



**318: ASTROBIOLOGY & THE FUTURE OF LIFE:  
EVIDENCE, ANALOGY & PREDICTION I**

1  
00:00:05,269 --> 00:00:02,470  
well hello

2  
00:00:08,470 --> 00:00:05,279  
welcome to the session on astrobiology

3  
00:00:10,390 --> 00:00:08,480  
and the future of life evidence analogy

4  
00:00:13,270 --> 00:00:10,400  
and prediction

5  
00:00:15,350 --> 00:00:13,280  
uh i'm very excited with the group

6  
00:00:17,830 --> 00:00:15,360  
people that we have to talk because of

7  
00:00:19,029 --> 00:00:17,840  
the number of people we have very strict

8  
00:00:20,950 --> 00:00:19,039  
timelines so i'm going to give everyone

9  
00:00:22,710 --> 00:00:20,960  
10 minutes if there is a chance for a

10  
00:00:24,390 --> 00:00:22,720  
question at the end of a talk

11  
00:00:25,830 --> 00:00:24,400  
we'll go ahead and have that question

12  
00:00:27,990 --> 00:00:25,840  
but 10 minutes per talk and then we'll

13  
00:00:29,349 --> 00:00:28,000

have an open discussion at the end so i

14

00:00:32,150 --> 00:00:29,359

hope you'll think a little bit about

15

00:00:33,830 --> 00:00:32,160

this question of the future

16

00:00:34,950 --> 00:00:33,840

and how we think about it

17

00:00:37,110 --> 00:00:34,960

well

18

00:00:47,990 --> 00:00:37,120

let's go ahead and turn things over to

19

00:00:54,229 --> 00:00:52,229

hi there can you hear me and see my

20

00:00:56,229 --> 00:00:54,239

screen

21

00:00:58,470 --> 00:00:56,239

we can

22

00:01:00,150 --> 00:00:58,480

good that's good news okay

23

00:01:02,549 --> 00:01:00,160

all right thank you so i'm setting my

24

00:01:05,189 --> 00:01:02,559

timer for the fabled 10 minutes and off

25

00:01:08,149 --> 00:01:05,199

we go so as you can see that is my talk

26

00:01:09,910 --> 00:01:08,159

title um as an anthropologist i am

27

00:01:11,910 --> 00:01:09,920

probably expected to use pictures of

28

00:01:15,190 --> 00:01:11,920

people um but i could not shake the

29

00:01:16,630 --> 00:01:15,200

desire to use trees um partly playing

30

00:01:19,830 --> 00:01:16,640

with the idea of what the tree of life

31

00:01:21,749 --> 00:01:19,840

really looks like um but they're all all

32

00:01:23,590 --> 00:01:21,759

metaphorically meaningful trees not just

33

00:01:25,109 --> 00:01:23,600

pretty inspirational ones if uh if you

34

00:01:28,070 --> 00:01:25,119

want to know more about what they kind

35

00:01:30,870 --> 00:01:28,080

of stand in for just ask me so yeah my

36

00:01:33,190 --> 00:01:30,880

my uh contention is that some uh

37

00:01:34,069 --> 00:01:33,200

anthropological lessons learned the hard

38

00:01:38,149 --> 00:01:34,079

way

39

00:01:39,990 --> 00:01:38,159

might uh aid astrobiological thinking um

40

00:01:41,429 --> 00:01:40,000

when lucas and i first talked about this

41

00:01:43,429 --> 00:01:41,439

session i just thought it was such a

42

00:01:45,429 --> 00:01:43,439

fantastic idea you know that question of

43

00:01:47,429 --> 00:01:45,439

what constitutes good research on the on

44

00:01:48,310 --> 00:01:47,439

the future of life um and i'm really

45

00:01:50,630 --> 00:01:48,320

looking forward to hearing other

46

00:01:53,830 --> 00:01:50,640

people's wisdom on this so i am yeah

47

00:01:56,469 --> 00:01:53,840

very grateful um to lucas for oops i

48

00:01:57,910 --> 00:01:56,479

don't want to annotate my slide um for

49

00:01:59,670 --> 00:01:57,920

suggesting that we do this and also

50

00:02:01,030 --> 00:01:59,680

congratulations to lucas on his recent

51  
00:02:03,030 --> 00:02:01,040  
tenure as the bloomberg chair at the

52  
00:02:04,230 --> 00:02:03,040  
library of congress yay

53  
00:02:05,429 --> 00:02:04,240  
um and thanks to frank and the

54  
00:02:07,429 --> 00:02:05,439  
organizing committees for all that

55  
00:02:09,350 --> 00:02:07,439  
they've done um i particularly

56  
00:02:11,190 --> 00:02:09,360  
appreciate being able to participate in

57  
00:02:12,390 --> 00:02:11,200  
this as a hybrid session i'm really

58  
00:02:13,830 --> 00:02:12,400  
grateful for that

59  
00:02:16,070 --> 00:02:13,840  
um so here's just the overview of what

60  
00:02:18,229 --> 00:02:16,080  
i'm going to try and cover um first i'm

61  
00:02:20,470 --> 00:02:18,239  
just going to recap extremely briefly

62  
00:02:22,550 --> 00:02:20,480  
some key points from lucas

63  
00:02:24,309 --> 00:02:22,560

regarding persistent ascent narratives

64

00:02:26,150 --> 00:02:24,319

um which are a really good jumping off

65

00:02:28,630 --> 00:02:26,160

point for us i'll say a little bit about

66

00:02:32,070 --> 00:02:28,640

my approach to this topic um i've worked

67

00:02:36,790 --> 00:02:33,750

there isn't a lot of time here which

68

00:02:39,110 --> 00:02:36,800

forces me to be very blunt and distilled

69

00:02:40,150 --> 00:02:39,120

but obviously like i've got a lot of

70

00:02:43,430 --> 00:02:40,160

stuff on my researchgate and

71

00:02:45,190 --> 00:02:43,440

academia.edu if you might be interested

72

00:02:46,790 --> 00:02:45,200

in reading some of my extended papers on

73

00:02:48,309 --> 00:02:46,800

this um i'll give you some brief

74

00:02:49,350 --> 00:02:48,319

observations about what anthropologists

75

00:02:51,670 --> 00:02:49,360

and archaeologists have learned the hard

76  
00:02:53,110 --> 00:02:51,680  
way that might be worth knowing about

77  
00:02:55,190 --> 00:02:53,120  
ditching millennial narratives

78  
00:02:57,750 --> 00:02:55,200  
remembering agency unpacking the unified

79  
00:02:59,430 --> 00:02:57,760  
we considering your sources uh being

80  
00:03:00,470 --> 00:02:59,440  
careful about collapse and contact in

81  
00:03:02,390 --> 00:03:00,480  
particular

82  
00:03:04,630 --> 00:03:02,400  
rethinking human animal and human

83  
00:03:07,430 --> 00:03:04,640  
technology relationships and also um

84  
00:03:10,149 --> 00:03:07,440  
actually being in the present um just a

85  
00:03:11,670 --> 00:03:10,159  
note as well that um

86  
00:03:13,190 --> 00:03:11,680  
yeah there's no tidy conclusion to this

87  
00:03:16,309 --> 00:03:13,200  
one but i do have a question about our

88  
00:03:18,550 --> 00:03:16,319

future habits and obsessions i also um

89

00:03:20,149 --> 00:03:18,560

just want to plug a session tomorrow

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00:03:22,149 --> 00:03:20,159

which includes philosophers social

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00:03:23,509 --> 00:03:22,159

