,910 --> 01:17:14,239
solar system

2185
01:17:18,630 --> 01:17:15,920
because when we did the calculation for

2186
01:17:20,550 --> 01:17:18,640
such systems there wasn't enough stuff

2187
01:17:22,550 --> 01:17:20,560
there wasn't there weren't enough

2188
01:17:25,750 --> 01:17:22,560

objects that could be ejected

2189

01:17:27,910 --> 01:17:25,760
to account for the abundance of

2190

01:17:29,750 --> 01:17:27,920
more more like objects say that and and

2191

01:17:31,270 --> 01:17:29,760
we can infer how many or more like

2192

01:17:33,910 --> 01:17:31,280
objects are needed

2193

01:17:35,510 --> 01:17:33,920
because the pan stars telescope surveyed

2194

01:17:37,430 --> 01:17:35,520
the sky for a few years and

2195

01:17:39,830 --> 01:17:37,440
had a certain sensitivity and so you can

2196

01:17:41,270 --> 01:17:39,840
tell from the detection of one object

2197

01:17:42,950 --> 01:17:41,280
how many more should exist

2198

01:17:45,189 --> 01:17:42,960
just like going to the kitchen finding

2199

01:17:45,830 --> 01:17:45,199
an ant over a certain area of the

2200

01:17:48,229 --> 01:17:45,840
cabinet

2201

01:17:49,910 --> 01:17:48,239

and then by knowing the total area of

2202

01:17:51,350 --> 01:17:49,920

the cabinet you know how many ants are

2203

01:17:53,430 --> 01:17:51,360

out there you know how frequently you

2204

01:17:56,709 --> 01:17:53,440

would see one of them within that area

2205

01:17:58,229 --> 01:17:56,719

so it turns out that you know the

2206

01:18:00,790 --> 01:17:58,239

population is far greater

2207

01:18:01,990 --> 01:18:00,800

than expected uh based on and that's why

2208

01:18:03,590 --> 01:18:02,000

i was

2209

01:18:05,350 --> 01:18:03,600

interested you know more because i

2210

01:18:08,630 --> 01:18:05,360

didn't expect it to be found

2211

01:18:11,510 --> 01:18:08,640

in the first one of course that's based

2212

01:18:14,070 --> 01:18:11,520

on our solar system and how we evolved

2213

01:18:15,830 --> 01:18:14,080

but it a more massive system i mean we

2214

01:18:17,750 --> 01:18:15,840

we found exoplanets that have

2215

01:18:19,990 --> 01:18:17,760

multiple asteroid belts for instance so

2216

01:18:22,390 --> 01:18:20,000

amaya moro martin actually repeated the

2217

01:18:24,070 --> 01:18:22,400

my collaborator repeated that exercise

2218

01:18:26,790 --> 01:18:24,080

after the discovery for mumwa

2219

01:18:27,430 --> 01:18:26,800

and included included all types of stars

2220

01:18:32,470 --> 01:18:27,440

and

2221

01:18:33,990 --> 01:18:32,480

very difficult to account for the

2222

01:18:36,470 --> 01:18:34,000

population of objects that

2223

01:18:37,110 --> 01:18:36,480

they would explain on women you know

2224

01:18:39,750 --> 01:18:37,120

even if you

2225

01:18:42,390 --> 01:18:39,760

sum over all types of stars and

2226

01:18:45,110 --> 01:18:42,400

planetary systems around them so

2227

01:18:46,310 --> 01:18:45,120

it's enigmatic i mean as i said you

2228

01:18:48,470 --> 01:18:46,320

learn something new

2229

01:18:49,750 --> 01:18:48,480

from these objects irrespective of

2230

01:18:53,110 --> 01:18:49,760

whether they are natural or

2231

01:18:53,990 --> 01:18:53,120

artificial sure well i have kind of a

2232

01:18:57,910 --> 01:18:54,000

philosophical

2233

01:18:59,750 --> 01:18:57,920

question uh most solar systems

2234

01:19:00,950 --> 01:18:59,760

i think i think i've read this there are

2235

01:19:03,590 --> 01:19:00,960

binary

2236

01:19:04,790 --> 01:19:03,600

and i'm just wondering would that make

2237

01:19:08,470 --> 01:19:04,800

any difference

2238

01:19:11,189 --> 01:19:08,480

and this is an opinion on evolution of

2239

01:19:11,590 --> 01:19:11,199

of living creatures a binary system well

2240

01:19:14,070 --> 01:19:11,600

if the

2241

01:19:15,110 --> 01:19:14,080

okay so there is roughly crudely

2242

01:19:18,790 --> 01:19:15,120

speaking there is

2243

01:19:22,470 --> 01:19:18,800

equal probability for binary stars to be

2244

01:19:24,790 --> 01:19:22,480

uh at the per logarithmic separate

2245

01:19:26,790 --> 01:19:24,800

logarithm of separation so if you change

2246

01:19:27,990 --> 01:19:26,800

the separation between the two stars by

2247

01:19:29,910 --> 01:19:28,000

a factor of 10

2248

01:19:31,270 --> 01:19:29,920

you have roughly equal probability every

2249

01:19:34,229 --> 01:19:31,280

factor of 10

2250

01:19:36,070 --> 01:19:34,239

uh and that means that you know a

2251

01:19:38,070 --> 01:19:36,080

substantial fraction of all systems will

2252

01:19:39,030 --> 01:19:38,080

be separated by a large distance such

2253

01:19:41,110 --> 01:19:39,040

that

2254

01:19:43,350 --> 01:19:41,120

uh it wouldn't affect the inner planets

2255

01:19:44,149 --> 01:19:43,360

like in the habitable zone around each

2256

01:19:46,550 --> 01:19:44,159

star so

2257

01:19:47,189 --> 01:19:46,560

each star will have its own habitable

2258

01:19:48,870 --> 01:19:47,199

zone and

2259

01:19:50,630 --> 01:19:48,880

the two stars will be separated by a

2260

01:19:51,830 --> 01:19:50,640

large enough distance so that

2261

01:19:53,750 --> 01:19:51,840

you know it's as if you had two

2262

01:19:56,070 --> 01:19:53,760

independent stars but

2263

01:19:58,149 --> 01:19:56,080

there should still be some where the two

2264

01:20:01,189 --> 01:19:58,159

stars are close enough to affect

2265

01:20:03,189 --> 01:20:01,199

each other's habitability and that is

2266

01:20:04,550 --> 01:20:03,199

a very interesting question because the

2267

01:20:08,470 --> 01:20:04,560

question is whether it will

2268

01:20:10,550 --> 01:20:08,480

help or hurt uh the prospects for life

2269

01:20:11,750 --> 01:20:10,560

if you have two sons that are not very

2270

01:20:14,870 --> 01:20:11,760

far apart

2271

01:20:17,750 --> 01:20:14,880

you know the the other son could

2272

01:20:18,629 --> 01:20:17,760

for example disturb the orbit of the

2273

01:20:20,709 --> 01:20:18,639

planet and not

2274

01:20:22,950 --> 01:20:20,719

allow it to be circular in the way that

2275

01:20:24,950 --> 01:20:22,960

the earth is going around the sun and

2276

01:20:27,189 --> 01:20:24,960

that would have implications for the

2277

01:20:28,790 --> 01:20:27,199

feasibility the possibility of life and

2278

01:20:31,030 --> 01:20:28,800

but there would be another source of

2279

01:20:32,070 --> 01:20:31,040

light and i don't think this is worked

2280

01:20:34,149 --> 01:20:32,080

out

2281

01:20:36,229 --> 01:20:34,159

in sufficient detail this this is a very

2282

01:20:39,110 --> 01:20:36,239

interesting question and

2283

01:20:41,030 --> 01:20:39,120

it's not that most stars are are so

2284

01:20:42,070 --> 01:20:41,040

close i mean it's a small minority maybe

2285

01:20:43,990 --> 01:20:42,080

10 percent are

2286

01:20:46,310 --> 01:20:44,000

close enough for the two stars to affect

2287

01:20:48,790 --> 01:20:46,320

habitability of each one of them

2288

01:20:50,709 --> 01:20:48,800

but nevertheless it's you know it's not

2289

01:20:51,990 --> 01:20:50,719

a negligible fraction of all stars so

2290

01:20:52,550 --> 01:20:52,000

it's an interesting very interesting

2291

01:20:55,669 --> 01:20:52,560

question

2292

01:20:57,030 --> 01:20:55,679

i should say also that uh a significant

2293

01:21:00,390 --> 01:20:57,040

fraction of stars are in

2294

01:21:02,390 --> 01:21:00,400

triple systems and quadruple systems

2295

01:21:04,149 --> 01:21:02,400

despite what you know there is a long

2296

01:21:07,350 --> 01:21:04,159

tradition in a storm of discussing

2297

01:21:09,590 --> 01:21:07,360

single stars but in fact you know

2298

01:21:10,870 --> 01:21:09,600

a significant fraction are in binaries

2299

01:21:13,750 --> 01:21:10,880

like half of them

2300

01:21:15,510 --> 01:21:13,760

and the another you know quarter is in

2301

01:21:16,070 --> 01:21:15,520

triple systems that have three stars

2302

01:21:18,229 --> 01:21:16,080

like

2303

01:21:21,110 --> 01:21:18,239

the alpha centauri system is a triple

2304

01:21:23,030 --> 01:21:21,120

the next you know the one next door the

2305

01:21:24,470 --> 01:21:23,040

the three stars closest to us are a

2306

01:21:26,870 --> 01:21:24,480

triple um

2307

01:21:27,590 --> 01:21:26,880

and then then you have quadruples also

2308

01:21:30,149 --> 01:21:27,600

not

2309

01:21:31,590 --> 01:21:30,159

you know in a significant fraction of

2310

01:21:36,149 --> 01:21:31,600

all stars and

2311

01:21:38,070 --> 01:21:36,159

uh the implications of that is not fully

2312

01:21:39,590 --> 01:21:38,080

understood in in in the scientific

2313

01:21:41,830 --> 01:21:39,600

literature you know and

2314

01:21:42,709 --> 01:21:41,840

it doesn't just affect habitability it

2315

01:21:45,590 --> 01:21:42,719

affects

2316

01:21:47,510 --> 01:21:45,600

a lot of other aspects of the evolution

2317

01:21:49,430 --> 01:21:47,520

of stars because one star can affect the

2318

01:21:51,590 --> 01:21:49,440

evolution of another and

2319

01:21:54,070 --> 01:21:51,600

um you know still work there is still

2320

01:21:56,229 --> 01:21:54,080

work to do for younger people

2321

01:21:58,229 --> 01:21:56,239

yeah right think about the two stars

2322

01:22:00,229 --> 01:21:58,239

side by side at one point and then

2323

01:22:01,750 --> 01:22:00,239

one goes behind the other well if you're

2324

01:22:03,270 --> 01:22:01,760

in that same plane of the orbit

2325

01:22:05,590 --> 01:22:03,280

at this point you're getting a lot more

2326

01:22:07,030 --> 01:22:05,600

radiation per square meter on your

2327

01:22:09,189 --> 01:22:07,040

surface and then here

2328

01:22:10,149 --> 01:22:09,199

you're getting a lot less so will that

2329

01:22:12,950 --> 01:22:10,159

variation

2330

01:22:13,830 --> 01:22:12,960

change the capability uh of life to

2331

01:22:16,229 --> 01:22:13,840

develop i mean

2332

01:22:17,270 --> 01:22:16,239

yeah a very very interesting thing to

2333

01:22:19,270 --> 01:22:17,280

explore yeah

2334

01:22:21,750 --> 01:22:19,280

uh but think about how beautiful the

2335

01:22:24,790 --> 01:22:21,760

view is to have two suns in the sky

2336

01:22:26,709 --> 01:22:24,800

you can never sleep sunsets sunsets all

2337

01:22:31,110 --> 01:22:26,719

the time or is it rising i can't tell

2338

01:22:34,229 --> 01:22:31,120

yeah the sun's set yeah

2339

01:22:37,590 --> 01:22:34,239

plural yeah that's right so

2340

01:22:39,910 --> 01:22:37,600

we can take calls um starting fairly

2341

01:22:44,229 --> 01:22:39,920

soon but you have another question mark

2342

01:22:46,070 --> 01:22:44,239

i'm actually um i uh

2343

01:22:47,510 --> 01:22:46,080

okay we we talked about you know the

2344

01:22:49,189 --> 01:22:47,520

ultimatuly in our

2345

01:22:51,430 --> 01:22:49,199

kuiper belt the kuiper belt object that

2346

01:22:53,030 --> 01:22:51,440

new horizons went through after pluto

2347

01:22:55,270 --> 01:22:53,040

and of course that was a contact binary

2348

01:22:57,750 --> 01:22:55,280

of two pancake objects

2349

01:22:59,110 --> 01:22:57,760

right so i'm thinking how that's

2350

01:23:03,270 --> 01:22:59,120

interesting because

2351
01:23:06,629 --> 01:23:03,280
if umua was really a pancake object

2352
01:23:09,510 --> 01:23:06,639
is it possible that omuamua

2353
01:23:11,189 --> 01:23:09,520
was not again not from our solar system

2354
01:23:11,910 --> 01:23:11,199
but from another star system but was an

2355
01:23:15,110 --> 01:23:11,920
ejected

2356
01:23:15,750 --> 01:23:15,120
uh well foreign kuiper belt object that

2357
01:23:17,910 --> 01:23:15,760
actually

2358
01:23:18,950 --> 01:23:17,920
was ejected somehow and came here i

2359
01:23:21,270 --> 01:23:18,960
don't understand

2360
01:23:22,149 --> 01:23:21,280
the mechanics by that because it would

2361
01:23:23,830 --> 01:23:22,159
seem to be

2362
01:23:25,430 --> 01:23:23,840
real traumatic for that to actually

2363
01:23:28,709 --> 01:23:25,440

happen well

2364

01:23:30,870 --> 01:23:28,719

so it wasn't it couldn't have been

2365

01:23:32,709 --> 01:23:30,880

a contact binary or two two objects

2366

01:23:34,870 --> 01:23:32,719

because

2367

01:23:35,990 --> 01:23:34,880

it was spinning around every eight hours

2368

01:23:38,709 --> 01:23:36,000

and uh

2369

01:23:39,669 --> 01:23:38,719

you wouldn't get that behavior um given

2370

01:23:42,149 --> 01:23:39,679

the the

2371

01:23:43,430 --> 01:23:42,159

the tidal force from the sun uh it would

2372

01:23:46,550 --> 01:23:43,440

not work out

2373

01:23:48,950 --> 01:23:46,560

uh but then uh in principle we don't

2374

01:23:50,950 --> 01:23:48,960

know where it came from and you know

2375

01:23:52,149 --> 01:23:50,960

the thing is that it came from the local

2376

01:23:54,870 --> 01:23:52,159

standard of rest and

2377

01:23:57,110 --> 01:23:54,880

and and there is no star in that the

2378

01:23:59,830 --> 01:23:57,120

frame that we can associate it with

2379

01:24:01,669 --> 01:23:59,840

if it was the most likely origin would

2380

01:24:01,990 --> 01:24:01,679

be from an old cloud because that's the

2381

01:24:04,470 --> 01:24:02,000

place

2382

01:24:06,790 --> 01:24:04,480

where most objects are loosely bound to

2383

01:24:09,750 --> 01:24:06,800

their star and you can rip them apart by

2384

01:24:12,070 --> 01:24:09,760

a passing star and but that then they

2385

01:24:14,550 --> 01:24:12,080

would share the motion of the

2386

01:24:16,229 --> 01:24:14,560

apparent star and we haven't seen a

2387

01:24:17,270 --> 01:24:16,239

parent star that shares the motion of

2388

01:24:19,830 --> 01:24:17,280

umuah

2389

01:24:20,950 --> 01:24:19,840

yeah what is a what is a planetesimal

2390

01:24:23,110 --> 01:24:20,960

ejection

2391

01:24:24,709 --> 01:24:23,120

planetesimal is just like a lego

2392

01:24:27,990 --> 01:24:24,719

building block of planets

2393

01:24:31,669 --> 01:24:28,000

so the way that planets are believed to

2394

01:24:33,270 --> 01:24:31,679

perform is that you have some debris

2395

01:24:35,030 --> 01:24:33,280

from the formation of the star

2396

01:24:36,470 --> 01:24:35,040

okay so when the sun formed it was a

2397

01:24:39,669 --> 01:24:36,480

cloud of gas

2398

01:24:40,149 --> 01:24:39,679

that collapsed and cooled and made the

2399

01:24:42,390 --> 01:24:40,159

sun

2400

01:24:43,430 --> 01:24:42,400

okay but there was some debris left over

2401
01:24:45,590 --> 01:24:43,440
from the sun about

2402
01:24:46,470 --> 01:24:45,600
you know a few percent of the mass of

2403
01:24:49,189 --> 01:24:46,480
the sun

2404
01:24:49,669 --> 01:24:49,199
and that debris uh cooled and made a

2405
01:24:51,669 --> 01:24:49,679
disc

2406
01:24:53,110 --> 01:24:51,679
of material around the sun and was

2407
01:24:55,350 --> 01:24:53,120
orbiting around

2408
01:24:56,709 --> 01:24:55,360
and then out of this disk of material

2409
01:24:59,590 --> 01:24:56,719
the heavy elements

2410
01:25:01,350 --> 01:24:59,600
sunk to the mid plane and they started

2411
01:25:02,790 --> 01:25:01,360
making dust particles and the dust

2412
01:25:05,189 --> 01:25:02,800
particles stuck together

2413
01:25:06,709 --> 01:25:05,199

to make bigger and bigger objects these

2414

01:25:08,470 --> 01:25:06,719

were the planetesimals

2415

01:25:10,709 --> 01:25:08,480

rocks you know that got bigger and

2416

01:25:11,350 --> 01:25:10,719

bigger by sticking together and then

2417

01:25:13,590 --> 01:25:11,360

eventually

2418

01:25:15,669 --> 01:25:13,600

the force of gravity bound them together

2419

01:25:17,510 --> 01:25:15,679

to make rocky objects like this

2420

01:25:19,110 --> 01:25:17,520

like the earth you know the earth is a

2421

01:25:21,510 --> 01:25:19,120

rock um

2422

01:25:22,310 --> 01:25:21,520

jupiter in addition to the rock in the

2423

01:25:24,550 --> 01:25:22,320

interior

2424

01:25:27,030 --> 01:25:24,560

is believe you know uh the rocker

2425

01:25:30,870 --> 01:25:27,040

created hydrogen and helium and

2426

01:25:32,390 --> 01:25:30,880

and became a gas giant but um

2427

01:25:34,470 --> 01:25:32,400

the initial building blocks are

2428

01:25:37,750 --> 01:25:34,480

basically planetesimals these are

2429

01:25:39,189 --> 01:25:37,760

just like lego pieces that come together

2430

01:25:41,189 --> 01:25:39,199

and make the planets and

2431

01:25:42,229 --> 01:25:41,199

many of these lego pieces were scattered

2432

01:25:45,030 --> 01:25:42,239

around and

2433

01:25:46,870 --> 01:25:45,040

they make up today the the oort cloud

2434

01:25:49,910 --> 01:25:46,880

they they are the rocks that

2435

01:25:51,189 --> 01:25:49,920

existed early on and were scattered by

2436

01:25:54,390 --> 01:25:51,199

the planets and

2437

01:25:56,149 --> 01:25:54,400

uh so by examining them we can tell what

2438

01:25:59,430 --> 01:25:56,159

the initial

2439

01:26:01,590 --> 01:25:59,440

lego pieces were i didn't even put up

2440

01:26:03,510 --> 01:26:01,600

the phone number yet but we have kevin

2441

01:26:05,830 --> 01:26:03,520

from augusta georgia on the line kevin

2442

01:26:08,149 --> 01:26:05,840

welcome to the show

2443

01:26:09,189 --> 01:26:08,159

hey martin how are you doing i'm well

2444

01:26:11,830 --> 01:26:09,199

how are you

2445

01:26:12,310 --> 01:26:11,840

you remembered the number how about that

2446

01:26:31,990 --> 01:26:12,320

i

2447

01:26:34,870 --> 01:26:32,000

energy

2448

01:26:37,510 --> 01:26:34,880

and there's a certain amount of cultural

2449

01:26:39,430 --> 01:26:37,520

inertia that goes on with science

2450

01:26:41,750 --> 01:26:39,440

and so i just i just like to hear his

2451
01:26:45,430 --> 01:26:41,760
comment about

2452
01:26:48,550 --> 01:26:45,440
you know why is it

2453
01:26:51,350 --> 01:26:48,560
that so many scientists and i've had