scientists and a futurist so you might

92

00:03:24,710 --> 00:03:23,519

want to come out for that

93

00:03:37,990 --> 00:03:24,720

um

94

00:03:40,149 --> 00:03:38,000

yesterday or that you can watch the

95

00:03:41,430 --> 00:03:40,159

recording there's a couple of key points

96

00:03:44,149 --> 00:03:41,440

from it that i would like to highlight

97

00:03:45,750 --> 00:03:44,159

as we begin um i hope that lucas himself

98

00:03:48,470 --> 00:03:45,760

can circle back to these in the panel

99

00:03:50,550 --> 00:03:48,480

discussion at the end um so yeah there's

100

00:03:53,270 --> 00:03:50,560

where you go to see the recording um

101  
00:03:55,910 --> 00:03:53,280  
from his full abstract here so he talked

102  
00:03:57,190 --> 00:03:55,920  
about the traditional ascent narratives

103  
00:03:58,710 --> 00:03:57,200  
um which described a journey in

104  
00:04:01,030 --> 00:03:58,720  
spiritual as well as physical space you

105  
00:04:04,149 --> 00:04:01,040  
remember the nested spheres um kind of

106  
00:04:05,830 --> 00:04:04,159  
medieval notion of the cosmos

107  
00:04:07,750 --> 00:04:05,840  
and then how the copernican revolution

108  
00:04:10,070 --> 00:04:07,760  
decoupled spiritual and physical

109  
00:04:11,910 --> 00:04:10,080  
elevation but he points out that ascent

110  
00:04:14,550 --> 00:04:11,920  
narratives remained

111  
00:04:17,830 --> 00:04:14,560  
they remained popular as biological

112  
00:04:19,509 --> 00:04:17,840  
theories paragraphs of revolution lower

113  
00:04:21,030 --> 00:04:19,519

entire life forms

114

00:04:22,950 --> 00:04:21,040

um of course darwin's theory of

115

00:04:24,870 --> 00:04:22,960

evolution disprove those theories and

116

00:04:26,629 --> 00:04:24,880

and lucas notes that sociologists

117

00:04:27,830 --> 00:04:26,639

observed concrete harm

118

00:04:29,749 --> 00:04:27,840

through theories of more and less

119

00:04:30,950 --> 00:04:29,759

advanced individuals and societies and

120

00:04:34,070 --> 00:04:30,960

i'll have a little more to say about

121

00:04:35,830 --> 00:04:34,080

that later um but despite this lucas

122

00:04:37,350 --> 00:04:35,840

points out many scientists continue to

123

00:04:38,950 --> 00:04:37,360

promote ascent narratives that predict

124

00:04:40,870 --> 00:04:38,960

normative social development through

125

00:04:43,189 --> 00:04:40,880

science radio astronomy and rocketry all

126

00:04:45,030 --> 00:04:43,199

up to interstellar colonization and he

127

00:04:46,150 --> 00:04:45,040

points out that such linear narratives

128

00:04:47,350 --> 00:04:46,160

are inconsistent with modern

129

00:04:48,390 --> 00:04:47,360

evolutionary theory and should be

130

00:04:51,270 --> 00:04:48,400

replaced by narratives of

131

00:04:53,350 --> 00:04:51,280

diversification and local adaptation to

132

00:04:54,870 --> 00:04:53,360

which i say

133

00:04:57,350 --> 00:04:54,880

oh man

134

00:04:59,189 --> 00:04:57,360

i certainly think lewis is right um and

135

00:05:01,510 --> 00:04:59,199

in his extended argument he's got the

136

00:05:03,189 --> 00:05:01,520

evolutionary biology theory a theology

137

00:05:04,710 --> 00:05:03,199

and history i'm just going to try and

138

00:05:06,870 --> 00:05:04,720

weigh in just a smidgen from the social

139

00:05:10,469 --> 00:05:06,880

science angle as we consider how to

140

00:05:12,790 --> 00:05:10,479

think about um the future of life so my

141

00:05:14,070 --> 00:05:12,800

contribution here um

142

00:05:15,590 --> 00:05:14,080

can't see who's in the room i know i

143

00:05:17,350 --> 00:05:15,600

know some of you but probably not all of

144

00:05:19,110 --> 00:05:17,360

you anyway i'm an anthropologist and an

145

00:05:21,270 --> 00:05:19,120

archaeologist um with a background in

146

00:05:22,629 --> 00:05:21,280

archaeological theory um or what we

147

00:05:24,150 --> 00:05:22,639

think we know about the archaeological

148

00:05:26,790 --> 00:05:24,160

past and how we think we know it so

149

00:05:27,909 --> 00:05:26,800

these epistemic questions um which are

150

00:05:29,510 --> 00:05:27,919

really important when you're dealing

151

00:05:31,350 --> 00:05:29,520

with you know tough data sets and

152

00:05:33,590 --> 00:05:31,360

partial recovery and all the things that

153

00:05:35,909 --> 00:05:33,600

archaeology is deliciously plagued with

154

00:05:39,590 --> 00:05:35,919

it's really good stuff to think with

155

00:05:42,550 --> 00:05:39,600

um i also work a lot on scientific and

156

00:05:44,150 --> 00:05:42,560

popular narratives about humanity's past

157

00:05:46,230 --> 00:05:44,160

and the philosophy of science so i teach

158

00:05:47,830 --> 00:05:46,240

archaeology as well as space related

159

00:05:49,830 --> 00:05:47,840

courses and i've been working around

160

00:05:52,230 --> 00:05:49,840

astrobiology and study for nearly 20

161

00:05:53,990 --> 00:05:52,240

years on a variety of themes including

162

00:05:55,670 --> 00:05:54,000

the evolution of intelligence evolution

163

00:05:57,990 --> 00:05:55,680

of humans issues at the intersection of

164

00:05:59,909 --> 00:05:58,000

astrobiology and society including space

165

00:06:01,430 --> 00:05:59,919

ethics post-detection societal impact

166

00:06:03,189 --> 00:06:01,440

issues and stuff like that and i've

167

00:06:04,950 --> 00:06:03,199

organized and participated in quite a

168

00:06:06,870 --> 00:06:04,960

few apps icon sessions and workshops by

169

00:06:08,309 --> 00:06:06,880

now including we did the evolution of

170

00:06:10,790 --> 00:06:08,319

intelligence last time this was in

171

00:06:12,710 --> 00:06:10,800

atlanta um and the rules of uh

172

00:06:13,990 --> 00:06:12,720

social sciences and in master biology

173

00:06:15,909 --> 00:06:14,000

science so if you're interested in any

174

00:06:18,150 --> 00:06:15,919

of that come find me virtually i'll be

175

00:06:19,909 --> 00:06:18,160

happy to chat and answer questions

176

00:06:21,110 --> 00:06:19,919

in relation to seti i just want to say i

177

00:06:22,950 --> 00:06:21,120

do quite a lot these days on

178

00:06:24,629 --> 00:06:22,960

post-detection problems not actually

179

00:06:27,189 --> 00:06:24,639

necessarily because i want to because

180

00:06:29,110 --> 00:06:27,199

but because somebody needs to

181

00:06:31,110 --> 00:06:29,120

but i really really emphasize working on

182

00:06:33,909 --> 00:06:31,120

the human side of that equation not the

183

00:06:35,909 --> 00:06:33,919

eti side personally i personally feel

184

00:06:41,909 --> 00:06:35,919

really dubious about the utility of a

185

00:06:45,510 --> 00:06:43,830

it can be sufficiently right for

186

00:06:46,629 --> 00:06:45,520

predictions to be useful and i think

187

00:06:48,790 --> 00:06:46,639

it's more likely for us to be

188

00:06:50,710 --> 00:06:48,800

detrimentally wrong and in my experience

189

00:06:52,150 --> 00:06:50,720

in archaeology it's really hard to

190

00:06:54,309 --> 00:06:52,160

understand a narrative and rewrite a

191

00:06:55,670 --> 00:06:54,319

story um sometimes you're better off not

192

00:06:57,589 --> 00:06:55,680

having a theory at all than trying to

193

00:06:59,350 --> 00:06:57,599

undo one in the face of evidence so

194

00:07:01,110 --> 00:06:59,360

personally i tend to just hold open that

195

00:07:02,390 --> 00:07:01,120

alien space and just kind of say look if

196

00:07:04,550 --> 00:07:02,400

we don't know anything about them if

197

00:07:05,830 --> 00:07:04,560

indeed they do exist but i do respect

198

00:07:07,589 --> 00:07:05,840

that other researchers have different

199

00:07:09,830 --> 00:07:07,599

approaches and i'm not saying that it's

200

00:07:11,430 --> 00:07:09,840

all useless that's certainly not what

201  
00:07:12,950 --> 00:07:11,440  
i'm contending i'm just explaining why i

202  
00:07:14,790 --> 00:07:12,960  
focus the way that i do personally

203  
00:07:17,670 --> 00:07:14,800  
people expect me to do alien sociology

204  
00:07:19,909 --> 00:07:17,680  
but i don't um i love these

205  
00:07:22,309 --> 00:07:19,919  
philosophical questions about the best

206  
00:07:23,909 --> 00:07:22,319  
ways to think how do we use the data

207  
00:07:25,830 --> 00:07:23,919  
that we have from earth to think through

208  
00:07:28,070 --> 00:07:25,840  
possibilities for life of all kinds

209  
00:07:30,550 --> 00:07:28,080  
elsewhere and how do we do that with

210  
00:07:32,550 --> 00:07:30,560  
maximum wisdom this is actually the very

211  
00:07:34,390 --> 00:07:32,560  
first topic that grabbed me when i

212  
00:07:38,550 --> 00:07:34,400  
attended my first workshop at the seti

213  
00:07:41,270 --> 00:07:38,560

institute in 2003

214

00:07:43,110 --> 00:07:41,280

i was just stunned by how differently

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00:07:45,189 --> 00:07:43,120

people in the city and astrobiology

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00:07:47,270 --> 00:07:45,199

community talk about humans compared to

217

00:07:48,710 --> 00:07:47,280

the way that we do in anthropology so

218

00:07:49,589 --> 00:07:48,720

over the years i've written a few papers

219

00:07:51,189 --> 00:07:49,599

on this

220

00:07:52,790 --> 00:07:51,199

um including social evolution state of

221

00:07:54,469 --> 00:07:52,800

the field and that one i go into

222

00:07:55,830 --> 00:07:54,479

collapse in historical trajectories and

223

00:07:58,150 --> 00:07:55,840

so i mentioned that because it may be of

224

00:07:59,670 --> 00:07:58,160

some news um to people who are in a

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00:08:02,150 --> 00:07:59,680

session if you're looking for something

226

00:08:04,230 --> 00:08:02,160

that addresses that topic from an

227

00:08:05,270 --> 00:08:04,240

astrobiostatic kind of perspective

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00:08:07,350 --> 00:08:05,280

ten thousand revolutions being

229

00:08:09,749 --> 00:08:07,360

technological um impossible predictions

230

00:08:11,189 --> 00:08:09,759

of the unprecedented i think may also be

231

00:08:13,270 --> 00:08:11,199

specifically relevant to some of what

232

00:08:15,670 --> 00:08:13,280

we're talking about here today and then

233

00:08:17,350 --> 00:08:15,680

a couple more the most recent one um how

234

00:08:19,990 --> 00:08:17,360

humans matter now

235

00:08:21,990 --> 00:08:20,000

so this kind of spells out the

236

00:08:23,990 --> 00:08:22,000

relevances of anthropology and

237

00:08:26,710 --> 00:08:24,000

archaeology for the new study how do we

238

00:08:28,550 --> 00:08:26,720

best use those data sets

239

00:08:30,309 --> 00:08:28,560

so in my title

240

00:08:32,550 --> 00:08:30,319

i suggested

241

00:08:34,070 --> 00:08:32,560

that some anthropology whoops where am i

242

00:08:35,110 --> 00:08:34,080

now that's

243

00:08:38,630 --> 00:08:35,120

what

244

00:08:40,389 --> 00:08:38,640

that some anthropological lessons

245

00:08:42,310 --> 00:08:40,399

learned the hard way may uh aid

246

00:08:45,350 --> 00:08:42,320

astrobiological thinking quick

247

00:08:46,630 --> 00:08:45,360

definitions here i'm including archaeo

248

00:08:48,470 --> 00:08:46,640

archaeology paleo anthropology

249

00:08:50,389 --> 00:08:48,480

biological and cultural anthropo astro

250

00:08:52,630 --> 00:08:50,399

bio i'm thinking big picture the hard

251

00:08:54,230 --> 00:08:52,640

way i mean really hard um

252

00:08:56,230 --> 00:08:54,240

anthropologists and archaeologists are

253

00:08:58,070 --> 00:08:56,240

frequently heart sick um partly because

254

00:09:00,070 --> 00:08:58,080

of the destruction of who and what we

255

00:09:02,070 --> 00:09:00,080

study and hold dear

256

00:09:04,630 --> 00:09:02,080

um but also partly because of the weight

257

00:09:07,350 --> 00:09:04,640

of past mistakes in our settler sciences

258

00:09:08,949 --> 00:09:07,360

astrobiology is positively restful by

259

00:09:10,710 --> 00:09:08,959

comparison

260

00:09:13,350 --> 00:09:10,720

though that will change of course when

261

00:09:15,030 --> 00:09:13,360

humans start seriously messing up other

262

00:09:16,710 --> 00:09:15,040

planets

263

00:09:20,070 --> 00:09:16,720

but on the bright side we do have this

264

00:09:21,590 --> 00:09:20,080

ton of data a long disciplinary history

265

00:09:23,269 --> 00:09:21,600

subjects who talk back to us and so

266

00:09:25,110 --> 00:09:23,279

we've become quite good at some things

267

00:09:27,590 --> 00:09:25,120

recently precisely because we were so

268

00:09:29,590 --> 00:09:27,600

bad at them before um

269

00:09:31,269 --> 00:09:29,600

so we're actively remaking the ways that

270

00:09:32,710 --> 00:09:31,279

we look at and understand and talk about

271

00:09:34,630 --> 00:09:32,720

the history of human beings on this

272

00:09:36,389 --> 00:09:34,640

planet we're really really kind of

273

00:09:37,990 --> 00:09:36,399

living that hard work

274

00:09:40,150 --> 00:09:38,000

in in our fields

275

00:09:44,070 --> 00:09:40,160

so for the final couple of minutes here

276

00:09:45,030 --> 00:09:44,080

just very very quick suggestions

277

00:09:46,870 --> 00:09:45,040

first

278

00:09:48,630 --> 00:09:46,880

if you're using human historical and

279

00:09:50,710 --> 00:09:48,640

archaeological record

280

00:09:52,310 --> 00:09:50,720

for raw material examples think through

281

00:09:54,150 --> 00:09:52,320

your ethics carefully

282

00:09:56,710 --> 00:09:54,160

um are you sure you're not

283

00:09:58,310 --> 00:09:56,720

misrepresenting somebody else's past um

284

00:10:00,150 --> 00:09:58,320

it's actually really hard to be sure

285

00:10:02,230 --> 00:10:00,160

about that and if you're using outdated

286

00:10:03,829 --> 00:10:02,240

sources you can better believe that

287

00:10:04,949 --> 00:10:03,839

they're not the best of our current

288

00:10:06,790 --> 00:10:04,959

knowledge

289

00:10:09,430 --> 00:10:06,800

remember that the people of the past had

290

00:10:11,030 --> 00:10:09,440

agency and free will and so do we easy

291

00:10:14,790 --> 00:10:11,040

to allied that

292

00:10:17,590 --> 00:10:14,800

avoid the fiction of the unified we

293

00:10:20,150 --> 00:10:17,600

obviously humans

294

00:10:22,470 --> 00:10:20,160

and biological species their cultures

295

00:10:25,030 --> 00:10:22,480

political situations power and quality

296

00:10:25,630 --> 00:10:25,040

of life vary enormously it matters when

297

00:10:27,670 --> 00:10:25,640

you're talking about the

298

00:10:30,150 --> 00:10:27,680

anti-anthropocene and it matters for

299

00:10:32,230 --> 00:10:30,160

future telling in general this book will

300

00:10:34,150 --> 00:10:32,240

rock your world if you haven't read it

301  
00:10:35,670 --> 00:10:34,160  
amplifying what lucas just said about

302  
00:10:37,110 --> 00:10:35,680  
his scent narratives the problem with

303  
00:10:38,870 --> 00:10:37,120  
them from the social perspective is not

304  
00:10:41,030 --> 00:10:38,880  
just the undesirable corollaries it's

305  
00:10:43,030 --> 00:10:41,040  
the accuracy

306  
00:10:44,949 --> 00:10:43,040  
humanities history shows a festival of

307  
00:10:46,310 --> 00:10:44,959  
possibilities and the millennial story

308  
00:10:48,389 --> 00:10:46,320  
about hunter-gatherers etc that we've

309  
00:10:50,550 --> 00:10:48,399  
been told it's more deeply political and

310  
00:10:53,190 --> 00:10:50,560  
eurocentric than most of us know

311  
00:10:54,949 --> 00:10:53,200  
fantastic book highly recommend it so

312  
00:10:56,870 --> 00:10:54,959  
use the historical record to explore the

313  
00:11:00,310 --> 00:10:56,880

range of possibilities instead and

314

00:11:03,509 --> 00:11:00,320

realize we've lost track of many of them

315

00:11:05,590 --> 00:11:03,519

you're gonna use human history new work

316

00:11:07,430 --> 00:11:05,600

be skeptical of popular synthesis which

317

00:11:10,069 --> 00:11:07,440

are written by authors working beyond

318

00:11:12,150 --> 00:11:10,079

your practical training time out of time

319

00:11:14,470 --> 00:11:12,160

i know that's terrible uh one more

320

00:11:16,230 --> 00:11:14,480

minute so look for wait for read the

321

00:11:17,829 --> 00:11:16,240

critiques by archaeologists medievalists

322

00:11:19,670 --> 00:11:17,839

indigenous scholars gender researchers

323

00:11:21,350 --> 00:11:19,680

etc reach out to your colleagues fellow

324

00:11:23,030 --> 00:11:21,360

students in those fields ask questions

325

00:11:25,030 --> 00:11:23,040

collaborate it's the only way to be on

326

00:11:25,990 --> 00:11:25,040

top of the changing best of our

327

00:11:27,750 --> 00:11:26,000

knowledge

328

00:11:29,190 --> 00:11:27,760

if you must talk about collapse read the

329

00:11:30,230 --> 00:11:29,200

recent archaeological literature i can

330

00:11:32,230 --> 00:11:30,240

promise you you won't think about

331

00:11:34,710 --> 00:11:32,240

collapse the same way anymore please i

332

00:11:36,630 --> 00:11:34,720

beg you release your island alone

333

00:11:37,949 --> 00:11:36,640

question assumptions about your

334

00:11:41,509 --> 00:11:37,959

long-lived

335

00:11:44,310 --> 00:11:41,519

technological et civilizations which

336

00:11:46,150 --> 00:11:44,320

they exist and their degree of pacifism

337

00:11:47,829 --> 00:11:46,160

these assumptions have a lot of

338

00:11:49,350 --> 00:11:47,839

implications they rest on a really

339

00:11:50,790 --> 00:11:49,360

wobbly foundation

340

00:11:52,629 --> 00:11:50,800

if you must talk about human alien

341

00:11:55,350 --> 00:11:52,639

contact be wary of the analogy of the

342

00:11:57,110 --> 00:11:55,360

invasions of the new world

343

00:11:58,550 --> 00:11:57,120

wants to stay on that in no time when

344

00:12:00,310 --> 00:11:58,560

thinking about encountering life on

345

00:12:01,829 --> 00:12:00,320

other worlds be realistic about humans

346

00:12:03,269 --> 00:12:01,839

trap record with other species in

347

00:12:05,509 --> 00:12:03,279

earth's environments

348

00:12:07,190 --> 00:12:05,519

remember human technology relationships

349

00:12:09,350 --> 00:12:07,200

are bogglingly complex often

350

00:12:11,590 --> 00:12:09,360

unpredictable when you just don't know

351  
00:12:12,949 --> 00:12:11,600  
something consider holding that space

352  
00:12:14,870 --> 00:12:12,959  
open instead of filling it with

353  
00:12:17,590 --> 00:12:14,880  
projections unless there's a really good

354  
00:12:19,910 --> 00:12:17,600  
reason to fill it

355  
00:12:21,509 --> 00:12:19,920  
finally astrobiology is future oriented

356  
00:12:22,949 --> 00:12:21,519  
in terms of the discoveries

357  
00:12:24,629 --> 00:12:22,959  
astrobiologists hope to make the

358  
00:12:25,829 --> 00:12:24,639  
possible results and the research

359  
00:12:28,230 --> 00:12:25,839  
timelines

360  
00:12:30,710 --> 00:12:28,240  
and astrobiological imagination propels

361  
00:12:33,190 --> 00:12:30,720  
us to other worlds other times many

362  
00:12:35,430 --> 00:12:33,200  
maybes but there are days when we should

363  
00:12:37,110 --> 00:12:35,440

be more present in the hearing now and i

364

00:12:44,050 --> 00:12:37,120

wonder sometimes

365

00:12:44,060 --> 00:12:49,829

[Applause]

366

00:12:55,190 --> 00:12:51,190

thank you catherine that was awesome

367

00:12:59,350 --> 00:12:57,110

hey everybody thank you

368

00:13:02,949 --> 00:12:59,360

that was wonderful i wish i i'll talk to

369

00:13:05,350 --> 00:13:02,959

you later about writing those down

370

00:13:06,389 --> 00:13:05,360

and i also know the the problems of

371

00:13:09,910 --> 00:13:06,399

having a

372

00:13:11,430 --> 00:13:09,920

uh research question thrust upon you so

373

00:13:13,590 --> 00:13:11,440

this is the one that has been thrust

374

00:13:15,910 --> 00:13:13,600

upon me the the question about how we

375

00:13:17,990 --> 00:13:15,920

can know anything about life as we do

376

00:13:19,829 --> 00:13:18,000

not yet know it it's gonna i'm gonna

377

00:13:21,910 --> 00:13:19,839

frame it in

378

00:13:23,430 --> 00:13:21,920

as the new n equals one problem but to

379

00:13:25,509 --> 00:13:23,440

do that i need to remind you of what the

380

00:13:27,110 --> 00:13:25,519

old n equals one problem is and i i

381

00:13:29,030 --> 00:13:27,120

believe you will recognize it when you

382

00:13:31,030 --> 00:13:29,040

see it it is

383

00:13:32,870 --> 00:13:31,040

uh given our single sample size we are

384

00:13:34,870 --> 00:13:32,880

not justified in concluding whether

385

00:13:37,269 --> 00:13:34,880

features of life on earth hold among

386

00:13:38,629 --> 00:13:37,279

other instances of life in the universe

387

00:13:39,670 --> 00:13:38,639

this has uh

388

00:13:42,389 --> 00:13:39,680

been

389

00:13:44,230 --> 00:13:42,399

said multiple times uh most cleanly by

390

00:13:46,230 --> 00:13:44,240

carol cleland and uh

391

00:13:48,470 --> 00:13:46,240

and we'll talk about that now

392

00:13:50,870 --> 00:13:48,480

essentially it's uh

393

00:13:53,430 --> 00:13:50,880

life on earth all shares common ancestry

394

00:13:57,110 --> 00:13:53,440

and any single individual

395

00:13:59,350 --> 00:13:57,120

does not cleanly represent their um

396

00:14:01,430 --> 00:13:59,360

their population so if you were asked

397

00:14:04,710 --> 00:14:01,440

for example to figure out what mammals

398

00:14:07,350 --> 00:14:04,720

were like based on just a single sample

399

00:14:10,069 --> 00:14:07,360

that is a zebra you might not capture

400

00:14:12,230 --> 00:14:10,079

the breath the diversity the size the

401  
00:14:13,350 --> 00:14:12,240  
scale the the

402  
00:14:15,910 --> 00:14:13,360  
digestion

403  
00:14:19,430 --> 00:14:15,920  
any of the features that actually

404  
00:14:21,110 --> 00:14:19,440  
make up make mammals special

405  
00:14:23,430 --> 00:14:21,120  
this is carol's example and i think it's

406  
00:14:26,629 --> 00:14:23,440  
a useful one so you might think that

407  
00:14:28,470 --> 00:14:26,639  
stripes and hooves are important and you

408  
00:14:30,629 --> 00:14:28,480  
might be wrong about those but you'd be

409  
00:14:32,470 --> 00:14:30,639  
right about multicellularity you might

410  
00:14:34,550 --> 00:14:32,480  
not pick up on the fact that mammals

411  
00:14:36,790 --> 00:14:34,560  
give live birth and have mammary glands

412  
00:14:40,550 --> 00:14:36,800  
especially if you have a single

413  
00:14:41,670 --> 00:14:40,560

zebra to to draw that inference from

414

00:14:45,430 --> 00:14:41,680

so

415

00:14:47,430 --> 00:14:45,440

i i've heard several people say this

416

00:14:49,590 --> 00:14:47,440

most cleanly

417

00:14:51,269 --> 00:14:49,600

carol said this a little while sorry i

418

00:14:52,389 --> 00:14:51,279

have to go back

419

00:14:54,629 --> 00:14:52,399

we know life on earth is

420

00:14:56,550 --> 00:14:54,639

non-representative so this is an image

421

00:14:58,629 --> 00:14:56,560

of poly extremophile

422

00:15:01,829 --> 00:14:58,639

space um

423

00:15:04,790 --> 00:15:01,839

that is the the pressures the depths uh

424

00:15:05,829 --> 00:15:04,800

oh the timing of these is affecting me

425

00:15:07,590 --> 00:15:05,839

um

426

00:15:09,590 --> 00:15:07,600

of life as we as we know it here on

427

00:15:10,310 --> 00:15:09,600

earth i don't know what i expected to

428

00:15:14,629 --> 00:15:10,320

see

429

00:15:18,710 --> 00:15:14,639

so

430

00:15:20,629 --> 00:15:18,720

the n equals one problem

431

00:15:22,790 --> 00:15:20,639

namely that for any sample that you care

432

00:15:24,230 --> 00:15:22,800

about there's going to be one category

433

00:15:26,310 --> 00:15:24,240

that it belongs to that's going to be

434

00:15:27,990 --> 00:15:26,320

salient and important in the case of

435

00:15:30,710 --> 00:15:28,000

zebras like

436

00:15:33,590 --> 00:15:30,720

it would be mammals in the case of life

437

00:15:36,550 --> 00:15:33,600

it would be life in general i argued

438

00:15:38,550 --> 00:15:36,560

against that in print in 2014

439

00:15:41,189 --> 00:15:38,560

the next two that we would recognize new

440

00:15:43,990 --> 00:15:41,199

cases we saw them as belonging to the

441

00:15:45,430 --> 00:15:44,000

same kind that we would recognize life

442

00:15:46,710 --> 00:15:45,440

when we saw it

443

00:15:48,710 --> 00:15:46,720

and that

444

00:15:50,150 --> 00:15:48,720

the kind life is held fixed and we just

445

00:15:52,150 --> 00:15:50,160

need to figure out what properties make

446

00:15:53,590 --> 00:15:52,160

it up those are the questions that i'm

447

00:15:58,310 --> 00:15:53,600

gonna or those are the assumptions that

448

00:16:03,189 --> 00:16:01,030

in the new n equals one problem

449

00:16:05,590 --> 00:16:03,199

which i'm going to formulate like this

450

00:16:07,990 --> 00:16:05,600

life on earth belongs to and provides

451  
00:16:10,150 --> 00:16:08,000  
equivalent evidence for an indefinite

452  
00:16:12,069 --> 00:16:10,160  
number of broader categories none of

453  
00:16:15,269 --> 00:16:12,079  
which are non-controversially equivalent

454  
00:16:17,910 --> 00:16:15,279  
to the life category itself

455  
00:16:20,550 --> 00:16:17,920  
so take life on earth

456  
00:16:22,870 --> 00:16:20,560  
you might be impressed by the lifelike

457  
00:16:24,470 --> 00:16:22,880  
behavior that it exhibits you might be

458  
00:16:26,470 --> 00:16:24,480  
think that the the cause for that is

459  
00:16:28,629 --> 00:16:26,480  
that it isn't evolving by a process of

460  
00:16:30,069 --> 00:16:28,639  
evolution by natural selection you might

461  
00:16:31,829 --> 00:16:30,079  
think that there's some sort of complex

462  
00:16:35,030 --> 00:16:31,839  
information that it is capturing that we

463  
00:16:36,550 --> 00:16:35,040

can uh that that's the the heart of life

464

00:16:39,430 --> 00:16:36,560

you might think that there's some sort

465

00:16:41,350 --> 00:16:39,440

of metabolism going on there's or any of

466

00:16:43,990 --> 00:16:41,360

the other categories we've we've heard

467

00:16:46,710 --> 00:16:44,000

uh time and again from elves everywhere

468

00:16:49,269 --> 00:16:46,720

namely um there's these categories that

469

00:16:51,509 --> 00:16:49,279

we think life on earth

470

00:16:53,829 --> 00:16:51,519

belongs to and and some people say oh

471

00:16:55,430 --> 00:16:53,839

that's just what is what life is and

472

00:16:57,509 --> 00:16:55,440

then we have this debate back and forth

473

00:16:59,350 --> 00:16:57,519

and you know you debate whether mules

474

00:17:01,509 --> 00:16:59,360

can reproduce and whether fire

475

00:17:03,590 --> 00:17:01,519

metabolizes you have this this back and

476  
00:17:05,110 --> 00:17:03,600  
forth where people uh take their

477  
00:17:08,390 --> 00:17:05,120  
preferred

478  
00:17:09,270 --> 00:17:08,400  
view and and argue about it

479  
00:17:10,309 --> 00:17:09,280  
um

480  
00:17:13,270 --> 00:17:10,319  
and so

481  
00:17:15,510 --> 00:17:13,280  
i think going back to the the

482  
00:17:18,069 --> 00:17:15,520  
formulation um

483  
00:17:20,150 --> 00:17:18,079  
when we say we know life on earth is

484  
00:17:22,309 --> 00:17:20,160  
non-representative i mean the question

485  
00:17:23,909 --> 00:17:22,319  
to me immediately is is of what right

486  
00:17:25,909 --> 00:17:23,919  
maybe it's very representative of

487  
00:17:28,309 --> 00:17:25,919  
metabolizing systems but it's not

488  
00:17:29,830 --> 00:17:28,319

representative of evolving systems or

489

00:17:31,270 --> 00:17:29,840

maybe it's very representative of

490

00:17:33,510 --> 00:17:31,280

lifelike behavior but it's not

491

00:17:35,909 --> 00:17:33,520

representative of complex information as

492

00:17:37,270 --> 00:17:35,919

we would expect to see it elsewhere in

493

00:17:39,510 --> 00:17:37,280

the universe

494

00:17:42,070 --> 00:17:39,520

and that i think is the heart of this

495

00:17:44,310 --> 00:17:42,080

um we had this old problem where we had

496

00:17:45,750 --> 00:17:44,320

this k this this example of life here on

497

00:17:48,710 --> 00:17:45,760

earth and we thought we would go and

498

00:17:50,070 --> 00:17:48,720

find the the aliens the martians

499

00:17:51,830 --> 00:17:50,080

and they would we'd know what they would

500

00:17:54,070 --> 00:17:51,840

look like and they would question our

501  
00:17:57,430 --> 00:17:54,080  
assumptions of course sorry the timings

502  
00:17:59,430 --> 00:17:57,440  
are going to be killing me

503  
00:18:01,750 --> 00:17:59,440  
but

504  
00:18:03,590 --> 00:18:01,760  
the new problem is we know that it has

505  
00:18:05,029 --> 00:18:03,600  
properties and these properties are

506  
00:18:05,830 --> 00:18:05,039  
essential

507  
00:18:07,909 --> 00:18:05,840  
to

508  
00:18:09,190 --> 00:18:07,919  
um any number of categories but the

509  
00:18:11,350 --> 00:18:09,200  
question is

510  
00:18:12,789 --> 00:18:11,360  
which category is the one that we care

511  
00:18:14,789 --> 00:18:12,799  
about

512  
00:18:17,110 --> 00:18:14,799  
so to convince you of this i don't think

513  
00:18:18,150 --> 00:18:17,120

i have yet but to convince you let's say

514

00:18:22,070 --> 00:18:18,160

um

515

00:18:24,310 --> 00:18:22,080

we could find any kind of data that we

516

00:18:26,390 --> 00:18:24,320

could find and we can break it down this

517

00:18:28,549 --> 00:18:26,400

way data where very few people agree

518

00:18:30,950 --> 00:18:28,559

which i think has happened numerous

519

00:18:32,870 --> 00:18:30,960

times before these tend to be dismissed

520

00:18:35,029 --> 00:18:32,880

right these um there's a couple of

521

00:18:37,430 --> 00:18:35,039

people like gil levin think thinking

522

00:18:39,510 --> 00:18:37,440

that we've discovered life on mars back

523

00:18:41,750 --> 00:18:39,520

in the 70s

524

00:18:45,029 --> 00:18:41,760

and the scientific community is a

525

00:18:47,669 --> 00:18:45,039

community we can ostracize people

526  
00:18:49,909 --> 00:18:47,679  
and so i think that's sometimes when we

527  
00:18:51,830 --> 00:18:49,919  
have cases where only very few people

528  
00:18:53,430 --> 00:18:51,840  
agree we find it easier just to not talk

529  
00:18:54,710 --> 00:18:53,440  
about some of those

530  
00:18:55,909 --> 00:18:54,720  
examples

531  
00:18:57,830 --> 00:18:55,919  
the questions that i find most

532  
00:19:00,150 --> 00:18:57,840  
interesting are when some experts agree

533  
00:19:02,950 --> 00:19:00,160  
and you have these factions forming

534  
00:19:05,029 --> 00:19:02,960  
where um you find some muck and people

535  
00:19:07,190 --> 00:19:05,039  
say this is a this is life and other

536  
00:19:10,070 --> 00:19:07,200  
people say that's not life

537  
00:19:12,230 --> 00:19:10,080  
if you go to any of the artificial life

538  
00:19:13,830 --> 00:19:12,240

symposium or origins of life conferences

539

00:19:16,630 --> 00:19:13,840

you'll see this this happen again and

540

00:19:18,950 --> 00:19:16,640

again where well-meaning scientists ask

541

00:19:21,270 --> 00:19:18,960

the question yeah but is it life

542