2454
01:26:53,110 --> 01:26:51,360
tons of conversations with scientists

2455
01:26:55,189 --> 01:26:53,120
and national laboratories

2456
01:26:56,390 --> 01:26:55,199
who know that there's a lot we don't

2457
01:26:59,350 --> 01:26:56,400
know yet

2458
01:26:59,990 --> 01:26:59,360
and why is it they're not willing to

2459
01:27:03,189 --> 01:27:00,000
kind of

2460
01:27:06,790 --> 01:27:03,199
you know go to new ground is

2461
01:27:07,590 --> 01:27:06,800
is funding all of it or i just want to

2462
01:27:11,189 --> 01:27:07,600
hear is

2463
01:27:13,189 --> 01:27:11,199

his his thoughts yeah so i i

2464

01:27:14,310 --> 01:27:13,199

thank you for the question i do think

2465

01:27:18,149 --> 01:27:14,320

that

2466

01:27:21,270 --> 01:27:18,159

are

2467

01:27:24,070 --> 01:27:21,280

afraid of taking risks or or

2468

01:27:25,510 --> 01:27:24,080

innovating and basically getting out of

2469

01:27:27,110 --> 01:27:25,520

their comfort zone and

2470

01:27:29,750 --> 01:27:27,120

one thing we learned from the history of

2471

01:27:31,750 --> 01:27:29,760

physics is very often

2472

01:27:33,510 --> 01:27:31,760

you know important discoveries take you

2473

01:27:35,350 --> 01:27:33,520

out of your comfort zone for example

2474

01:27:37,350 --> 01:27:35,360

quantum mechanics you know one of the

2475

01:27:39,270 --> 01:27:37,360

main pillars of physics

2476

01:27:41,669 --> 01:27:39,280

took a lot of physicists out of their

2477

01:27:43,750 --> 01:27:41,679

comfort zone including albert einstein

2478

01:27:45,669 --> 01:27:43,760

he argued that quantum mechanics cannot

2479

01:27:48,070 --> 01:27:45,679

have spooky action at the distance

2480

01:27:49,270 --> 01:27:48,080

and he was wrong so even a hundred years

2481

01:27:51,669 --> 01:27:49,280

later after

2482

01:27:53,350 --> 01:27:51,679

after the discovery of quantum mechanics

2483

01:27:54,310 --> 01:27:53,360

it still makes a lot of physicists

2484

01:27:57,189 --> 01:27:54,320

uncomfortable but

2485

01:27:59,350 --> 01:27:57,199

but who cares that's what reality is and

2486

01:28:00,149 --> 01:27:59,360

we should be guided by evidence not by

2487

01:28:03,030 --> 01:28:00,159

the

2488

01:28:05,669 --> 01:28:03,040

uh prejudice that physicists have to be

2489

01:28:08,470 --> 01:28:05,679

in their comfort zone that that's the

2490

01:28:09,430 --> 01:28:08,480

moral of this story and uh unfortunately

2491

01:28:11,510 --> 01:28:09,440

not many

2492

01:28:13,110 --> 01:28:11,520

physicists are courageous enough to

2493

01:28:15,430 --> 01:28:13,120

accept that

2494

01:28:17,350 --> 01:28:15,440

the the evidence should be the key they

2495

01:28:19,110 --> 01:28:17,360

prefer to believe in

2496

01:28:20,629 --> 01:28:19,120

you know to stay in their comfort zone

2497

01:28:21,030 --> 01:28:20,639

and you know it's not very different

2498

01:28:22,870 --> 01:28:21,040

than

2499

01:28:24,310 --> 01:28:22,880

what happened during the days of galileo

2500

01:28:25,590 --> 01:28:24,320

where everyone thought that the sun

2501

01:28:27,669 --> 01:28:25,600

moves around the earth

2502

01:28:29,590 --> 01:28:27,679

that was the more comfortable position

2503

01:28:31,110 --> 01:28:29,600

obviously it was flattering your ego to

2504

01:28:32,229 --> 01:28:31,120

believe that we are in the center of the

2505

01:28:33,990 --> 01:28:32,239

universe and

2506

01:28:36,149 --> 01:28:34,000

uh it also was consistent with some

2507

01:28:38,629 --> 01:28:36,159

religious uh beliefs and

2508

01:28:39,430 --> 01:28:38,639

so everyone agreed to that and that was

2509

01:28:41,830 --> 01:28:39,440

it but

2510

01:28:44,470 --> 01:28:41,840

the point is science is not a matter of

2511

01:28:46,790 --> 01:28:44,480

consensus it's not a majority view

2512

01:28:48,390 --> 01:28:46,800

it's not like politics it it should be

2513

01:28:51,510 --> 01:28:48,400

based on evidence and

2514

01:28:53,669 --> 01:28:51,520

a single individual may make the correct

2515

01:28:55,910 --> 01:28:53,679

argument based on the evidence it's not

2516

01:28:57,350 --> 01:28:55,920

a matter of popularity contest

2517

01:28:59,270 --> 01:28:57,360

you know it doesn't depend on the number

2518

01:29:00,310 --> 01:28:59,280

of likes on twitter it just depends on

2519

01:29:02,550 --> 01:29:00,320

the evidence

2520

01:29:03,350 --> 01:29:02,560

and that's what um unfortunately many

2521

01:29:06,950 --> 01:29:03,360

people uh

2522

01:29:10,390 --> 01:29:06,960

including scientists are failing to to

2523

01:29:12,709 --> 01:29:10,400

accept and uh the the issue of funding

2524

01:29:13,830 --> 01:29:12,719

is is a by-product you know when the

2525

01:29:17,510 --> 01:29:13,840

scientific community

2526

01:29:20,709 --> 01:29:17,520

has a mainstream that is uh reluctant to

2527

01:29:22,790 --> 01:29:20,719

uh uh innovate

2528

01:29:25,110 --> 01:29:22,800

then the committees that provide the

2529

01:29:28,149 --> 01:29:25,120

funding are reluctant to innovate

2530

01:29:28,870 --> 01:29:28,159

uh you know and and what i find strange

2531

01:29:31,510 --> 01:29:28,880

is that

2532

01:29:32,390 --> 01:29:31,520

in the commercial sector in companies

2533

01:29:36,229 --> 01:29:32,400

like

2534

01:29:39,189 --> 01:29:36,239

google spacex and others and apple

2535

01:29:40,390 --> 01:29:39,199

you find much more risk-taking than in

2536

01:29:43,030 --> 01:29:40,400

academia

2537

01:29:44,070 --> 01:29:43,040

and you that is really paradoxical

2538

01:29:46,709 --> 01:29:44,080

because there are

2539

01:29:47,830 --> 01:29:46,719

these these entities these companies are

2540

01:29:51,110 --> 01:29:47,840

for-profit

2541

01:29:53,270 --> 01:29:51,120

and academia is not for profit so

2542

01:29:54,310 --> 01:29:53,280

in principle and and also academia has

2543

01:29:57,189 --> 01:29:54,320

tenure which

2544

01:29:58,709 --> 01:29:57,199

is supposed to give but professors the

2545

01:30:01,990 --> 01:29:58,719

freedom of mind so that they

2546

01:30:05,590 --> 01:30:02,000

would not be worried about their job uh

2547

01:30:09,669 --> 01:30:05,600

prospects and uh nevertheless uh

2548

01:30:11,750 --> 01:30:09,679

somehow the current culture is much more

2549

01:30:13,110 --> 01:30:11,760

conservative and less daring less

2550

01:30:15,350 --> 01:30:13,120

risk-taking

2551

01:30:16,709 --> 01:30:15,360

a lot of scientists are worried about

2552

01:30:18,870 --> 01:30:16,719

putting skin in the game

2553

01:30:19,990 --> 01:30:18,880

and and making you know getting into

2554

01:30:23,030 --> 01:30:20,000

subjects that may risk

2555

01:30:23,430 --> 01:30:23,040

their uh you know reputation and you

2556

01:30:25,110 --> 01:30:23,440

know

2557

01:30:27,270 --> 01:30:25,120

and and that is really unfortunate

2558

01:30:29,590 --> 01:30:27,280

because um

2559

01:30:31,830 --> 01:30:29,600

we you know we will not discover new

2560

01:30:35,110 --> 01:30:31,840

things if we don't dare to to

2561

01:30:36,950 --> 01:30:35,120

find them and you know i see that mostly

2562

01:30:39,110 --> 01:30:36,960

the thing that bothers me the most is

2563

01:30:40,709 --> 01:30:39,120

that in the culture of theoretical

2564

01:30:42,950 --> 01:30:40,719

physics right now there are lots of

2565

01:30:43,990 --> 01:30:42,960

speculative ideas like extra dimensions

2566

01:30:47,590 --> 01:30:44,000

string theory

2567

01:30:51,110 --> 01:30:47,600

the multiverse you know super string

2568

01:30:53,030 --> 01:30:51,120

super symmetry uh and those ideas are

2569

01:30:54,790 --> 01:30:53,040

not supported by experimental evidence

2570

01:30:57,430 --> 01:30:54,800

and nevertheless they have a very

2571

01:30:58,790 --> 01:30:57,440

elevated status they are popular uh in

2572

01:31:00,709 --> 01:30:58,800

the mainstream and

2573

01:31:02,550 --> 01:31:00,719

how do you understand that given that

2574

01:31:04,229 --> 01:31:02,560

there is no evidence it's because

2575

01:31:06,149 --> 01:31:04,239

there is no experimental check and

2576

01:31:08,070 --> 01:31:06,159

therefore the people that work on these

2577

01:31:08,790 --> 01:31:08,080

subjects do not put any skin in the game

2578

01:31:10,709 --> 01:31:08,800

they cannot

2579

01:31:12,070 --> 01:31:10,719

be proven wrong and that's a very

2580

01:31:14,229 --> 01:31:12,080

comfortable place to be

2581

01:31:16,310 --> 01:31:14,239

you just demonstrate that you are smart

2582

01:31:19,030 --> 01:31:16,320

by making mathematical

2583

01:31:20,390 --> 01:31:19,040

gymnastics and you can never be proven

2584

01:31:22,070 --> 01:31:20,400

wrong because there are no experiments

2585

01:31:23,910 --> 01:31:22,080

to test your ideas

2586

01:31:25,110 --> 01:31:23,920

and that's a more comfortable place to

2587

01:31:28,390 --> 01:31:25,120

be than

2588

01:31:31,430 --> 01:31:28,400

testing your ideas against evidence

2589

01:31:35,030 --> 01:31:31,440

so how do we move how do we move uh

2590

01:31:37,110 --> 01:31:35,040

traditional science uh off of that

2591

01:31:39,590 --> 01:31:37,120

you know paradigm where they have

2592

01:31:42,950 --> 01:31:39,600

comfort and no one has to sit out

2593

01:31:43,270 --> 01:31:42,960

because honestly it seeps into ufology

2594

01:31:46,229 --> 01:31:43,280

too

2595

01:31:47,830 --> 01:31:46,239

so you have i mean really great people i

2596

01:31:48,709 --> 01:31:47,840

mean i'm i was involved with the

2597

01:31:51,510 --> 01:31:48,719

scientists

2598

01:31:53,430 --> 01:31:51,520

scientific pollution for ufology but

2599

01:31:55,590 --> 01:31:53,440

it's the same paradigm

2600

01:31:57,430 --> 01:31:55,600

where you face a situation where the

2601
01:31:59,590 --> 01:31:57,440
tools might not be right

2602
01:32:00,470 --> 01:31:59,600
but we're not thinking enough outside

2603
01:32:03,669 --> 01:32:00,480
the box

2604
01:32:05,990 --> 01:32:03,679
yeah so i i have i think the way to

2605
01:32:08,390 --> 01:32:06,000
change the culture is to reward people

2606
01:32:11,110 --> 01:32:08,400
that are willing to take risks

2607
01:32:12,149 --> 01:32:11,120
so right now the reward system is geared

2608
01:32:14,870 --> 01:32:12,159
towards

2609
01:32:16,550 --> 01:32:14,880
you know it's being done by uh selection

2610
01:32:18,629 --> 01:32:16,560
committees that are made of the same

2611
01:32:20,629 --> 01:32:18,639
people that do not innovate you see

2612
01:32:22,390 --> 01:32:20,639
and if you were to change the reward

2613
01:32:23,830 --> 01:32:22,400

system where you reward people that are

2614

01:32:26,149 --> 01:32:23,840

willing to take risks

2615

01:32:28,229 --> 01:32:26,159

even if they fail you know at least they

2616

01:32:29,030 --> 01:32:28,239

went in some original direction that is

2617

01:32:33,590 --> 01:32:29,040

out of the

2618

01:32:36,310 --> 01:32:33,600

if you reward such people then

2619

01:32:38,390 --> 01:32:36,320

more will follow uh because it will be

2620

01:32:40,870 --> 01:32:38,400

recognized that that's a bit a benefit

2621

01:32:42,229 --> 01:32:40,880

you know that it enhances our chance of

2622

01:32:44,070 --> 01:32:42,239

discovery and

2623

01:32:45,830 --> 01:32:44,080

uh so that has to change i think the

2624

01:32:48,390 --> 01:32:45,840

reward system that the

2625

01:32:50,310 --> 01:32:48,400

uh grants the funding that we give

2626

01:32:51,990 --> 01:32:50,320

should be geared towards innovation more

2627

01:32:53,189 --> 01:32:52,000

than towards repeating things that we

2628

01:32:55,189 --> 01:32:53,199

already know

2629

01:32:56,550 --> 01:32:55,199

and the other thing is i'm hoping you

2630

01:32:58,629 --> 01:32:56,560

know i wrote my book

2631

01:33:00,550 --> 01:32:58,639

for the younger generation because you

2632

01:33:01,110 --> 01:33:00,560

know you wouldn't expect marian to

2633

01:33:03,750 --> 01:33:01,120

annette

2634

01:33:05,590 --> 01:33:03,760

to embrace the principles of the french

2635

01:33:06,870 --> 01:33:05,600

revolution because she benefited from

2636

01:33:08,870 --> 01:33:06,880

the old system

2637

01:33:10,550 --> 01:33:08,880

and so the people that are thriving in

2638

01:33:11,750 --> 01:33:10,560

the current intellectual culture of

2639

01:33:13,430 --> 01:33:11,760

academia

2640

01:33:14,790 --> 01:33:13,440

will never change it because they

2641

01:33:17,270 --> 01:33:14,800

benefit from it

2642

01:33:19,350 --> 01:33:17,280

they created the system that they enjoy

2643

01:33:20,310 --> 01:33:19,360

they have these comfort zones and they

2644

01:33:22,070 --> 01:33:20,320

enjoy them

2645

01:33:23,910 --> 01:33:22,080

if you were to move them away from those

2646

01:33:27,430 --> 01:33:23,920

comfort zone they would get upset

2647

01:33:29,510 --> 01:33:27,440

and they do get upset so my hope is the

2648

01:33:30,229 --> 01:33:29,520

younger generation will not come in with

2649

01:33:32,390 --> 01:33:30,239

those

2650

01:33:33,430 --> 01:33:32,400

prejudices and perhaps will be more

2651

01:33:34,870 --> 01:33:33,440

open-minded and

2652

01:33:37,110 --> 01:33:34,880

i wrote my book for the younger

2653

01:33:38,709 --> 01:33:37,120

generation excellent

2654

01:33:40,950 --> 01:33:38,719

well thank you dr love and thank you

2655

01:33:42,629 --> 01:33:40,960

martin thanks thanks kevin great

2656

01:33:45,189 --> 01:33:42,639

questions

2657

01:33:45,750 --> 01:33:45,199

all right now we have uh uh and i'll get

2658

01:33:48,550 --> 01:33:45,760

back to you

2659

01:33:49,590 --> 01:33:48,560

uh mark uh after this i know you have

2660

01:33:52,310 --> 01:33:49,600

more questions

2661

01:33:53,990 --> 01:33:52,320

um greg from north carolina welcome to

2662

01:33:57,270 --> 01:33:54,000

the show

2663

01:34:00,149 --> 01:33:57,280

thank you martin hi avi hi mark

2664

01:34:02,229 --> 01:34:00,159

how are you how you doing you got a

2665

01:34:04,790 --> 01:34:02,239

question for our guest

2666

01:34:06,629 --> 01:34:04,800

sure sure you know i you mentioned that

2667

01:34:09,030 --> 01:34:06,639

we're getting better at tracking

2668

01:34:10,709 --> 01:34:09,040

things that come into our solar system

2669

01:34:11,990 --> 01:34:10,719

and this is way out there but i was just

2670

01:34:15,270 --> 01:34:12,000

wondering

2671

01:34:15,669 --> 01:34:15,280

what would it take to capture one of

2672

01:34:18,070 --> 01:34:15,679

these

2673

01:34:19,110 --> 01:34:18,080

objects and would it even be wise to do

2674

01:34:22,470 --> 01:34:19,120

that

2675

01:34:25,910 --> 01:34:22,480

and pull it into a an earth orbit or a

2676

01:34:29,590 --> 01:34:25,920

orbit around the sun to study it further

2677

01:34:32,149 --> 01:34:29,600

right so um uh it's not a trivial matter

2678

01:34:34,709 --> 01:34:32,159

to bring such an object to earth but

2679

01:34:36,550 --> 01:34:34,719

what we can do are two things one is

2680

01:34:39,910 --> 01:34:36,560

potentially we can land on it

2681

01:34:40,950 --> 01:34:39,920

and study it from up close but we can

2682

01:34:43,750 --> 01:34:40,960

also look for

2683

01:34:46,709 --> 01:34:43,760

interstellar meteors these are objects

2684

01:34:49,830 --> 01:34:46,719

that collide with the earth

2685

01:34:51,750 --> 01:34:49,840

so most of the meteors that we see are

2686

01:34:53,750 --> 01:34:51,760

coming from the solar system and we can

2687

01:34:54,149 --> 01:34:53,760

tell that because we see the motion that

2688

01:35:00,790 --> 01:34:54,159

they

2689

01:35:02,790 --> 01:35:00,800

to burn up as meteors and there would be

2690

01:35:03,830 --> 01:35:02,800

a small minority of all meteors that

2691

01:35:06,870 --> 01:35:03,840

will have

2692

01:35:08,709 --> 01:35:06,880

initial velocity that is

2693

01:35:10,629 --> 01:35:08,719

such that it would indicate they come

2694

01:35:13,750 --> 01:35:10,639

from interstellar space

2695

01:35:15,910 --> 01:35:13,760

and i call them interstellar meteors

2696

01:35:17,910 --> 01:35:15,920

and if we find those interstellar

2697

01:35:20,390 --> 01:35:17,920

meteors which we can

2698

01:35:22,629 --> 01:35:20,400

then you know if they're big enough

2699

01:35:24,870 --> 01:35:22,639

bigger than the size of a person then

2700

01:35:25,910 --> 01:35:24,880

they will not burn up all together there

2701

01:35:29,109 --> 01:35:25,920

would be some

2702

01:35:30,070 --> 01:35:29,119

something left from them when they reach

2703

01:35:32,790 --> 01:35:30,080

the ground

2704

01:35:34,950 --> 01:35:32,800

and then we can examine that so instead

2705

01:35:36,149 --> 01:35:34,960

of capturing an interstellar object what

2706

01:35:39,270 --> 01:35:36,159

we can look for

2707

01:35:40,229 --> 01:35:39,280

are interstellar meteors that we can

2708

01:35:43,590 --> 01:35:40,239

examine when

2709

01:35:46,870 --> 01:35:43,600

they hit the ground and in addition

2710

01:35:48,310 --> 01:35:46,880

you know the moon and the uh potentially

2711

01:35:49,830 --> 01:35:48,320

even mars but

2712

01:35:52,070 --> 01:35:49,840

let's focus on the moon because it's

2713

01:35:55,030 --> 01:35:52,080

nearby the moon collected

2714

01:35:57,270 --> 01:35:55,040

uh all the objects that impacted on it

2715

01:35:59,990 --> 01:35:57,280

over the past few billion years

2716

01:36:00,629 --> 01:36:00,000

because it has no geological activity on

2717

01:36:02,709 --> 01:36:00,639

earth

2718

01:36:04,310 --> 01:36:02,719

everything that is on the surface right

2719

01:36:05,990 --> 01:36:04,320

now you know will get mixed by

2720

01:36:08,550 --> 01:36:06,000

geological activity

2721

01:36:10,629 --> 01:36:08,560

within 100 million years from now and

2722

01:36:11,270 --> 01:36:10,639

but on the moon there is not such mixing