00:19:22,470 --> 00:19:21,280

this is an open question argument when

543

00:19:26,630 --> 00:19:22,480

somebody says

544

00:19:28,390 --> 00:19:26,640

a is b and somebody can reasonably say

545

00:19:29,750 --> 00:19:28,400

but is a b

546

00:19:33,830 --> 00:19:29,760

that means that there's something not

547

00:19:35,510 --> 00:19:33,840

fully captured by that equivalence so

548

00:19:37,430 --> 00:19:35,520

every time

549

00:19:39,430 --> 00:19:37,440

people go with their their preferred

550

00:19:41,590 --> 00:19:39,440

view and they say oh that's just what

551  
00:19:42,470 --> 00:19:41,600  
life is and other people say well it but

552  
00:19:43,909 --> 00:19:42,480  
is it

553  
00:19:45,669 --> 00:19:43,919  
that shows that there's these factions

554  
00:19:46,950 --> 00:19:45,679  
that can easily form

555  
00:19:48,390 --> 00:19:46,960  
the third case is the case that

556  
00:19:50,070 --> 00:19:48,400  
everybody would love right the case

557  
00:19:52,789 --> 00:19:50,080  
where you just find an alien that

558  
00:19:54,710 --> 00:19:52,799  
happens to look exactly like humans

559  
00:19:56,390 --> 00:19:54,720  
but that actually gives us too little

560  
00:19:59,350 --> 00:19:56,400  
information it doesn't help us decide

561  
00:20:00,310 --> 00:19:59,360  
the problem cases later on

562  
00:20:03,110 --> 00:20:00,320  
um

563  
00:20:05,750 --> 00:20:03,120

ideally ideally that's what we find

564

00:20:07,430 --> 00:20:05,760

every time we will always it'll just

565

00:20:09,909 --> 00:20:07,440

bunk us over the head we'll see rabbits

566

00:20:12,230 --> 00:20:09,919

on mars or under the

567

00:20:14,549 --> 00:20:12,240

water and in europa that would be that'd

568

00:20:16,070 --> 00:20:14,559

be problematic um

569

00:20:18,390 --> 00:20:16,080

but i don't think that that's what we

570

00:20:19,750 --> 00:20:18,400

should expect instead i think ways we

571

00:20:22,230 --> 00:20:19,760

can avoid this

572

00:20:25,750 --> 00:20:22,240

is by either voting or just everybody

573

00:20:27,830 --> 00:20:25,760

that we disagree with dying mysteriously

574

00:20:29,590 --> 00:20:27,840

so let's focus on the first one the hope

575

00:20:31,669 --> 00:20:29,600

is that life is going to be something

576

00:20:34,549 --> 00:20:31,679

like chemistry biology is going to be

577

00:20:36,789 --> 00:20:34,559

like chemistry the ancients knew what

578

00:20:40,310 --> 00:20:36,799

the what water was they knew what gold

579

00:20:43,669 --> 00:20:40,320

was um and then came modern atomic

580

00:20:46,470 --> 00:20:43,679

theory and we supplanted this concept of

581

00:20:49,669 --> 00:20:46,480

gold this yellow malleable uh

582

00:20:51,990 --> 00:20:49,679

substance with an atomic number and we

583

00:20:54,070 --> 00:20:52,000

said this explains all of the things

584

00:20:56,470 --> 00:20:54,080

that are interesting about the things

585

00:20:59,350 --> 00:20:56,480

that the ancients were

586

00:21:03,750 --> 00:20:59,360

were calling gold so

587

00:21:04,870 --> 00:21:03,760

we said no no gold just is atomic gold

588

00:21:06,470 --> 00:21:04,880

although i've seen gold a couple of

589

00:21:09,190 --> 00:21:06,480

times in my life i've never counted the

590

00:21:10,390 --> 00:21:09,200

number of protons in a sample right so

591

00:21:12,310 --> 00:21:10,400

so there's a sense in which it's

592

00:21:14,870 --> 00:21:12,320

actually not very useful

593

00:21:17,190 --> 00:21:14,880

and there's another sense in which

594

00:21:19,510 --> 00:21:17,200

there was a choice that chemistry made

595

00:21:21,430 --> 00:21:19,520

and that choice you can see it in the

596

00:21:24,710 --> 00:21:21,440

periodic table the periodic table is

597

00:21:26,390 --> 00:21:24,720

this masterwork this ideal if a science

598

00:21:28,470 --> 00:21:26,400

could have something like the periodic

599

00:21:32,070 --> 00:21:28,480

table

600

00:21:33,669 --> 00:21:32,080

then then it divides reality we think in

601  
00:21:36,230 --> 00:21:33,679  
one of the best ways

602  
00:21:37,909 --> 00:21:36,240  
namely by number of protons

603  
00:21:41,110 --> 00:21:37,919  
but you could have divided it in terms

604  
00:21:43,750 --> 00:21:41,120  
of isotopes or ions or any number of

605  
00:21:45,590 --> 00:21:43,760  
other things you could have uh

606  
00:21:47,190 --> 00:21:45,600  
divided it in terms of the pressures

607  
00:21:50,149 --> 00:21:47,200  
that you would expect the elements to

608  
00:21:53,590 --> 00:21:50,159  
see in the behaviors they would exhibit

609  
00:21:55,990 --> 00:21:53,600  
elements are posits essences are posits

610  
00:21:59,270 --> 00:21:56,000  
they're theoretical posits and in

611  
00:22:02,549 --> 00:21:59,280  
chemistry we convinced the public that

612  
00:22:04,789 --> 00:22:02,559  
that the chemical elements just were

613  
00:22:06,789 --> 00:22:04,799

the elements we cared about and we i

614

00:22:09,510 --> 00:22:06,799

don't expect that we will see that in

615

00:22:11,669 --> 00:22:09,520

biology at all because we already have

616

00:22:13,990 --> 00:22:11,679

the problem cases the cases of rna

617

00:22:16,470 --> 00:22:14,000

worlds of viruses of prions

618

00:22:18,950 --> 00:22:16,480

we already know that the that factions

619

00:22:21,669 --> 00:22:18,960

form we already know that that we're not

620

00:22:23,590 --> 00:22:21,679

going to find the neat case that their

621

00:22:25,190 --> 00:22:23,600

stable property cluster that everybody

622

00:22:28,870 --> 00:22:25,200

will be happy with

623

00:22:30,310 --> 00:22:28,880

so let me just wrap up very quickly

624

00:22:33,270 --> 00:22:30,320

there are an indefinite number of

625

00:22:34,710 --> 00:22:33,280

answers over what the category life is

626

00:22:36,390 --> 00:22:34,720

any evidence we

627

00:22:37,830 --> 00:22:36,400

speaks to an indefinite number of

628

00:22:40,310 --> 00:22:37,840

categories

629

00:22:54,950 --> 00:22:40,320

what is life is a decision it is not a

630

00:23:14,390 --> 00:22:57,830

our next discussion will be david diemer

631

00:23:22,070 --> 00:23:18,630

in 1993 jim casting and his co-authors

632

00:23:23,830 --> 00:23:22,080

came up with the concept of habitability

633

00:23:25,830 --> 00:23:23,840

and the habitable zone

634

00:23:27,830 --> 00:23:25,840

and that's kind of those words have

635

00:23:30,070 --> 00:23:27,840

grown into our language and

636

00:23:31,350 --> 00:23:30,080

very commonly used because they're

637

00:23:33,510 --> 00:23:31,360

useful

638

00:23:37,430 --> 00:23:33,520

however habitability does not

639

00:23:39,990 --> 00:23:37,440

necessarily include the origin of life

640

00:23:43,350 --> 00:23:40,000

and my co-authors and i have

641

00:23:46,390 --> 00:23:43,360

discovered that a word is missing and

642

00:23:48,630 --> 00:23:46,400

the word that we're going to try to use

643

00:23:51,830 --> 00:23:48,640

among ourselves and maybe other people

644

00:23:56,549 --> 00:23:51,840

will find it useful is er ability

645

00:23:59,669 --> 00:23:56,559

now er ability has the combining term er

646

00:24:04,149 --> 00:23:59,679

as original earliest primitive

647

00:24:07,269 --> 00:24:04,159

and eris hecko way back in 1860 use that

648

00:24:10,710 --> 00:24:07,279

same combining term uh to describe

649

00:24:12,549 --> 00:24:10,720

earthline or primordial slime

650

00:24:14,630 --> 00:24:12,559

so if you look over at the image on the

651  
00:24:17,909 --> 00:24:14,640  
right hand side of the screen here's a

652  
00:24:19,590 --> 00:24:17,919  
primitive planet there's no life there

653  
00:24:21,909 --> 00:24:19,600  
is it habitable

654  
00:24:24,310 --> 00:24:21,919  
probably it's got liquid water there

655  
00:24:26,549 --> 00:24:24,320  
depending on how long that liquid water

656  
00:24:29,350 --> 00:24:26,559  
lasts on the planet uh we would call

657  
00:24:33,669 --> 00:24:29,360  
that a habitable planet but can life

658  
00:24:35,990 --> 00:24:33,679  
begin on this planet that involves a

659  
00:24:39,590 --> 00:24:36,000  
large number of other

660  
00:24:42,230 --> 00:24:39,600  
sorts of um considerations

661  
00:24:43,430 --> 00:24:42,240  
so let me just tell you a bit about her

662  
00:24:46,789 --> 00:24:43,440  
ability

663  
00:24:48,950 --> 00:24:46,799

uh it has to do with conditions that

664

00:24:51,830 --> 00:24:48,960

allow life to begin

665

00:24:54,789 --> 00:24:51,840

so down below you see some um

666

00:24:56,789 --> 00:24:54,799

planets so we these are exoplanets

667

00:24:59,830 --> 00:24:56,799

they're artists representations of

668

00:25:02,230 --> 00:24:59,840

course we can't really see them this way

669

00:25:06,070 --> 00:25:02,240

but these are in the habitable zone

670

00:25:09,190 --> 00:25:06,080

around their stars so if water was there

671

00:25:11,350 --> 00:25:09,200

it would probably be liquid water

672

00:25:12,950 --> 00:25:11,360

could life begin

673

00:25:16,070 --> 00:25:12,960

on such planets

674

00:25:18,710 --> 00:25:16,080

not unless there are conditions that

675

00:25:20,630 --> 00:25:18,720

allow them to be herbal

676

00:25:22,630 --> 00:25:20,640

so let me illustrate that with this

677

00:25:25,029 --> 00:25:22,640

little simple diagram

678

00:25:28,789 --> 00:25:25,039

on the left you see a flask with a

679

00:25:32,470 --> 00:25:28,799

bacterial culture medium in it if i add

680

00:25:34,549 --> 00:25:32,480

one bacterial cell a live e coli cell

681

00:25:35,590 --> 00:25:34,559

for instance and come back two days

682

00:25:37,669 --> 00:25:35,600

later

683

00:25:40,470 --> 00:25:37,679

it is loaded with

684

00:25:43,269 --> 00:25:40,480

billions if not trillions of new cells

685

00:25:46,950 --> 00:25:43,279

so certainly there's no doubt that that

686

00:25:50,070 --> 00:25:46,960

is a habitable medium but if we just let

687

00:25:53,510 --> 00:25:50,080

it set there year after year

688

00:25:56,310 --> 00:25:53,520

louis pasteur showed us long ago that it

689

00:25:59,190 --> 00:25:56,320

was no life could begin under these

690

00:26:02,710 --> 00:25:59,200

conditions we would say that that is an

691

00:26:05,750 --> 00:26:02,720

inurable solution just as certain kinds

692

00:26:08,470 --> 00:26:05,760

of planetary conditions would not be

693

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

sufficient for the emergence of life

694

00:26:13,830 --> 00:26:10,559

so what we're doing now is to try to

695

00:26:16,710 --> 00:26:13,840

sort this out and see what we can

696

00:26:19,510 --> 00:26:16,720

put together as a way to

697

00:26:22,149 --> 00:26:19,520

define this word by the kinds of

698

00:26:24,870 --> 00:26:22,159

conditions that are going to be required

699

00:26:26,870 --> 00:26:24,880

for life to emerge so let's just take

700

00:26:28,549 --> 00:26:26,880

some dry scent

701  
00:26:30,230 --> 00:26:28,559  
i think everybody will agree that that's

702  
00:26:32,630 --> 00:26:30,240  
inurable

703  
00:26:35,110 --> 00:26:32,640  
life is not going to begin in dry sand

704  
00:26:37,750 --> 00:26:35,120  
now let's add some water to the dry sand

705  
00:26:40,149 --> 00:26:37,760  
suddenly it becomes habitable because

706  
00:26:41,909 --> 00:26:40,159  
there are certain microorganisms

707  
00:26:44,070 --> 00:26:41,919  
that can make do

708  
00:26:46,070 --> 00:26:44,080  
just with light as an energy source as

709  
00:26:48,549 --> 00:26:46,080  
long as some minerals and certain

710  
00:26:51,430 --> 00:26:48,559  
nutrients are available but certainly

711  
00:26:54,149 --> 00:26:51,440  
would not expect life to begin in wet

712  
00:26:56,310 --> 00:26:54,159  
sand let's add a mixture of organic

713  
00:26:58,710 --> 00:26:56,320

compounds such as we might extract from

714

00:27:02,070 --> 00:26:58,720

a carbonaceous meteorite well this is

715

00:27:05,269 --> 00:27:02,080

getting more complex but if the organic

716

00:27:07,909 --> 00:27:05,279

compounds are chemical equilibrium

717

00:27:10,390 --> 00:27:07,919

nothing would happen no matter how long

718

00:27:13,350 --> 00:27:10,400

we waited so we have to add something

719

00:27:16,310 --> 00:27:13,360

else and of course you guessed it we

720

00:27:19,510 --> 00:27:16,320

must add energy to move those organic

721

00:27:22,389 --> 00:27:19,520

compounds away from equilibrium

722

00:27:25,350 --> 00:27:22,399

now something can happen but it has to

723

00:27:27,909 --> 00:27:25,360

be a relatively specific reaction that

724

00:27:30,950 --> 00:27:27,919

happens if we're on the way to life as

725

00:27:32,830 --> 00:27:30,960

we know it and that is the energy source

726

00:27:35,029 --> 00:27:32,840

must be used to drive

727

00:27:37,990 --> 00:27:35,039

polymerization of some of those

728

00:27:39,909 --> 00:27:38,000

compounds that can be monomers this

729

00:27:42,230 --> 00:27:39,919

would be amino acids

730

00:27:43,990 --> 00:27:42,240

and they we know that those are in the

731

00:27:46,470 --> 00:27:44,000

merchants and meteorite for instance so

732

00:27:49,430 --> 00:27:46,480

they would very likely be available on

733

00:27:53,669 --> 00:27:49,440

the early earth we also know that the

734

00:27:55,269 --> 00:27:53,679

bases nucleobases of dna and rna

735

00:27:56,789 --> 00:27:55,279

some of them at least are in the

736

00:27:59,350 --> 00:27:56,799

merchants of meteorite and other

737

00:28:02,389 --> 00:27:59,360

meteorites so it's likely that there

738

00:28:06,590 --> 00:28:02,399

might be compounds able to polymerize

739

00:28:09,909 --> 00:28:06,600

into peptides short peptides and

740

00:28:11,590 --> 00:28:09,919

oligonucleotides short strands of dna or

741

00:28:14,470 --> 00:28:11,600

rna

742

00:28:16,950 --> 00:28:14,480

then there's got to be one more step and

743

00:28:19,430 --> 00:28:16,960

that is that if we're going to have

744

00:28:23,110 --> 00:28:19,440

cellular life begin there has to be a

745

00:28:25,190 --> 00:28:23,120

way to encapsulate it uh in lipid

746

00:28:27,510 --> 00:28:25,200

boundaries such as what we call

747

00:28:30,070 --> 00:28:27,520

liposomes or lipid vesicles

748

00:28:32,789 --> 00:28:30,080

furthermore you've got to remember that

749

00:28:34,149 --> 00:28:32,799

if you have a milligram of lipid and

750

00:28:38,710 --> 00:28:34,159

turn it into

751  
00:28:41,110 --> 00:28:38,720  
small lipid vesicles we have populations

752  
00:28:42,630 --> 00:28:41,120  
of what we call protocells that have

753  
00:28:44,389 --> 00:28:42,640  
encapsulated

754  
00:28:46,870 --> 00:28:44,399  
some of the polymers

755  
00:28:49,029 --> 00:28:46,880  
every protocell is different at this

756  
00:28:52,310 --> 00:28:49,039  
point from all the rest because there's

757  
00:28:54,630 --> 00:28:52,320  
been nothing directing uh the kinds of

758  
00:28:57,430 --> 00:28:54,640  
polymers that they would encapsulate or

759  
00:29:00,230 --> 00:28:57,440  
the sizes of the protocells so something

760  
00:29:05,110 --> 00:29:00,240  
else has to happen and that is we have

761  
00:29:07,669 --> 00:29:05,120  
to add selection there must be

762  
00:29:09,269 --> 00:29:07,679  
things happening in the environment that

763  
00:29:12,710 --> 00:29:09,279

will select

764

00:29:15,510 --> 00:29:12,720

more robust protocells or protocells

765

00:29:17,990 --> 00:29:15,520

with catalytic activity for example or

766

00:29:19,909 --> 00:29:18,000

pigments that can pick up light energy

767

00:29:23,510 --> 00:29:19,919

and do something with it

768

00:29:25,830 --> 00:29:23,520

so selection can begin in populations of

769

00:29:28,710 --> 00:29:25,840

these protocells and then we would have

770

00:29:32,070 --> 00:29:28,720

the first steps of evolution at this

771

00:29:35,430 --> 00:29:32,080

point if these were on a habitable

772

00:29:37,669 --> 00:29:35,440

planet i would say that the planet also

773

00:29:38,870 --> 00:29:37,679

has the conditions required for her

774

00:29:41,430 --> 00:29:38,880

ability

775

00:29:44,389 --> 00:29:41,440

well there's pretty broadly based uh

776

00:29:47,430 --> 00:29:44,399

sorts of things let's go to a little bit

777

00:29:52,149 --> 00:29:47,440

more specific considerations let's think

778

00:29:53,269 --> 00:29:52,159

about uh the sorts of goldilocks

779

00:29:55,430 --> 00:29:53,279

that would

780

00:29:56,789 --> 00:29:55,440

we would want to have available and

781

00:29:59,669 --> 00:29:56,799

those can be

782

00:30:00,710 --> 00:29:59,679

illustrated by the strips of colors that

783

00:30:06,630 --> 00:30:00,720

you see

784

00:30:09,350 --> 00:30:06,640

having to do with temperature it's if

785

00:30:11,830 --> 00:30:09,360

the temperature is frozen uh life could

786

00:30:14,870 --> 00:30:11,840

not begin in ice if the temperature is

787

00:30:17,510 --> 00:30:14,880

so high to have the solution boiling

788

00:30:20,230 --> 00:30:17,520

that would be difficult to have the

789

00:30:23,190 --> 00:30:20,240

bits and pieces of life come together in

790

00:30:27,190 --> 00:30:23,200

such a way as to get a living system

791

00:30:29,590 --> 00:30:27,200

same is true of dry and wet uh and also

792

00:30:31,669 --> 00:30:29,600

light and dark if there is no light

793

00:30:33,830 --> 00:30:31,679

energy uh the

794

00:30:36,230 --> 00:30:33,840

the organisms would be stuffed at a very

795

00:30:38,549 --> 00:30:36,240

primitive level there's too much light

796

00:30:41,750 --> 00:30:38,559

energy such as uv light

797

00:30:44,470 --> 00:30:41,760

that is damaging to the compounds so

798

00:30:46,870 --> 00:30:44,480

these three strips come together in such

799

00:30:51,269 --> 00:30:46,880

a way that there is what we call an

800

00:30:53,909 --> 00:30:51,279

herbal center and that is a synaquinone

801  
00:30:56,389 --> 00:30:53,919  
or her ability is to have those centers

802  
00:30:59,110 --> 00:30:56,399  
fill up off to the right is a number of

803  
00:31:00,870 --> 00:30:59,120  
specific ionic solutes uh you can go all

804  
00:31:03,190 --> 00:31:00,880  
the way from saturated to dilute

805  
00:31:04,630 --> 00:31:03,200  
solutions and make the same sort of

806  
00:31:06,470 --> 00:31:04,640  
argument

807  
00:31:08,389 --> 00:31:06,480  
so let's now

808  
00:31:11,590 --> 00:31:08,399  
go to

809  
00:31:15,190 --> 00:31:11,600  
the sorts of things that we can

810  
00:31:17,430 --> 00:31:15,200  
add to planets to let them have

811  
00:31:19,029 --> 00:31:17,440  
herbal or ability

812  
00:31:21,830 --> 00:31:19,039  
there are two kinds of factors

813  
00:31:23,750 --> 00:31:21,840

geophysical and geochemical i can only

814

00:31:26,630 --> 00:31:23,760

touch on a few of these in the time that

815

00:31:29,990 --> 00:31:26,640

i have so let's just go down a couple of

816

00:31:33,029 --> 00:31:30,000

lists of geophysical of course the size

817

00:31:34,310 --> 00:31:33,039

of the planetary body is going to be a

818

00:31:36,389 --> 00:31:34,320

part of it

819

00:31:38,870 --> 00:31:36,399

we also have to think of whether the

820

00:31:39,990 --> 00:31:38,880

planet is rotating or not that is going

821

00:31:41,190 --> 00:31:40,000

to have

822

00:31:43,909 --> 00:31:41,200

some

823

00:31:46,470 --> 00:31:43,919

effect on her ability presence or

824

00:31:49,350 --> 00:31:46,480

absence of the moon in my opinion

825

00:31:51,750 --> 00:31:49,360

probably not essential mars doesn't have

826  
00:31:54,789 --> 00:31:51,760  
moons but i think that early mars as you

827  
00:31:57,110 --> 00:31:54,799  
will see is probably herbal planetary

828  
00:31:58,549 --> 00:31:57,120  
core composition that is going to be

829  
00:32:01,990 --> 00:31:58,559  
important because that can drive

830  
00:32:04,710 --> 00:32:02,000  
volcanic activity and that in turn can

831  
00:32:06,149 --> 00:32:04,720  
go a long way toward making a planet

832  
00:32:07,830 --> 00:32:06,159  
herbal

833  
00:32:10,549 --> 00:32:07,840  
i'm just going to go through the rest of

834  
00:32:13,590 --> 00:32:10,559  
these quickly get down to

835  
00:32:15,509 --> 00:32:13,600  
geochemical activity which is the next

836  
00:32:17,590 --> 00:32:15,519  
slide

837  
00:32:19,509 --> 00:32:17,600  
these are a little bit more complex and

838  
00:32:22,470 --> 00:32:19,519

again i have to go through them rather

839

00:32:25,190 --> 00:32:22,480

quickly to finish up the atmosphere

840

00:32:28,630 --> 00:32:25,200

really can't have molecular oxygen as we

841

00:32:30,310 --> 00:32:28,640

do today oxygen's corrosive of the kinds

842

00:32:33,269 --> 00:32:30,320

of molecules that we'd want to have

843

00:32:35,190 --> 00:32:33,279

there for life to begin the water if

844

00:32:37,590 --> 00:32:35,200

it's going to be a reactant has to be

845

00:32:39,990 --> 00:32:37,600

within temperature ranges that support

846

00:32:43,430 --> 00:32:40,000

prebiotic reactions the ionic

847

00:32:45,990 --> 00:32:43,440

concentrations have to be in moderate

848

00:32:47,830 --> 00:32:46,000

they can't be too salty brines or

849

00:32:49,669 --> 00:32:47,840

completely diluted

850

00:32:52,389 --> 00:32:49,679

there has to be of course elemental

851

00:32:55,909 --> 00:32:52,399

cofactors there must be

852

00:32:58,789 --> 00:32:55,919

intermediate ph ranges and there must be

853

00:33:00,230 --> 00:32:58,799

a continuous source of organic compounds

854

00:33:02,470 --> 00:33:00,240

made available

855

00:33:04,149 --> 00:33:02,480

for the rest of these i'll quickly

856

00:33:07,509 --> 00:33:04,159

click through because i want to get down

857

00:33:10,950 --> 00:33:07,519

to mars as an example

858

00:33:11,830 --> 00:33:10,960

dave david we need to wrap up okay

859

00:33:16,070 --> 00:33:11,840

uh

860

00:33:18,950 --> 00:33:16,080

mars began herbal but became inureable

861

00:33:20,870 --> 00:33:18,960

as the atmosphere was eroded

862

00:33:24,070 --> 00:33:20,880

the earth is

863

00:33:27,509 --> 00:33:24,080

began herbal but oddly enough became

864

00:33:30,070 --> 00:33:27,519

also ineurable darwin said it best

865

00:33:32,710 --> 00:33:30,080

atmos the life on earth has become so

866

00:33:35,029 --> 00:33:32,720

complex that it would simply eat the

867

00:33:35,909 --> 00:33:35,039

compounds required for the origin of

868

00:33:37,990 --> 00:33:35,919

life

869

00:33:40,870 --> 00:33:38,000

notice that this paper is coming on

870

00:33:43,190 --> 00:33:40,880

astrobiology in the next few months so

871

00:33:45,350 --> 00:33:43,200

in it we give the details of the

872

00:33:48,560 --> 00:33:45,360

argument i've made here today thank you

873

00:33:54,549 --> 00:33:48,570

for your attention

874

00:34:11,430 --> 00:33:58,230

wonderful our next talk will be

875

00:34:15,669 --> 00:34:12,230

hi

876

00:34:17,750 --> 00:34:15,679

so uh let's go forward to the next light

877

00:34:21,109 --> 00:34:17,760

so we are talking about desert uh

878

00:34:23,669 --> 00:34:21,119

terrestrial deserts are expanding biome

879

00:34:25,990 --> 00:34:23,679

due to the enhanced anthropogenic and

880

00:34:29,750 --> 00:34:26,000

climate factors so there's been tons and

881

00:34:31,829 --> 00:34:29,760

tons of paper talking about this in

882

00:34:34,950 --> 00:34:31,839

particular comparing present-day

883

00:34:37,909 --> 00:34:34,960

bioclimatic information between other

884

00:34:41,030 --> 00:34:37,919

regions like the mojave desert as a part

885

00:34:42,149 --> 00:34:41,040

of the american southwest and atacama

886

00:34:43,829 --> 00:34:42,159

desert

887

00:34:46,950 --> 00:34:43,839

they would

888

00:34:48,470 --> 00:34:46,960

provide information and prediction about

889

00:34:50,790 --> 00:34:48,480

the onset

890

00:34:53,909 --> 00:34:50,800