2723

01:36:14,310 --> 01:36:11,280

and

2724

01:36:16,870 --> 01:36:14,320

the moon is within

2725

01:36:18,070 --> 01:36:16,880

a few meters from the surface layer

2726

01:36:20,790 --> 01:36:18,080

right now and

2727

01:36:21,189 --> 01:36:20,800

um and so the moon collected everything

2728

01:36:22,870 --> 01:36:21,199

and

2729

01:36:24,229 --> 01:36:22,880

also it doesn't have an atmosphere so

2730

01:36:26,629 --> 01:36:24,239

nothing burned up

2731

01:36:28,390 --> 01:36:26,639

and so one way to think of the moon is

2732

01:36:30,790 --> 01:36:28,400

like a museum you know

2733

01:36:32,709 --> 01:36:30,800

when we establish a sustainable base on

2734

01:36:35,270 --> 01:36:32,719

on the moon we should

2735

01:36:35,830 --> 01:36:35,280

go around and search on the surface for

2736

01:36:38,629 --> 01:36:35,840

any

2737

01:36:39,990 --> 01:36:38,639

equipment that may have been collected

2738

01:36:42,790 --> 01:36:40,000

as a result of

2739

01:36:44,229 --> 01:36:42,800

impacting the the moon so i think we

2740

01:36:47,109 --> 01:36:44,239

have opportunities

2741

01:36:48,950 --> 01:36:47,119

either by intestinal meteors or

2742

01:36:51,669 --> 01:36:48,960

searching the moon surface

2743

01:36:51,990 --> 01:36:51,679

to find pieces of equipment that hit the

2744

01:36:54,550 --> 01:36:52,000

moon

2745

01:36:55,990 --> 01:36:54,560

or the earth over the past few billion

2746

01:36:58,310 --> 01:36:56,000

years

2747

01:37:00,550 --> 01:36:58,320

great great very good well i appreciate

2748

01:37:04,070 --> 01:37:00,560

you answering that question

2749

01:37:07,270 --> 01:37:04,080

thanks for the call thank you martin

2750

01:37:10,550 --> 01:37:07,280

all right next we have lewis los angeles

2751
01:37:12,870 --> 01:37:10,560
lewis welcome to the show hey martin

2752
01:37:15,910 --> 01:37:12,880
thank you for having me on as always

2753
01:37:19,109 --> 01:37:15,920
what a killer guest i absolutely love

2754
01:37:21,430 --> 01:37:19,119
love love this show um avi i think i

2755
01:37:22,310 --> 01:37:21,440
have seen every single interview you've

2756
01:37:25,750 --> 01:37:22,320
done

2757
01:37:28,629 --> 01:37:25,760
um again with doing an excellent one my

2758
01:37:29,590 --> 01:37:28,639
favorite publication that you've done

2759
01:37:31,750 --> 01:37:29,600
yet

2760
01:37:33,270 --> 01:37:31,760
is the interview you did with the

2761
01:37:37,030 --> 01:37:33,280
scientific american

2762
01:37:39,109 --> 01:37:37,040
i believe it was yes the journalist

2763
01:37:40,310 --> 01:37:39,119

that was coming at you with these

2764

01:37:43,830 --> 01:37:40,320

questions

2765

01:37:46,310 --> 01:37:43,840

was really pompous and very aggressive

2766

01:37:48,070 --> 01:37:46,320

and at first it turned me off but what

2767

01:37:51,750 --> 01:37:48,080

set me at ease

2768

01:37:55,109 --> 01:37:51,760

was your confidence and your rebuttals

2769

01:37:57,750 --> 01:37:55,119

to these really hard questions

2770

01:37:59,750 --> 01:37:57,760

you almost made him look foolish by the

2771

01:38:01,510 --> 01:37:59,760

end

2772

01:38:03,830 --> 01:38:01,520

and it was a text interview you could

2773

01:38:06,550 --> 01:38:03,840

only read this interview and i was just

2774

01:38:08,229 --> 01:38:06,560

i stood up and applauded by myself and

2775

01:38:09,669 --> 01:38:08,239

my bedroom when i was done reading it

2776

01:38:13,990 --> 01:38:09,679

because i'm like this

2777

01:38:17,830 --> 01:38:14,000

we need more overloads in in this world

2778

01:38:21,030 --> 01:38:17,840

and so my question to you sir is

2779

01:38:24,550 --> 01:38:21,040

how do we get your colleagues

2780

01:38:27,910 --> 01:38:24,560

and your peers to get their heads

2781

01:38:30,629 --> 01:38:27,920

out of their collective butts and start

2782

01:38:31,590 --> 01:38:30,639

looking at this data with a more open

2783

01:38:35,109 --> 01:38:31,600

mind with a

2784

01:38:38,709 --> 01:38:35,119

child-like eyes what do we need to

2785

01:38:41,990 --> 01:38:38,719

do to get these guys on board and stop

2786

01:38:42,310 --> 01:38:42,000

being so stubborn and close-minded about

2787

01:38:44,470 --> 01:38:42,320

this

2788

01:38:45,830 --> 01:38:44,480

thank you for taking the question thank

2789

01:38:48,070 --> 01:38:45,840

you so much for doing

2790

01:38:50,149 --> 01:38:48,080

all of these interviews and putting all

2791

01:38:53,189 --> 01:38:50,159

of this wonderful information out there

2792

01:38:54,629 --> 01:38:53,199

you truly truly truly are making some

2793

01:38:57,430 --> 01:38:54,639

wonderful headway

2794

01:38:58,550 --> 01:38:57,440

in the topic thank you very much for the

2795

01:39:00,709 --> 01:38:58,560

kind words i mean

2796

01:39:02,870 --> 01:39:00,719

uh you know these these interviews there

2797

01:39:04,149 --> 01:39:02,880

were about 300 of them over the past

2798

01:39:06,790 --> 01:39:04,159

eight weeks and

2799

01:39:08,310 --> 01:39:06,800

most of my days started at 4 00 a.m in

2800

01:39:11,350 --> 01:39:08,320

order to accommodate

2801
01:39:12,390 --> 01:39:11,360
those back back interviews and uh i

2802
01:39:16,470 --> 01:39:12,400
should say that

2803
01:39:20,629 --> 01:39:16,480
uh that you know the general public's uh

2804
01:39:23,350 --> 01:39:20,639
uh view was pretty much our heart was

2805
01:39:24,310 --> 01:39:23,360
right on target and uh i resonated with

2806
01:39:27,430 --> 01:39:24,320
the general public

2807
01:39:29,590 --> 01:39:27,440
a lot and uh just like you pointed out

2808
01:39:31,109 --> 01:39:29,600
there are lots of people out there that

2809
01:39:33,510 --> 01:39:31,119
agree with with what i

2810
01:39:34,950 --> 01:39:33,520
say and that explains the popularity of

2811
01:39:36,629 --> 01:39:34,960
the book you know it became

2812
01:39:38,470 --> 01:39:36,639
bestseller within the first week of

2813
01:39:40,950 --> 01:39:38,480

publication on the new york times list

2814

01:39:42,950 --> 01:39:40,960

and also in germany and other places

2815

01:39:44,310 --> 01:39:42,960

so it's clear that the public agrees

2816

01:39:46,229 --> 01:39:44,320

with these arguments

2817

01:39:48,390 --> 01:39:46,239

but it's also clear that something is

2818

01:39:50,310 --> 01:39:48,400

wrong in the scientific culture because

2819

01:39:51,830 --> 01:39:50,320

i get a lot of pushback and i get

2820

01:39:54,470 --> 01:39:51,840

attacked personally

2821

01:39:56,229 --> 01:39:54,480

on issues you know that are really

2822

01:39:58,390 --> 01:39:56,239

puzzling for me because i'm trying to

2823

01:39:59,990 --> 01:39:58,400

advocate more funding for the search for

2824

01:40:01,669 --> 01:40:00,000

technological signatures and then some

2825

01:40:05,750 --> 01:40:01,679

people have blamed me for

2826

01:40:07,910 --> 01:40:05,760

uh actually arguing against that

2827

01:40:09,990 --> 01:40:07,920

it really goes completely opposite to my

2828

01:40:13,910 --> 01:40:10,000

message and

2829

01:40:16,229 --> 01:40:13,920

i find it really strange frankly that

2830

01:40:18,310 --> 01:40:16,239

somehow my scientific colleagues are not

2831

01:40:21,270 --> 01:40:18,320

getting it and

2832

01:40:22,310 --> 01:40:21,280

and i think that it implies that it will

2833

01:40:25,510 --> 01:40:22,320

not be easy

2834

01:40:28,070 --> 01:40:25,520

to to change the the current culture and

2835

01:40:29,990 --> 01:40:28,080

uh unless of course young people that

2836

01:40:31,590 --> 01:40:30,000

enter the halls of academia

2837

01:40:33,030 --> 01:40:31,600

in the coming years you know will bring

2838

01:40:35,590 --> 01:40:33,040

a fresh

2839

01:40:36,310 --> 01:40:35,600

perspective into it and i heard from a

2840

01:40:39,189 --> 01:40:36,320

lot of people

2841

01:40:41,030 --> 01:40:39,199

they wrote emails to me that indicate

2842

01:40:43,350 --> 01:40:41,040

that they are supportive of my views

2843

01:40:45,030 --> 01:40:43,360

people in academia but they're afraid to

2844

01:40:46,390 --> 01:40:45,040

speak out because

2845

01:40:48,950 --> 01:40:46,400

they're worried about their job

2846

01:40:50,070 --> 01:40:48,960

prospects and that includes even senior

2847

01:40:52,149 --> 01:40:50,080

people you know that

2848

01:40:54,149 --> 01:40:52,159

are afraid to do that you know i don't

2849

01:40:56,310 --> 01:40:54,159

care less because um

2850

01:40:58,070 --> 01:40:56,320

i think that it's important this this

2851

01:41:00,470 --> 01:40:58,080

question is so important for the public

2852

01:41:03,750 --> 01:41:00,480

that scientists must address it and

2853

01:41:05,270 --> 01:41:03,760

uh it's such a big issue that you know i

2854

01:41:07,430 --> 01:41:05,280

don't care how much damage i

2855

01:41:09,109 --> 01:41:07,440

encounter you know because when i was at

2856

01:41:10,709 --> 01:41:09,119

age 18 i went to

2857

01:41:13,030 --> 01:41:10,719

i was recruited to the military in

2858

01:41:14,790 --> 01:41:13,040

israel and there was a saying among the

2859

01:41:17,270 --> 01:41:14,800

soldiers when i went through part

2860

01:41:19,109 --> 01:41:17,280

parachute paratrooper training that

2861

01:41:20,790 --> 01:41:19,119

sometimes the soldier has to put his

2862

01:41:22,870 --> 01:41:20,800

body on the barbed wire

2863

01:41:24,790 --> 01:41:22,880

so that others can pass through and

2864

01:41:27,510 --> 01:41:24,800

that's pretty much my

2865

01:41:29,270 --> 01:41:27,520

attitude in this context that them you

2866

01:41:31,189 --> 01:41:29,280

know i'm willing to suffer the pain

2867

01:41:32,790 --> 01:41:31,199

so that the younger generation of today

2868

01:41:34,310 --> 01:41:32,800

will be able to discuss this subject

2869

01:41:34,950 --> 01:41:34,320

freely because i think it's extremely

2870

01:41:36,629 --> 01:41:34,960

important

2871

01:41:38,310 --> 01:41:36,639

you know it's one of those scientific

2872

01:41:40,550 --> 01:41:38,320

questions that will have a huge impact

2873

01:41:41,990 --> 01:41:40,560

on our society if we find the answer

2874

01:41:43,750 --> 01:41:42,000

and we have the ability to find the

2875

01:41:45,510 --> 01:41:43,760

answer it's only that

2876

01:41:47,590 --> 01:41:45,520

you know many of my colleagues are

2877

01:41:49,750 --> 01:41:47,600

refusing to discuss it openly

2878

01:41:51,510 --> 01:41:49,760

and i do think that it's just a matter

2879

01:41:54,550 --> 01:41:51,520

of

2880

01:41:57,189 --> 01:41:54,560

social norms within the culture because

2881

01:41:58,390 --> 01:41:57,199

there is no merit to the argument

2882

01:42:00,390 --> 01:41:58,400

scientifically that

2883

01:42:01,430 --> 01:42:00,400

we are unique and special i mean we

2884

01:42:02,790 --> 01:42:01,440

should be open-minded

2885

01:42:04,870 --> 01:42:02,800

the possibility that there might be

2886

01:42:07,189 --> 01:42:04,880

others on our cosmic street

2887

01:42:09,189 --> 01:42:07,199

and we just need to search for them you

2888

01:42:10,790 --> 01:42:09,199

know my daughters when they were infants

2889

01:42:11,750 --> 01:42:10,800

they tended to think that they are the

2890

01:42:13,109 --> 01:42:11,760

smartest

2891

01:42:14,950 --> 01:42:13,119

and when we took them to the

2892

01:42:17,030 --> 01:42:14,960

kindergarten they realized that

2893

01:42:18,709 --> 01:42:17,040

there are smarter kids around and of

2894

01:42:20,149 --> 01:42:18,719

course they would have preferred to stay

2895

01:42:22,149 --> 01:42:20,159

at home and

2896

01:42:24,390 --> 01:42:22,159

maintain the illusion but you know

2897

01:42:28,310 --> 01:42:24,400

science is about getting information

2898

01:42:30,470 --> 01:42:28,320

and um

2899

01:42:32,390 --> 01:42:30,480

for example you may argue okay we don't

2900

01:42:33,830 --> 01:42:32,400

want that information and

2901

01:42:35,750 --> 01:42:33,840

uh look at what happened to the

2902

01:42:38,070 --> 01:42:35,760

dinosaurs you know they they

2903

01:42:39,669 --> 01:42:38,080

enjoyed eating grass and just focusing

2904

01:42:41,270 --> 01:42:39,679

on their immediate environment and they

2905

01:42:41,990 --> 01:42:41,280

had huge bodies so they thought that

2906

01:42:45,510 --> 01:42:42,000

they are resilient

2907

01:42:46,950 --> 01:42:45,520

to any danger and then came this rock 66

2908

01:42:49,030 --> 01:42:46,960

million years ago and

2909

01:42:50,790 --> 01:42:49,040

uh three quarters of four life forms on

2910

01:42:52,310 --> 01:42:50,800

earth where it went extinct including

2911

01:42:55,109 --> 01:42:52,320

the dinosaurs so

2912

01:42:56,790 --> 01:42:55,119

um just focusing on your immediate needs

2913

01:42:58,629 --> 01:42:56,800

and environment and ignoring the big

2914

01:43:00,470 --> 01:42:58,639

picture is not a good approach and

2915

01:43:02,070 --> 01:43:00,480

we know that already from the pandemic

2916

01:43:03,990 --> 01:43:02,080

you know if you think that you can just

2917

01:43:06,470 --> 01:43:04,000

worry about your local politics and not

2918

01:43:09,189 --> 01:43:06,480

worry about what happens in wuhan china

2919

01:43:11,350 --> 01:43:09,199

then you are wrong because one day the

2920

01:43:13,510 --> 01:43:11,360

virus will come to your doorstep and you

2921

01:43:16,310 --> 01:43:13,520

need to understand the bigger picture

2922

01:43:17,189 --> 01:43:16,320

in order to figure out how to to respond

2923

01:43:19,830 --> 01:43:17,199

to it and

2924

01:43:21,350 --> 01:43:19,840

and by the big picture i mean also our

2925

01:43:23,750 --> 01:43:21,360

environment with the stars

2926

01:43:25,030 --> 01:43:23,760

we want to know who our neighbors are

2927

01:43:27,109 --> 01:43:25,040

because at some point you know we've

2928

01:43:28,310 --> 01:43:27,119

been broadcasting radio waves radio

2929

01:43:31,109 --> 01:43:28,320

signals for

2930

01:43:33,430 --> 01:43:31,119

a century more than a century now and if

2931

01:43:34,790 --> 01:43:33,440

if they have any radio telescopes like

2932

01:43:36,950 --> 01:43:34,800

we possess

2933

01:43:38,629 --> 01:43:36,960

they may know about us already so you

2934

01:43:40,310 --> 01:43:38,639

know

2935

01:43:43,590 --> 01:43:40,320

sometime in the future we might hear

2936

01:43:45,510 --> 01:43:43,600

back and we want to know who is around

2937

01:43:47,350 --> 01:43:45,520

uh when you enter a room full of

2938

01:43:50,310 --> 01:43:47,360

strangers

2939

01:43:51,910 --> 01:43:50,320

the smart thing to do is first be quiet

2940

01:43:53,590 --> 01:43:51,920

and listen because you never know if

2941

01:43:55,750 --> 01:43:53,600

there are predators around that

2942

01:43:57,430 --> 01:43:55,760

could risk your existence and you know

2943

01:43:58,870 --> 01:43:57,440

it's really important for us to figure

2944

01:44:01,109 --> 01:43:58,880

out who is around

2945

01:44:02,229 --> 01:44:01,119

because it gives us a better perspective

2946

01:44:05,750 --> 01:44:02,239

about our place

2947

01:44:07,430 --> 01:44:05,760

but coming back to my um

2948

01:44:09,590 --> 01:44:07,440

colleagues you know i'm really

2949

01:44:11,350 --> 01:44:09,600

frustrated by this and i'm worried that

2950

01:44:13,030 --> 01:44:11,360

it will not be easy and

2951

01:44:15,430 --> 01:44:13,040

my hope is really that the younger

2952

01:44:19,030 --> 01:44:15,440

generation and maybe the public

2953

01:44:21,109 --> 01:44:19,040

will change somehow the culture uh

2954

01:44:22,550 --> 01:44:21,119

you know the public has influence

2955

01:44:24,629 --> 01:44:22,560

because the public funds

2956

01:44:26,310 --> 01:44:24,639

science and the public should have a

2957

01:44:28,870 --> 01:44:26,320

voice about what scientists

2958

01:44:31,350 --> 01:44:28,880

do and if scientists prefer to work on

2959

01:44:33,990 --> 01:44:31,360

extra dimensions that have no

2960

01:44:34,870 --> 01:44:34,000

or or on some forms of dark matter that

2961

01:44:37,590 --> 01:44:34,880

have no

2962

01:44:40,149 --> 01:44:37,600

direct impact on our lives while

2963

01:44:41,750 --> 01:44:40,159

ignoring the question of are we alone

2964

01:44:43,590 --> 01:44:41,760

the public should have a voice that's

2965

01:44:44,870 --> 01:44:43,600

saying no you should actually address

2966

01:44:48,470 --> 01:44:44,880

some of the questions that they

2967

01:44:49,030 --> 01:44:48,480

that we care about yep um are we alone

2968

01:44:52,070 --> 01:44:49,040

and if

2969

01:44:55,030 --> 01:44:52,080

whoever changes that whoever has

2970

01:44:55,510 --> 01:44:55,040

the evidence i mean it would be i would

2971

01:44:57,590 --> 01:44:55,520

think

2972

01:44:59,030 --> 01:44:57,600

the greatest discovery of all time you

2973

01:45:01,669 --> 01:44:59,040

know i mean agree

2974

01:45:02,950 --> 01:45:01,679

i don't know what else would top it life

2975

01:45:04,390 --> 01:45:02,960

after death if

2976

01:45:06,070 --> 01:45:04,400

evidence or something like that i don't

2977

01:45:08,790 --> 01:45:06,080

know

2978

01:45:09,189 --> 01:45:08,800

right now we have mike from cincinnati

2979

01:45:12,950 --> 01:45:09,199

mike

2980

01:45:15,910 --> 01:45:12,960

welcome to the show well hi

2981

01:45:17,830 --> 01:45:15,920

uh great show i came late so i'm not

2982

01:45:19,510 --> 01:45:17,840

sure if this has been asked or not but

2983

01:45:22,790 --> 01:45:19,520

i'd like to ask since you have both

2984

01:45:25,669 --> 01:45:22,800

mark and abby there uh

2985

01:45:26,950 --> 01:45:25,679

why isn't there a camera on both sides

2986

01:45:29,750 --> 01:45:26,960

of the moon a tv

2987

01:45:31,590 --> 01:45:29,760

camera broadcasting live back to the

2988

01:45:33,990 --> 01:45:31,600

earth talk about getting people