of high priority conditions in the

891

00:34:55,909 --> 00:34:53,919

american southwest over the next decades

892

00:34:58,150 --> 00:34:55,919

and there's a lot of talking about that

893

00:35:02,230 --> 00:34:58,160

in the ipcc

894

00:35:05,109 --> 00:35:02,240

uh 2022 the sixth one and it's just

895

00:35:06,790 --> 00:35:05,119

humongous document and you can

896

00:35:10,310 --> 00:35:06,800

browse by yourself

897

00:35:12,630 --> 00:35:10,320

um so uh the mojave desert

898

00:35:15,349 --> 00:35:12,640

is uh as in the core part of the

899

00:35:18,150 --> 00:35:15,359

american southwest

900

00:35:22,230 --> 00:35:18,160

and southwest and um

901  
00:35:25,670 --> 00:35:22,240  
encompass california and nevada and is

902  
00:35:29,030 --> 00:35:25,680  
chain bound by the the sierra nevada so

903  
00:35:32,390 --> 00:35:29,040  
high elevation and because the site of

904  
00:35:35,190 --> 00:35:32,400  
uh parallel chains of um

905  
00:35:38,390 --> 00:35:35,200  
of of the mountains it creates a

906  
00:35:41,430 --> 00:35:38,400  
rainshadow exactly also other happens

907  
00:35:44,390 --> 00:35:41,440  
the atacama this is wise as a

908  
00:35:47,589 --> 00:35:44,400  
ice desert and so you can see here

909  
00:35:50,069 --> 00:35:47,599  
the beautifully colored picture from the

910  
00:35:52,069 --> 00:35:50,079  
databasing which is a nice website

911  
00:35:54,230 --> 00:35:52,079  
resources where you can map maximum

912  
00:35:57,109 --> 00:35:54,240  
temperature and uh

913  
00:35:59,510 --> 00:35:57,119

rainfall and reddit index you can really

914

00:36:01,910 --> 00:35:59,520

see that the dead valet at that kind of

915

00:36:03,670 --> 00:36:01,920

super color things is where we get the

916

00:36:07,349 --> 00:36:03,680

highest temperatures

917

00:36:09,510 --> 00:36:07,359

and also we have a high aridity index

918

00:36:13,349 --> 00:36:09,520

uh beside the sierras so it

919

00:36:15,270 --> 00:36:13,359

characterized the dead valet that's a

920

00:36:18,630 --> 00:36:15,280

within the mojave desert not just as a

921

00:36:20,150 --> 00:36:18,640

hard side but just high priority side

922

00:36:21,349 --> 00:36:20,160

which is probably

923

00:36:22,470 --> 00:36:21,359

might not

924

00:36:24,950 --> 00:36:22,480

know

925

00:36:28,790 --> 00:36:24,960

is not very

926

00:36:30,950 --> 00:36:28,800

very well known so um so we have been um

927

00:36:34,710 --> 00:36:30,960

over the past uh

928

00:36:38,630 --> 00:36:34,720

14 15 years uh setting up um

929

00:36:41,349 --> 00:36:38,640

rainfall measurements using hobo rg3

930

00:36:43,829 --> 00:36:41,359

range is a tipping bucket as it allows

931

00:36:45,910 --> 00:36:43,839

for the continuous monitoring or

932

00:36:48,390 --> 00:36:45,920

rainfall and we have been setting up at

933

00:36:50,470 --> 00:36:48,400

the elevation between 650

934

00:36:52,310 --> 00:36:50,480

and 1000 meters why because this is the

935

00:36:55,270 --> 00:36:52,320

mountains this northern part of that

936

00:36:57,990 --> 00:36:55,280

valley so it's kind of sensitive region

937

00:37:00,310 --> 00:36:58,000

where to look at these variations also

938

00:37:02,230 --> 00:37:00,320

not very well known in terms of the uh

939

00:37:04,870 --> 00:37:02,240

the rain precipitation

940

00:37:07,589 --> 00:37:04,880

so these are my favorite possible

941

00:37:10,470 --> 00:37:07,599

curves where we were able to

942

00:37:11,430 --> 00:37:10,480

recover uh two years the data just in

943

00:37:13,990 --> 00:37:11,440

time

944

00:37:17,470 --> 00:37:14,000

and you can see the blue curve which is

945

00:37:20,790 --> 00:37:17,480

the cumulative rain and we can see that

946

00:37:22,710 --> 00:37:20,800

2020 was a super wet year and then the

947

00:37:24,870 --> 00:37:22,720

blue curve becomes flat which means

948

00:37:28,390 --> 00:37:24,880

there's not been rain enough so there's

949

00:37:31,030 --> 00:37:28,400

about more than 20 months that qualifies

950

00:37:35,109 --> 00:37:31,040

almost like in one of the longest period

951  
00:37:38,310 --> 00:37:35,119  
that uh of of drought that we have

952  
00:37:43,109 --> 00:37:38,320  
so here it's so you can see the uh

953  
00:37:45,109 --> 00:37:43,119  
dataset we gather from 2004 to 2022 of

954  
00:37:47,670 --> 00:37:45,119  
the monthly distribution rain where you

955  
00:37:49,750 --> 00:37:47,680  
can see that uh typically in the mojave

956  
00:37:51,750 --> 00:37:49,760  
desert in the dead valley the rain is

957  
00:37:53,990 --> 00:37:51,760  
concentrated between october and

958  
00:37:57,109 --> 00:37:54,000  
february and then we have the summer

959  
00:37:59,910 --> 00:37:57,119  
monsoons and but you can see the tour

960  
00:38:02,710 --> 00:37:59,920  
the the more recent times we have empty

961  
00:38:05,510 --> 00:38:02,720  
space like blank spaces just because

962  
00:38:07,750 --> 00:38:05,520  
we're getting lesser rain bought in

963  
00:38:09,670 --> 00:38:07,760

summer and in winter actually sometimes

964

00:38:11,589 --> 00:38:09,680

more in summer independence that the

965

00:38:14,710 --> 00:38:11,599

years are wet or dry

966

00:38:17,349 --> 00:38:14,720

so um so this is the local local local

967

00:38:19,190 --> 00:38:17,359

data and we can see the total annual for

968

00:38:22,069 --> 00:38:19,200

the same period of time and we have the

969

00:38:25,829 --> 00:38:22,079

dot lines that clearly show there is a

970

00:38:29,030 --> 00:38:25,839

downward trend of we get the minima of

971

00:38:31,750 --> 00:38:29,040

in the rain uh get lesser and lesser

972

00:38:33,990 --> 00:38:31,760

over time and we can also look at the

973

00:38:38,390 --> 00:38:34,000

big picture that the climate regional

974

00:38:40,310 --> 00:38:38,400

data so matches what we see locally okay

975

00:38:44,390 --> 00:38:40,320

and

976

00:38:46,950 --> 00:38:44,400

dry cycles are a common future or

977

00:38:49,270 --> 00:38:46,960

climates but yet the drought cycles

978

00:38:51,829 --> 00:38:49,280

observed over the past 1 years include

979

00:38:54,069 --> 00:38:51,839

dry years with lava's minima this

980

00:38:56,870 --> 00:38:54,079

appears to impact the mojave desert by

981

00:39:00,310 --> 00:38:56,880

default the southwestern

982

00:39:03,190 --> 00:39:00,320

united states and this translate in some

983

00:39:05,829 --> 00:39:03,200

effect and some impact on on the entire

984

00:39:08,710 --> 00:39:05,839

ecosystem from what we can see plants

985

00:39:12,230 --> 00:39:08,720

and vascular plants what we cannot see

986

00:39:13,349 --> 00:39:12,240

um so it's getting hotter the same data

987

00:39:15,510 --> 00:39:13,359

set from

988

00:39:18,790 --> 00:39:15,520

1895

989

00:39:19,990 --> 00:39:18,800  
to 2020 can clearly show that is this

990

00:39:22,950 --> 00:39:20,000  
trend

991

00:39:25,270 --> 00:39:22,960  
about two three celsius degrees that's

992

00:39:26,950 --> 00:39:25,280  
for the mojave region the entire

993

00:39:29,190 --> 00:39:26,960  
regional data set

994

00:39:32,230 --> 00:39:29,200  
and then you can see the kind of like

995

00:39:35,349 --> 00:39:32,240  
spiraling up you know the curve

996

00:39:37,349 --> 00:39:35,359  
also matches with anadactyl observation

997

00:39:39,190 --> 00:39:37,359  
which is means on a doctor perceived by

998

00:39:41,030 --> 00:39:39,200  
people when you talk to the people

999

00:39:43,349 --> 00:39:41,040  
that's been staying long enough in that

1000

00:39:44,230 --> 00:39:43,359  
valley uh that

1001  
00:39:48,230 --> 00:39:44,240  
the

1002  
00:39:49,829 --> 00:39:48,240  
summer temperature where part of those

1003  
00:39:52,790 --> 00:39:49,839  
minima

1004  
00:39:54,710 --> 00:39:52,800  
are becoming hotter so just basically

1005  
00:39:56,790 --> 00:39:54,720  
the ecosystem doesn't have even those

1006  
00:40:00,150 --> 00:39:56,800  
three hours of reliefs where the you

1007  
00:40:02,790 --> 00:40:00,160  
know everybody out eat and feed and uh

1008  
00:40:05,270 --> 00:40:02,800  
you know that is possible uh to continue

1009  
00:40:06,069 --> 00:40:05,280  
life in the desert by adaptation

1010  
00:40:10,630 --> 00:40:06,079  
um

1011  
00:40:21,109 --> 00:40:10,640  
the

1012  
00:40:24,230 --> 00:40:21,119  
last seven years at global level have

1013  
00:40:25,910 --> 00:40:24,240

been the the top hottest so this was a

1014

00:40:27,670 --> 00:40:25,920

breaking news like everything is really

1015

00:40:30,230 --> 00:40:27,680

becoming hotter we can see from the

1016

00:40:32,790 --> 00:40:30,240

local data the sub-regional data

1017

00:40:34,710 --> 00:40:32,800

original data and global data

1018

00:40:37,589 --> 00:40:34,720

so what is the impact on life because

1019

00:40:39,589 --> 00:40:37,599

this is what we really care most is that

1020

00:40:42,069 --> 00:40:39,599

you can see here all those pictures from

1021

00:40:43,910 --> 00:40:42,079

that valley so that valley is arid but

1022

00:40:46,390 --> 00:40:43,920

within the dead valley we have the high

1023

00:40:49,430 --> 00:40:46,400

periodicity gradient so we can see happy

1024

00:40:51,109 --> 00:40:49,440

plants supplements dead bodies uh

1025

00:40:53,990 --> 00:40:51,119

biological models will be never

1026

00:40:57,349 --> 00:40:54,000

recovered and if you stay long enough

1027

00:40:59,510 --> 00:40:57,359

you walk for 15 years over there you can

1028

00:41:02,710 --> 00:40:59,520

perceive like the change

1029

00:41:04,470 --> 00:41:02,720

as we speak so plants die never recover

1030

00:41:06,710 --> 00:41:04,480

when you get the wet

1031

00:41:09,349 --> 00:41:06,720

with with your back

1032

00:41:11,910 --> 00:41:09,359

to understand the impact of the iodine

1033

00:41:14,309 --> 00:41:11,920

transition on the future

1034

00:41:15,990 --> 00:41:14,319

mojave desert we can look at what's

1035

00:41:17,829 --> 00:41:16,000

happened along the latitudinal

1036

00:41:19,990 --> 00:41:17,839

precipitation gradients across the

1037

00:41:22,470 --> 00:41:20,000

atacama desert so as you know the

1038

00:41:25,270 --> 00:41:22,480

atacama desert has been defined as

1039

00:41:26,870 --> 00:41:25,280

mars like soil because in the northern

1040

00:41:30,470 --> 00:41:26,880

part we

1041

00:41:33,349 --> 00:41:30,480

soils were analyzed and beard the the

1042

00:41:36,069 --> 00:41:33,359

very very small amount of

1043

00:41:38,710 --> 00:41:36,079

biologically active microbes

1044

00:41:41,270 --> 00:41:38,720

so we can see that along the rainfall

1045

00:41:44,790 --> 00:41:41,280

the goals gradient goes from north south

1046

00:41:47,510 --> 00:41:44,800

to north we can see the reduction in

1047

00:41:50,470 --> 00:41:47,520

vascular plant density first in turmoil

1048

00:41:52,950 --> 00:41:50,480

desert ecosystem we also have a shift in

1049

00:41:54,150 --> 00:41:52,960

the thermo lesser lashes shrubs and

1050

00:41:56,710 --> 00:41:54,160

insects

1051  
00:42:00,710 --> 00:41:56,720  
in going toward the hypolytic algae and

1052  
00:42:03,270 --> 00:42:00,720  
hypolytic cyanobacteria to places where

1053  
00:42:04,150 --> 00:42:03,280  
going farther north where the biology

1054  
00:42:06,390 --> 00:42:04,160  
wins

1055  
00:42:08,230 --> 00:42:06,400  
in the

1056  
00:42:11,190 --> 00:42:08,240  
and uh and then

1057  
00:42:14,150 --> 00:42:11,200  
toward to lesser than minus two

1058  
00:42:17,030 --> 00:42:14,160  
millimeters the biology lose so this is

1059  
00:42:19,510 --> 00:42:17,040  
what is stopped okay but this gives us a

1060  
00:42:22,069 --> 00:42:19,520  
window in what could happen

1061  
00:42:23,430 --> 00:42:22,079  
when the reddit index drops

1062  
00:42:26,150 --> 00:42:23,440  
so as a

1063  
00:42:28,230 --> 00:42:26,160

open portal in the future so here's the

1064

00:42:30,230 --> 00:42:28,240

micro biomass in

1065