2989

01:45:36,070 --> 01:45:34,000

interested it doesn't seem like it would

2990

01:45:39,669 --> 01:45:36,080

be that expensive

2991

01:45:41,590 --> 01:45:39,679

and also telescopes built on the moon

2992

01:45:44,950 --> 01:45:41,600

would they be able to photograph

2993

01:45:46,790 --> 01:45:44,960

better something like al muammu

2994

01:45:48,950 --> 01:45:46,800

the moon is not far enough from the

2995

01:45:52,310 --> 01:45:48,960

earth to offer

2996

01:45:55,270 --> 01:45:52,320

a a very different vantage point but

2997

01:45:56,229 --> 01:45:55,280

people are discussing putting telescopes

2998

01:45:57,990 --> 01:45:56,239

on the moon

2999

01:45:59,669 --> 01:45:58,000

the one advantage is there is no

3000

01:46:01,270 --> 01:45:59,679

atmosphere so you know the atmosphere

3001

01:46:05,270 --> 01:46:01,280

blurs the image

3002

01:46:05,910 --> 01:46:05,280

that you get uh from sources on the sky

3003

01:46:09,189 --> 01:46:05,920

and

3004

01:46:10,870 --> 01:46:09,199

uh also the the moon at radio

3005

01:46:13,030 --> 01:46:10,880

wavelengths doesn't have

3006

01:46:14,310 --> 01:46:13,040

an ionosphere that blocks radio waves at

3007

01:46:16,390 --> 01:46:14,320

low frequencies and

3008

01:46:17,430 --> 01:46:16,400

there are many advantages for astronomy

3009

01:46:20,070 --> 01:46:17,440

to the moon

3010

01:46:20,550 --> 01:46:20,080

uh but of course it's very expensive to

3011

01:46:23,830 --> 01:46:20,560

bring

3012

01:46:27,030 --> 01:46:23,840

stuff to the moon and build it there and

3013

01:46:29,109 --> 01:46:27,040

the idea of having astronomy on the moon

3014

01:46:30,229 --> 01:46:29,119

is old you know they're decades old but

3015

01:46:32,870 --> 01:46:30,239

maybe you know

3016

01:46:34,870 --> 01:46:32,880

i wrote even a paper just about a year

3017

01:46:36,229 --> 01:46:34,880

ago about the building a gravitational

3018

01:46:37,750 --> 01:46:36,239

wave observatory in

3019

01:46:39,750 --> 01:46:37,760

the moon because it doesn't have any

3020

01:46:41,669 --> 01:46:39,760

seismic noise there and

3021

01:46:43,750 --> 01:46:41,679

it could be much more sensitive than the

3022

01:46:45,510 --> 01:46:43,760

ligo experiment on earth

3023

01:46:47,750 --> 01:46:45,520

so there are many advantages to

3024

01:46:50,149 --> 01:46:47,760

astronomy on the moon but

3025

01:46:52,629 --> 01:46:50,159

it's mainly the cost of bringing stuff

3026

01:46:54,950 --> 01:46:52,639

there and building it there

3027

01:46:57,030 --> 01:46:54,960

which we haven't figured out yet because

3028

01:46:59,270 --> 01:46:57,040

we don't have a sustainable base

3029

01:47:00,709 --> 01:46:59,280

there is a plan called the artemis by

3030

01:47:02,550 --> 01:47:00,719

nasa to go to

3031

01:47:04,790 --> 01:47:02,560

to build a sustainable base on the moon

3032

01:47:05,430 --> 01:47:04,800

but it's not clear how quickly that

3033

01:47:09,430 --> 01:47:05,440

would be

3034

01:47:11,830 --> 01:47:09,440

realized perhaps in a few years

3035

01:47:13,030 --> 01:47:11,840

can i add to that yeah yeah sure go

3036

01:47:15,189 --> 01:47:13,040

ahead

3037

01:47:16,310 --> 01:47:15,199

you know as far as having telescopes on

3038

01:47:18,070 --> 01:47:16,320

the moon

3039

01:47:20,070 --> 01:47:18,080

it's actually far better to just have

3040

01:47:21,510 --> 01:47:20,080

them in orbit or put them at a lagrange

3041

01:47:24,470 --> 01:47:21,520

point which is like a parking

3042

01:47:25,590 --> 01:47:24,480

spot in space um if you put them on the

3043

01:47:28,709 --> 01:47:25,600

moon you've got other

3044

01:47:30,629 --> 01:47:28,719

issues to worry about that is every

3045

01:47:31,910 --> 01:47:30,639

impact to the moon it still gets hit by

3046

01:47:34,149 --> 01:47:31,920

the way you know

3047

01:47:35,669 --> 01:47:34,159

a lot regularly actually it doesn't have

3048

01:47:37,990 --> 01:47:35,679

an atmosphere to burn up

3049

01:47:39,990 --> 01:47:38,000

yeah right and it's going to splash

3050

01:47:40,870 --> 01:47:40,000

stuff up into the exosphere the area

3051

01:47:42,310 --> 01:47:40,880

around the moon

3052

01:47:44,310 --> 01:47:42,320

and guess what that's going to land

3053

01:47:45,750 --> 01:47:44,320

eventually on your telescope

3054

01:47:47,030 --> 01:47:45,760

so how you're going to clean it now you

3055

01:47:49,030 --> 01:47:47,040

got to have somebody there now you have

3056

01:47:51,270 --> 01:47:49,040

a way to do that

3057

01:47:52,870 --> 01:47:51,280

yeah yeah really exactly you know uh

3058

01:47:54,629 --> 01:47:52,880

which is one of my thoughts about why

3059

01:47:56,310 --> 01:47:54,639

did spirit and opportunity die well

3060

01:47:57,830 --> 01:47:56,320

because there was dust accumulation on

3061

01:47:59,590 --> 01:47:57,840

the panels for the most part right i

3062

01:48:02,390 --> 01:47:59,600

mean that started to reduce

3063

01:48:03,590 --> 01:48:02,400

microvolts by microvolts are gone uh so

3064

01:48:04,390 --> 01:48:03,600

a windshield wiper would have been great

3065

01:48:06,629 --> 01:48:04,400

there

3066

01:48:08,310 --> 01:48:06,639

perseverance has such a thing it has a

3067

01:48:10,149 --> 01:48:08,320

dust off built in to do that

3068

01:48:11,430 --> 01:48:10,159

for not solar panels but for

3069

01:48:13,030 --> 01:48:11,440

instrumentation but

3070

01:48:15,189 --> 01:48:13,040

beside the point i just think that the

3071

01:48:17,109 --> 01:48:15,199

telescope concept is

3072

01:48:19,109 --> 01:48:17,119

far better served by putting it up in an

3073

01:48:22,149 --> 01:48:19,119

orbit even if it's a

3074

01:48:24,070 --> 01:48:22,159

very large orbit above the earth okay or

3075

01:48:25,830 --> 01:48:24,080

put it on a million miles away at a

3076

01:48:27,750 --> 01:48:25,840

lagrange point it might be a far

3077

01:48:28,950 --> 01:48:27,760

better solution and that's where james

3078

01:48:31,189 --> 01:48:28,960

webb is going for instance

3079

01:48:33,109 --> 01:48:31,199

so i think that's a better idea the

3080

01:48:34,870 --> 01:48:33,119

camera thing

3081

01:48:37,270 --> 01:48:34,880

what's that so that people could

3082

01:48:37,750 --> 01:48:37,280

actually watch impacts on the moon and

3083

01:48:39,830 --> 01:48:37,760

have a

3084

01:48:41,990 --> 01:48:39,840

you know a windshield wiper no that that

3085

01:48:42,229 --> 01:48:42,000

is uh that is an interesting suggestion

3086

01:48:46,070 --> 01:48:42,239

and

3087

01:48:47,990 --> 01:48:46,080

with my student

3088

01:48:49,590 --> 01:48:48,000

i can share it with you if you send me

3089

01:48:51,990 --> 01:48:49,600

an email where we

3090

01:48:53,270 --> 01:48:52,000

talked about a camera that will record

3091

01:48:56,149 --> 01:48:53,280

impacts on the moon

3092

01:48:56,550 --> 01:48:56,159

yes that's right would you be able to

3093

01:49:01,350 --> 01:48:56,560

see

3094

01:49:03,430 --> 01:49:01,360

uh meteorites going by in the atmosphere

3095

01:49:05,590 --> 01:49:03,440

exactly what we no we were talking about

3096

01:49:08,709 --> 01:49:05,600

impacts on the moon but

3097

01:49:12,229 --> 01:49:08,719

you can also look at earth yes right

3098

01:49:14,470 --> 01:49:12,239

actually uh we're running um

3099

01:49:15,830 --> 01:49:14,480

i run i run two observatories i have one

3100

01:49:16,550 --> 01:49:15,840

in connecticut and we're actually doing

3101

01:49:17,910 --> 01:49:16,560

a remote

3102

01:49:20,149 --> 01:49:17,920

view of the moon we're actually watching

3103

01:49:22,149 --> 01:49:20,159

the moon during a lunar eclipse

3104

01:49:23,990 --> 01:49:22,159

and during the height of the eclipse we

3105

01:49:26,070 --> 01:49:24,000

caught a meteor strike the moon

3106

01:49:27,589 --> 01:49:26,080

oh we're one of five groups on the

3107

01:49:28,310 --> 01:49:27,599

planet that actually saw the meteor

3108

01:49:30,390 --> 01:49:28,320

strike

3109

01:49:31,830 --> 01:49:30,400

i didn't know that yeah yeah i can send

3110

01:49:33,510 --> 01:49:31,840

you the the exact location you can

3111

01:49:35,350 --> 01:49:33,520

actually see it's a little flat

3112

01:49:37,109 --> 01:49:35,360

addiction yeah it was a very small

3113

01:49:38,550 --> 01:49:37,119

object but still right i mean that's

3114

01:49:39,669 --> 01:49:38,560

that's very good and there's a spanish

3115

01:49:40,870 --> 01:49:39,679

group by the way that's always

3116

01:49:42,709 --> 01:49:40,880

monitoring the moon

3117

01:49:44,470 --> 01:49:42,719

by the way speaking about the dust that

3118

01:49:46,870 --> 01:49:44,480

you were talking about before it's very

3119

01:49:48,229 --> 01:49:46,880

sharp on the moon it's different from

3120

01:49:51,030 --> 01:49:48,239

the dust we have here

3121

01:49:52,310 --> 01:49:51,040

um because there is no atmosphere and

3122