00:42:33,750 --> 00:42:30,240

that valley versus

1066

00:42:37,190 --> 00:42:33,760

so atacama in the hyperid can goes from

1067

00:42:39,750 --> 00:42:37,200

this is atp based only active cells

1068

00:42:40,710 --> 00:42:39,760

let's say 10 to 2 to 10 to 3 cells per

1069

00:42:42,870 --> 00:42:40,720

gram

1070

00:42:45,750 --> 00:42:42,880

then you see the dead valet

1071

00:42:49,349 --> 00:42:45,760

the biomass microbial biomass can go

1072

00:42:51,430 --> 00:42:49,359

from 10 to 3 to 10 to 6 cells per grams

1073

00:42:54,470 --> 00:42:51,440

in barren volcanic materials and

1074

00:42:57,190 --> 00:42:54,480

vegetated clay rich or grounds still

1075

00:42:59,349 --> 00:42:57,200

vegetated still arid and that valley is

1076

00:43:01,670 --> 00:42:59,359

50 times weather than the hyperion core

1077

00:43:04,470 --> 00:43:01,680

the atacama desert is less than two

1078

00:43:08,790 --> 00:43:06,470

so

1079

00:43:10,870 --> 00:43:08,800

okay conclusion in the context of

1080

00:43:12,470 --> 00:43:10,880

american southwest climate evolution

1081

00:43:15,589 --> 00:43:12,480

climate models predict increasing

1082

00:43:18,390 --> 00:43:15,599

varidity of already arid regions

1083

00:43:20,710 --> 00:43:18,400

the valley is already one of the hottest

1084

00:43:23,109 --> 00:43:20,720

dry place on earth within the mojave

1085

00:43:25,510 --> 00:43:23,119

desert an easy climatic and member for

1086

00:43:29,190 --> 00:43:25,520

the entire american southwest

1087

00:43:30,950 --> 00:43:29,200

our 24 2021 precipitation data from two

1088

00:43:32,950 --> 00:43:30,960

northern the valley stations are

1089

00:43:35,430 --> 00:43:32,960

consistent with the western regional

1090

00:43:38,550 --> 00:43:35,440

climate center precipitation data

1091

00:43:40,790 --> 00:43:38,560

highlighting increasing area conditions

1092

00:43:43,430 --> 00:43:40,800

the edification seems driven by

1093

00:43:45,589 --> 00:43:43,440

increasing global air temperature

1094

00:43:47,990 --> 00:43:45,599

within the last seven years ranked as

1095

00:43:51,030 --> 00:43:48,000

the top seven hottest of the century

1096

00:43:53,910 --> 00:43:51,040

higher minimum temperature utter summer

1097

00:43:55,829 --> 00:43:53,920

higher than 35 centigrades decreasing

1098

00:43:58,069 --> 00:43:55,839

rainfall events supporting long-term

1099

00:44:00,390 --> 00:43:58,079

desert vegetation

1100

00:44:02,069 --> 00:44:00,400

and this can affect abundance growth

1101

00:44:04,309 --> 00:44:02,079

diversity and distribution of

1102

00:44:07,430 --> 00:44:04,319

microorganisms this is very important a

1103

00:44:09,829 --> 00:44:07,440

level of soil and productivity over time

1104

00:44:11,910 --> 00:44:09,839

so and bottom line the north south

1105

00:44:14,309 --> 00:44:11,920

precipitation gradient

1106

00:44:17,109 --> 00:44:14,319

across the takama desert represent a

1107

00:44:19,030 --> 00:44:17,119

bioclimate analogue for the iperarida a

1108

00:44:21,109 --> 00:44:19,040

priori transition in the american

1109

00:44:22,790 --> 00:44:21,119

southwest how much time i have that was

1110

00:44:27,190 --> 00:44:22,800

it oh okay

1111

00:44:32,390 --> 00:44:30,309

so if you want 20 seconds okay 22nd is

1112

00:44:35,109 --> 00:44:32,400

that i'm going to traumatize you with

1113

00:44:36,390 --> 00:44:35,119

additional lights this plot is becoming

1114

00:44:39,990 --> 00:44:36,400

this

1115

00:44:41,990 --> 00:44:40,000

tada after flooding in 2017

1116

00:44:44,150 --> 00:44:42,000

the atacama deserts probably is no

1117

00:44:45,990 --> 00:44:44,160

longer mars-like

1118

00:44:48,470 --> 00:44:46,000

and i'm going to traumatize you even

1119

00:44:49,750 --> 00:44:48,480

more bad news for astro biology well

1120

00:44:51,190 --> 00:44:49,760

good news for another type of

1121

00:44:52,790 --> 00:44:51,200

astrobiology

1122

00:44:58,309 --> 00:44:52,800

is what is happening

1123

00:45:03,750 --> 00:45:01,190

2017

1124

00:45:04,710 --> 00:45:03,760

2019

1125

00:45:10,870 --> 00:45:04,720

and

1126

00:45:12,790 --> 00:45:10,880

events that happens basically every year

1127

00:45:14,710 --> 00:45:12,800

and these accounts why we've been seeing

1128

00:45:17,829 --> 00:45:14,720

those speaks in

1129

00:45:20,790 --> 00:45:17,839

the last you know astrobiology driven

1130

00:45:23,010 --> 00:45:20,800

work or we've been doing atacama so

1131

00:45:30,150 --> 00:45:23,020

that's thank you

1132

00:45:40,870 --> 00:45:32,710

wonderful example of recent trends that

1133

00:45:40,880 --> 00:45:44,630

and we have michael wong

1134

00:45:49,510 --> 00:45:46,550

all right hello everyone it's good to

1135

00:45:52,150 --> 00:45:49,520

see you all um thank you for organizing

1136

00:45:54,550 --> 00:45:52,160

lucas this uh this really important and

1137

00:45:56,790 --> 00:45:54,560

fun session um so today i'm excited to

1138

00:45:59,030 --> 00:45:56,800

tell you a little bit about a paper that

1139

00:46:02,150 --> 00:45:59,040

my colleague stuart bartlett and i wrote

1140

00:46:04,550 --> 00:46:02,160

and recently published in jrs interface

1141

00:46:07,109 --> 00:46:04,560

called asymptotic burnout and homo

1142

00:46:09,030 --> 00:46:07,119

homeostatic awakening a new solution to

1143

00:46:11,349 --> 00:46:09,040

the fermi paradox and don't worry if

1144

00:46:13,030 --> 00:46:11,359

these terms are unfamiliar to you we

1145

00:46:14,470 --> 00:46:13,040

literally made them up for this paper

1146

00:46:15,829 --> 00:46:14,480

and i will explain them to you in the

1147

00:46:17,750 --> 00:46:15,839

next 10 minutes

1148

00:46:19,589 --> 00:46:17,760

so uh but let's just start with one that

1149

00:46:22,150 --> 00:46:19,599

you probably have heard of before the

1150

00:46:23,990 --> 00:46:22,160

fermi paradox this is stated as in a

1151

00:46:27,270 --> 00:46:24,000

universe that seems amenable to

1152

00:46:29,430 --> 00:46:27,280

abiogenesis and the evolution of life

1153

00:46:32,390 --> 00:46:29,440

why haven't we seen definitive evidence

1154

00:46:33,990 --> 00:46:32,400

of extraterrestrial civilizations this

1155

00:46:36,550 --> 00:46:34,000

can be sometimes couched in the

1156

00:46:38,550 --> 00:46:36,560

framework of the kardashev scale and the

1157

00:46:40,950 --> 00:46:38,560

question can be posed why don't we have

1158

00:46:42,390 --> 00:46:40,960

any evidence of type 3 civilizations at

1159

00:46:45,430 --> 00:46:42,400

the galactic scale

1160

00:46:48,069 --> 00:46:45,440

in our galaxy or from as far as we know

1161

00:46:49,829 --> 00:46:48,079

in any other galaxy that we can observe

1162

00:46:52,390 --> 00:46:49,839

i think that there are two main things

1163

00:46:55,030 --> 00:46:52,400

missing to this logical framework the

1164

00:46:57,589 --> 00:46:55,040

first is that evolution we now know is

1165

00:47:00,950 --> 00:46:57,599

not only a gradual process but it is

1166

00:47:03,349 --> 00:47:00,960

punctuated by major transitions and two

1167

00:47:05,829 --> 00:47:03,359

that crises or singularities may occur

1168

00:47:08,230 --> 00:47:05,839

at the scale of cities and planets that

1169

00:47:10,230 --> 00:47:08,240

necessitate another major transition and

1170

00:47:11,990 --> 00:47:10,240

i'll explain what i mean by singularity

1171

00:47:15,430 --> 00:47:12,000

in just a sec

1172

00:47:18,069 --> 00:47:15,440

but to me the fermi paradox appears as a

1173

00:47:19,750 --> 00:47:18,079

paradox because there is an implicit

1174

00:47:22,230 --> 00:47:19,760

assumption that the trajectory of

1175

00:47:25,109 --> 00:47:22,240

quote-unquote progress can be

1176  
00:47:26,870 --> 00:47:25,119  
extrapolated from the past but this may

1177  
00:47:28,470 --> 00:47:26,880  
not be so

1178  
00:47:31,109 --> 00:47:28,480  
okay let me talk about the singularity

1179  
00:47:34,710 --> 00:47:31,119  
so this comes from research thinking

1180  
00:47:37,190 --> 00:47:34,720  
about cities as sociological organisms

1181  
00:47:38,829 --> 00:47:37,200  
so there's been well-documented research

1182  
00:47:42,870 --> 00:47:38,839  
showing that

1183  
00:47:45,109 --> 00:47:42,880  
socioeconomic metrics patents gdp r d

1184  
00:47:47,109 --> 00:47:45,119  
total energy usage etc

1185  
00:47:49,670 --> 00:47:47,119  
scale super linearly with city

1186  
00:47:51,510 --> 00:47:49,680  
population so in log log plots like i'm

1187  
00:47:53,589 --> 00:47:51,520  
showing you here on the left hand side

1188  
00:47:54,950 --> 00:47:53,599

you see these linear trends and they

1189

00:47:57,510 --> 00:47:54,960

have a slope of greater than one

1190

00:47:59,829 --> 00:47:57,520

something around 1.15 or so

1191

00:48:01,829 --> 00:47:59,839

and this super linear scaling has been

1192

00:48:03,750 --> 00:48:01,839

attributed to the social nature of

1193

00:48:06,309 --> 00:48:03,760

cities that social networks are driven

1194

00:48:08,790 --> 00:48:06,319

by information flow overlaying on top of

1195

00:48:10,950 --> 00:48:08,800

energy and material networks and so

1196

00:48:12,710 --> 00:48:10,960

there's an analogy to be made between

1197

00:48:14,870 --> 00:48:12,720

cities and stars from astrophysics we

1198

00:48:16,870 --> 00:48:14,880

know that stars are basically nuclear

1199

00:48:19,270 --> 00:48:16,880

reactors where the larger the star is

1200

00:48:20,790 --> 00:48:19,280

the faster it is able to sustain

1201

00:48:22,549 --> 00:48:20,800

nuclear reactions the faster it goes

1202

00:48:24,470 --> 00:48:22,559

through nuclear reactions the same thing

1203

00:48:26,549 --> 00:48:24,480

for cities the larger city is the faster

1204

00:48:27,910 --> 00:48:26,559

the social interactions in cities are in

1205

00:48:31,270 --> 00:48:27,920

fact it's been shown that people

1206

00:48:33,270 --> 00:48:31,280

actually walk faster in larger cities

1207

00:48:35,589 --> 00:48:33,280

can we so so um

1208

00:48:37,670 --> 00:48:35,599

research by bettencourt uh at all have

1209

00:48:39,750 --> 00:48:37,680

shown that super linear scaling can

1210

00:48:41,510 --> 00:48:39,760

drive singularities and so by

1211

00:48:43,190 --> 00:48:41,520

singularity this means an infinite

1212

00:48:45,430 --> 00:48:43,200

amount of n and it's just something that

1213

00:48:48,150 --> 00:48:45,440

scales super linearly population or

1214

00:48:49,670 --> 00:48:48,160

energy usage in a finite amount of time

1215

00:48:51,510 --> 00:48:49,680

and obviously that is not possible

1216

00:48:53,990 --> 00:48:51,520

that's not sustainable or reachable but

1217

00:48:55,829 --> 00:48:54,000

you can push back this singularity or

1218

00:48:57,589 --> 00:48:55,839

crisis further and further in time

1219

00:48:59,510 --> 00:48:57,599

through innovations that reset

1220

00:49:01,109 --> 00:48:59,520

parameters in this general growth

1221

00:49:03,829 --> 00:49:01,119

equation

1222

00:49:05,589 --> 00:49:03,839

now the time scale between necessary

1223

00:49:08,069 --> 00:49:05,599

innovations to keep pushing yourself

1224

00:49:10,790 --> 00:49:08,079

back further in time uh in the future

1225

00:49:12,790 --> 00:49:10,800

before you reach a crisis will decrease

1226

00:49:14,829 --> 00:49:12,800

as time goes on so the pace of

1227

00:49:17,030 --> 00:49:14,839

innovations must

1228

00:49:19,589 --> 00:49:17,040

increase can we

1229

00:49:21,190 --> 00:49:19,599

extrapolate this to the planetary scale

1230

00:49:23,190 --> 00:49:21,200

i think that we might

1231

00:49:24,870 --> 00:49:23,200

because we are currently undergoing a

1232

00:49:26,710 --> 00:49:24,880

major transition in information

1233

00:49:28,549 --> 00:49:26,720

processing right now and we can see the

1234

00:49:30,870 --> 00:49:28,559

evolution of life as a series of major

1235

00:49:32,390 --> 00:49:30,880

transitions uh information processing