01:49:54,870 --> 01:49:52,320

every you know it can

3123

01:49:56,390 --> 01:49:54,880

cut your your if you were to touch it it

3124

01:49:59,270 --> 01:49:56,400

would cut your skin

3125

01:49:59,669 --> 01:49:59,280

yeah wow it went through the astronauts

3126

01:50:01,830 --> 01:49:59,679

uh

3127

01:50:02,709 --> 01:50:01,840

insulation on their boots and i forget

3128

01:50:04,470 --> 01:50:02,719

which one it was

3129

01:50:06,950 --> 01:50:04,480

one of the apollo astronauts couldn't go

3130

01:50:10,870 --> 01:50:06,960

out for his final eva

3131

01:50:11,990 --> 01:50:10,880

because his ankle uh his ankle seal was

3132

01:50:13,510 --> 01:50:12,000

actually cut right down to the

3133

01:50:15,669 --> 01:50:13,520

insulation

3134

01:50:18,709 --> 01:50:15,679

it's because he duffed his feet so you

3135

01:50:21,830 --> 01:50:21,189

i i talked to alan bean who was a fourth

3136

01:50:24,950 --> 01:50:21,840

man

3137

01:50:27,109 --> 01:50:24,960

on the moon he actually put dust

3138

01:50:29,430 --> 01:50:27,119

from a flag or something in his

3139

01:50:31,189 --> 01:50:29,440

paintings

3140

01:50:33,189 --> 01:50:31,199

and i'm actually going to play this uh

3141

01:50:34,149 --> 01:50:33,199

on youtube on his uh would have been his

3142

01:50:36,390 --> 01:50:34,159

80th birthday

3143

01:50:38,310 --> 01:50:36,400

oh i have his paintings i had i had

3144

01:50:39,030 --> 01:50:38,320

dinner with alan a long time ago

3145

01:50:41,830 --> 01:50:39,040

actually

3146

01:50:42,470 --> 01:50:41,840

wow his paintings are amazing very good

3147

01:50:45,030 --> 01:50:42,480

um

3148

01:50:45,750 --> 01:50:45,040

so i i had something really weird happen

3149

01:50:47,270 --> 01:50:45,760

too but

3150

01:50:48,470 --> 01:50:47,280

you probably have had this happen mark

3151
01:50:49,589 --> 01:50:48,480
because you're in the telescope all the

3152
01:50:51,109 --> 01:50:49,599
time but i happen to be at

3153
01:50:53,350 --> 01:50:51,119
the university of new hampshire in their

3154
01:50:56,629 --> 01:50:53,360
observatory and looking up

3155
01:50:58,390 --> 01:50:56,639
um at orion and and all of a sudden

3156
01:51:00,470 --> 01:50:58,400
there was a flash across

3157
01:51:01,830 --> 01:51:00,480
really bright flash and it was a meteor

3158
01:51:03,270 --> 01:51:01,840
that went in front of right in front of

3159
01:51:06,310 --> 01:51:03,280
the telescope what are the odds of that

3160
01:51:06,870 --> 01:51:06,320
i mean does that happen yeah it does it

3161
01:51:08,390 --> 01:51:06,880
does

3162
01:51:10,870 --> 01:51:08,400
here's the other thing too did you ever

3163
01:51:12,310 --> 01:51:10,880

look up in the sky and to you abby too

3164

01:51:15,750 --> 01:51:12,320

ever look up in the sky and you see a

3165

01:51:17,430 --> 01:51:15,760

flash that's just appears and it's gone

3166

01:51:18,950 --> 01:51:17,440

well that's see you better duck because

3167

01:51:20,470 --> 01:51:18,960

that could be a meteor coming right at

3168

01:51:22,790 --> 01:51:20,480

you

3169

01:51:24,229 --> 01:51:22,800

right no trail because it's coming right

3170

01:51:25,830 --> 01:51:24,239

at you of course

3171

01:51:27,910 --> 01:51:25,840

one thing to keep in mind is small

3172

01:51:29,510 --> 01:51:27,920

objects are much more common than big

3173

01:51:31,270 --> 01:51:29,520

objects and

3174

01:51:33,270 --> 01:51:31,280

you know the small ones smaller than the

3175

01:51:34,229 --> 01:51:33,280

size of a person they simply burn up all

3176
01:51:36,870 --> 01:51:34,239
together

3177
01:51:38,310 --> 01:51:36,880
yeah right right it's more fun to warn

3178
01:51:40,229 --> 01:51:38,320
people about having to duck when they

3179
01:51:43,830 --> 01:51:40,239
see something coming right at them

3180
01:51:47,030 --> 01:51:43,840
yeah um avi you you must

3181
01:51:48,550 --> 01:51:47,040
have i mean i emailed you and

3182
01:51:50,950 --> 01:51:48,560
i'm not even going to say how i got your

3183
01:51:53,510 --> 01:51:50,960
email but you must get

3184
01:51:54,470 --> 01:51:53,520
thousands of emails oh yeah since this

3185
01:51:57,270 --> 01:51:54,480
book came out

3186
01:51:58,550 --> 01:51:57,280
right and and how do you i'm so glad you

3187
01:52:01,669 --> 01:51:58,560
responded to me but

3188
01:52:02,790 --> 01:52:01,679

um how do you keep up with all the

3189

01:52:05,350 --> 01:52:02,800

publicity you just mentioned

3190

01:52:07,109 --> 01:52:05,360

earlier you had 300 interviews yeah well

3191

01:52:09,189 --> 01:52:07,119

i wake up at the 4am

3192

01:52:11,430 --> 01:52:09,199

i mean i i take some time to jog every

3193

01:52:14,310 --> 01:52:11,440

morning at 5am in the company of

3194

01:52:14,709 --> 01:52:14,320

birds ducks and rabbits i like nature

3195

01:52:19,750 --> 01:52:14,719

and

3196

01:52:21,669 --> 01:52:19,760

sunrise which is beautiful

3197

01:52:22,870 --> 01:52:21,679

but after that they're starting around

3198

01:52:25,430 --> 01:52:22,880

eight am

3199

01:52:27,750 --> 01:52:25,440

over the past eight weeks and i had back

3200

01:52:28,550 --> 01:52:27,760

to back interviews until seven pm every

3201

01:52:31,109 --> 01:52:28,560

day

3202

01:52:31,589 --> 01:52:31,119

and it's exhausting and i try to you

3203

01:52:34,629 --> 01:52:31,599

know

3204

01:52:36,790 --> 01:52:34,639

some days i couldn't have lunch and i

3205

01:52:37,830 --> 01:52:36,800

try to also answer all the emails that i

3206

01:52:40,390 --> 01:52:37,840

get and

3207

01:52:41,270 --> 01:52:40,400

it's a lot of work but um i think it's

3208

01:52:43,350 --> 01:52:41,280

important

3209

01:52:44,629 --> 01:52:43,360

especially because this issue is

3210

01:52:47,990 --> 01:52:44,639

extremely important and

3211

01:52:50,070 --> 01:52:48,000

you know my publicist in the uk

3212

01:52:52,550 --> 01:52:50,080

uh so i have a team of people that you

3213

01:52:55,589 --> 01:52:52,560

know a a literary agent

3214

01:52:57,830 --> 01:52:55,599

editor and publicists and the publicist

3215

01:52:58,070 --> 01:52:57,840

in the uk was telling me great job avi

3216

01:53:01,830 --> 01:52:58,080

you

3217

01:53:03,910 --> 01:53:01,840

of sales and so forth

3218

01:53:06,070 --> 01:53:03,920

and i said look i'm not marketing the

3219

01:53:06,629 --> 01:53:06,080

book i'm just trying to convey a message

3220

01:53:10,310 --> 01:53:06,639

and

3221

01:53:12,470 --> 01:53:10,320

you know the if the public was not there

3222

01:53:13,990 --> 01:53:12,480

didn't was not resonating with my

3223

01:53:16,310 --> 01:53:14,000

message i wouldn't care less i would

3224

01:53:17,990 --> 01:53:16,320

still deliver the same message so

3225

01:53:19,589 --> 01:53:18,000

you know the book sales could have gone

3226

01:53:23,109 --> 01:53:19,599

down and i wouldn't care

3227

01:53:24,709 --> 01:53:23,119

about it so it's just a byproduct of the

3228

01:53:27,750 --> 01:53:24,719

fact that the public

3229

01:53:29,109 --> 01:53:27,760

uh appreciates the message and um that's

3230

01:53:30,950 --> 01:53:29,119

the way i see it and

3231

01:53:33,669 --> 01:53:30,960

the opportunity of having the interviews

3232

01:53:34,950 --> 01:53:33,679

is to it's a platform for me to express

3233

01:53:37,669 --> 01:53:34,960

these views and

3234

01:53:38,229 --> 01:53:37,679

i i don't you know that's the way i see

3235

01:53:41,830 --> 01:53:38,239

it

3236

01:53:43,510 --> 01:53:41,840

the backlash from the scientific

3237

01:53:47,830 --> 01:53:43,520

community at the same time so

3238

01:53:49,430 --> 01:53:47,840

some of it is quite painful um and

3239

01:53:51,910 --> 01:53:49,440

i have to deal with all of that at the

3240

01:53:52,870 --> 01:53:51,920

same time so you know i'm trying to be

3241

01:53:56,550 --> 01:53:52,880

resilient

3242

01:53:58,390 --> 01:53:56,560

uh trying to to

3243

01:54:00,310 --> 01:53:58,400

you know behave as if i'm made of

3244

01:54:02,149 --> 01:54:00,320

titanium

3245

01:54:03,589 --> 01:54:02,159

well we are out of time but i want to

3246

01:54:04,229 --> 01:54:03,599

thank you so much it's been such a

3247

01:54:06,470 --> 01:54:04,239

pleasure

3248

01:54:07,589 --> 01:54:06,480

really it's been really wonderful thank

3249

01:54:09,270 --> 01:54:07,599

you you

3250

01:54:10,950 --> 01:54:09,280

and i hope you keep getting the message

3251

01:54:13,990 --> 01:54:10,960

out there thank you

3252

01:54:16,470 --> 01:54:14,000

take care and mark thanks a lot

3253

01:54:17,669 --> 01:54:16,480

and we had a run all right it was a

3254

01:54:19,830 --> 01:54:17,679

great run wasn't it

3255

01:54:22,229 --> 01:54:19,840

yeah all right talk to you later all

3256

01:54:25,490 --> 01:54:22,239

right everyone we'll see you next week

3257

01:54:34,830 --> 01:54:25,500

and remember to keep your eyes to the

3258

01:54:43,530 --> 01:54:36,740

sky