1236

00:49:34,790 --> 00:49:32,400

happening at the chemical scale within

1237

00:49:37,270 --> 00:49:34,800

our genomes then in the neuronal

1238

00:49:39,349 --> 00:49:37,280

architecture of our brains and finally

1239

00:49:41,670 --> 00:49:39,359

now in this distributed information

1240

00:49:43,430 --> 00:49:41,680

processing global scale through our

1241

00:49:44,950 --> 00:49:43,440

technology or what caleb scharf might

1242

00:49:45,750 --> 00:49:44,960

call the data ohm

1243

00:49:48,549 --> 00:49:45,760

so

1244

00:49:49,990 --> 00:49:48,559

technology has enabled us to sidestep

1245

00:49:52,549 --> 00:49:50,000

literally sidestep the physical

1246

00:49:54,309 --> 00:49:52,559

limitations of human social interactions

1247

00:49:55,990 --> 00:49:54,319

and remember that it's the social

1248

00:49:59,030 --> 00:49:56,000

interactions that seem to drive the

1249

00:50:01,510 --> 00:49:59,040

super linear scaling of cities and so

1250

00:50:04,710 --> 00:50:01,520

therefore i i think that a planet need

1251  
00:50:06,710 --> 00:50:04,720  
not physically be one global city for a

1252  
00:50:07,990 --> 00:50:06,720  
planetary civilization to behave like

1253  
00:50:09,829 --> 00:50:08,000  
one in other words you don't need to

1254  
00:50:11,589 --> 00:50:09,839  
have coruscant for our star wars fans in

1255  
00:50:14,069 --> 00:50:11,599  
the audience for a planetary

1256  
00:50:16,069 --> 00:50:14,079  
civilization to scale superlinearly

1257  
00:50:18,390 --> 00:50:16,079  
and so the asymptotic burnout hypothesis

1258  
00:50:20,630 --> 00:50:18,400  
is this that a planetary civilization

1259  
00:50:23,190 --> 00:50:20,640  
optimizing for growth and productivity

1260  
00:50:25,109 --> 00:50:23,200  
will march towards a singularity at some

1261  
00:50:28,150 --> 00:50:25,119  
point it will no longer be able to be

1262  
00:50:29,829 --> 00:50:28,160  
sustained by the resources resources

1263  
00:50:31,829 --> 00:50:29,839

that it can

1264

00:50:33,349 --> 00:50:31,839

collect because of the singularity

1265

00:50:35,109 --> 00:50:33,359

infinite amount of energy usage in a

1266

00:50:37,190 --> 00:50:35,119

finite amount of time

1267

00:50:39,030 --> 00:50:37,200

and you know it's a problem that these

1268

00:50:40,790 --> 00:50:39,040

cycles of innovation keep getting faster

1269

00:50:42,870 --> 00:50:40,800

and faster but not only that the

1270

00:50:45,270 --> 00:50:42,880

magnitude of disruptive fluctuations

1271

00:50:48,230 --> 00:50:45,280

that the civilization can impart on

1272

00:50:50,790 --> 00:50:48,240

itself grows as energy and information

1273

00:50:53,670 --> 00:50:50,800

harnessing powers grow so our unlocking

1274

00:50:54,470 --> 00:50:53,680

of fossil fuels has induced climate

1275

00:50:56,790 --> 00:50:54,480

change

1276

00:50:59,030 --> 00:50:56,800

our unlocking of the power of the atom

1277

00:51:01,589 --> 00:50:59,040

has induced the potential for nuclear

1278

00:51:02,950 --> 00:51:01,599

disaster and our unlocking of or the

1279

00:51:04,950 --> 00:51:02,960

invention of the internet and our

1280

00:51:07,910 --> 00:51:04,960

distributive cognitive processes through

1281

00:51:10,710 --> 00:51:07,920

our technology invites what i call a

1282

00:51:12,710 --> 00:51:10,720

disinformation catastrophe

1283

00:51:14,549 --> 00:51:12,720

so is there a way out of this we propose

1284

00:51:16,630 --> 00:51:14,559

a hypothetical scenario called a

1285

00:51:18,150 --> 00:51:16,640

homeostatic awakening which is that

1286

00:51:20,710 --> 00:51:18,160

prior to burnout a planetary

1287

00:51:22,549 --> 00:51:20,720

civilization has the chance to realize

1288

00:51:25,589 --> 00:51:22,559

the trajectory that it is on and affect

1289

00:51:28,069 --> 00:51:25,599

some kind of conscious adjustment to it

1290

00:51:30,390 --> 00:51:28,079

on earth this awakening has required a

1291

00:51:32,230 --> 00:51:30,400

cognitive horizon that only emerged at

1292

00:51:34,150 --> 00:51:32,240

the scale of civilization so we're kind

1293

00:51:36,230 --> 00:51:34,160

of in a catch-22 here we kind of need to

1294

00:51:38,470 --> 00:51:36,240

be a planetary civilization before you

1295

00:51:40,870 --> 00:51:38,480

can realize that civilizations tend to

1296

00:51:43,430 --> 00:51:40,880

set themselves up on these superlinear

1297

00:51:45,270 --> 00:51:43,440

trajectories towards burnout

1298

00:51:46,950 --> 00:51:45,280

therefore the window of opportunity that

1299

00:51:49,190 --> 00:51:46,960

a civilization may have

1300

00:51:51,510 --> 00:51:49,200

could be very short compared to classic

1301  
00:51:53,510 --> 00:51:51,520  
geological and evolutionary time scales

1302  
00:51:55,349 --> 00:51:53,520  
and also the requirements for rewriting

1303  
00:51:57,109 --> 00:51:55,359  
the underlying dynamics of society in

1304  
00:51:59,510 --> 00:51:57,119  
this way are highly unknown because we

1305  
00:52:01,510 --> 00:51:59,520  
haven't done it yet

1306  
00:52:03,349 --> 00:52:01,520  
are there reasons for optimism we

1307  
00:52:05,190 --> 00:52:03,359  
outlined several in the paper i'll give

1308  
00:52:06,950 --> 00:52:05,200  
you one here which is that previous

1309  
00:52:09,270 --> 00:52:06,960  
evolutionary adaptations show that

1310  
00:52:11,670 --> 00:52:09,280  
homeostasis can be achieved when new

1311  
00:52:13,190 --> 00:52:11,680  
levels of organization emerge so for

1312  
00:52:15,109 --> 00:52:13,200  
instance bacteria can do this thing

1313  
00:52:17,030 --> 00:52:15,119

called quorum sensing which is they can

1314

00:52:18,470 --> 00:52:17,040

understand that they're in a very the

1315

00:52:19,990 --> 00:52:18,480

the population of cells around them is

1316

00:52:22,790 --> 00:52:20,000

very dense and that will actually

1317

00:52:24,549 --> 00:52:22,800

trigger a change in their uh gene

1318

00:52:26,069 --> 00:52:24,559

expression that changes their behavior

1319

00:52:28,230 --> 00:52:26,079

as a result of living in a very dense

1320

00:52:29,910 --> 00:52:28,240

environment multicellularity of course

1321

00:52:31,510 --> 00:52:29,920

is a very classic example of how

1322

00:52:33,349 --> 00:52:31,520

homeostasis can be achieved at new

1323

00:52:35,430 --> 00:52:33,359

levels of organization and there's been

1324

00:52:37,270 --> 00:52:35,440

very recent research into how cancer

1325

00:52:40,230 --> 00:52:37,280

cells can be normalized through

1326  
00:52:42,030 --> 00:52:40,240  
bioelectric signaling in the organism

1327  
00:52:43,790 --> 00:52:42,040  
so i wonder is

1328  
00:52:46,390 --> 00:52:43,800  
self-awareness-driven priorities

1329  
00:52:49,190 --> 00:52:46,400  
re-prioritization towards homeostasis

1330  
00:52:52,230 --> 00:52:49,200  
the next transition that life takes or

1331  
00:52:54,630 --> 00:52:52,240  
must take after civilization as we know

1332  
00:52:56,150 --> 00:52:54,640  
it so in graphical form we hypothesize

1333  
00:52:58,390 --> 00:52:56,160  
this that after the origin of the data

1334  
00:53:00,069 --> 00:52:58,400  
ohm or the onset of civilization

1335  
00:53:02,230 --> 00:53:00,079  
civilizations will increase in

1336  
00:53:03,910 --> 00:53:02,240  
population size and either

1337  
00:53:06,069 --> 00:53:03,920  
follow a burnout trajectory after they

1338  
00:53:07,670 --> 00:53:06,079

reach this burnout horizon or realize

1339

00:53:09,510 --> 00:53:07,680

that they're headed towards that and

1340

00:53:11,750 --> 00:53:09,520

then consciously adjust their path

1341

00:53:14,470 --> 00:53:11,760

towards homeostatic reorientation

1342

00:53:16,309 --> 00:53:14,480

meaning that the volume of state space

1343

00:53:18,390 --> 00:53:16,319

that belongs to these hypothetical type

1344

00:53:20,870 --> 00:53:18,400

three civilizations is relatively

1345

00:53:22,790 --> 00:53:20,880

difficult to reach

1346

00:53:24,710 --> 00:53:22,800

so we think that this constitutes a

1347

00:53:26,630 --> 00:53:24,720

novel solution or quote unquote solution

1348

00:53:29,109 --> 00:53:26,640

to the fermi paradox because previous

1349

00:53:31,349 --> 00:53:29,119

solutions often invoke bottlenecks that

1350

00:53:34,230 --> 00:53:31,359

are probability based they're basically

1351  
00:53:35,750 --> 00:53:34,240  
equating a low very very low value to a

1352  
00:53:38,390 --> 00:53:35,760  
drake equation parameter so maybe the

1353  
00:53:40,470 --> 00:53:38,400  
origin of life happens one out of one to

1354  
00:53:41,910 --> 00:53:40,480  
the power 100 times or the origin of

1355  
00:53:43,430 --> 00:53:41,920  
complex life or the origin of

1356  
00:53:45,589 --> 00:53:43,440  
intelligence or civilizations is just

1357  
00:53:47,109 --> 00:53:45,599  
super super rare but our proposal is

1358  
00:53:49,190 --> 00:53:47,119  
different it's that maybe there's an

1359  
00:53:51,190 --> 00:53:49,200  
inevitable barrier emergent from the

1360  
00:53:52,950 --> 00:53:51,200  
dynamics of energy and information flow

1361  
00:53:54,630 --> 00:53:52,960  
within a living system that

1362  
00:53:56,950 --> 00:53:54,640  
civilizations will either meet and face

1363  
00:53:59,190 --> 00:53:56,960

plant into or realize they're headed

1364

00:54:01,109 --> 00:53:59,200

towards and learn to redirect themselves

1365

00:54:02,710 --> 00:54:01,119

around

1366

00:54:04,470 --> 00:54:02,720

so the implications of this one of the

1367

00:54:06,710 --> 00:54:04,480

implications is that the expected

1368

00:54:09,270 --> 00:54:06,720

lifetime of civilizations might be

1369

00:54:11,030 --> 00:54:09,280

bimodal if this hypothesis is borne out

1370

00:54:13,349 --> 00:54:11,040

actually i should note um that this

1371

00:54:15,589 --> 00:54:13,359

whole thought process was spurred by a

1372

00:54:17,430 --> 00:54:15,599

panel that bob hazen invited me to all

1373

00:54:19,109 --> 00:54:17,440

about this expected lifetime of

1374

00:54:20,950 --> 00:54:19,119

civilizations i started thinking what in

1375

00:54:22,309 --> 00:54:20,960

the world can i possibly say about this

1376

00:54:24,470 --> 00:54:22,319

uh but anyway that's an anecdote that's

1377

00:54:28,870 --> 00:54:24,480

probably too long for uh this 10-minute

1378

00:54:30,630 --> 00:54:28,880

talk so bimodal uh distribution to I um

1379

00:54:32,309 --> 00:54:30,640

you know we would expect if this

1380

00:54:34,069 --> 00:54:32,319

hypothesis were true that you would have

1381

00:54:35,990 --> 00:54:34,079

a pile up of civilizations that have

1382

00:54:37,270 --> 00:54:36,000

collapsed due to burnout a pileup of

1383

00:54:39,190 --> 00:54:37,280

civilizations that have achieved

1384

00:54:40,630 --> 00:54:39,200

homeostatic reorientation and virtually

1385

00:54:42,630 --> 00:54:40,640

nothing in between

1386

00:54:44,309 --> 00:54:42,640

in fact jill tarter

1387

00:54:45,750 --> 00:54:44,319

proposed to us that maybe it's the

1388

00:54:47,670 --> 00:54:45,760

detection of extraterrestrial

1389

00:54:50,230 --> 00:54:47,680

intelligence that is what gets you from

1390

00:54:51,670 --> 00:54:50,240

one hump to the other um but i think

1391

00:54:53,430 --> 00:54:51,680

there's there might be a catch to this

1392

00:54:55,750 --> 00:54:53,440

which is that civilizations that are

1393

00:54:57,190 --> 00:54:55,760

about to burn out may be the easiest to

1394

00:54:59,910 --> 00:54:57,200

detect because they are dissipating

1395

00:55:01,589 --> 00:54:59,920

energy at a wildly unsustainable rate

1396

00:55:03,910 --> 00:55:01,599

whereas uh those that have achieved

1397

00:55:05,510 --> 00:55:03,920

homeostatic reorientation may be

1398

00:55:07,510 --> 00:55:05,520

indistinguishable from nature or very

1399

00:55:09,510 --> 00:55:07,520

difficult to detect

1400

00:55:11,349 --> 00:55:09,520

so i'll leave you with my conclusions uh

1401

00:55:13,589 --> 00:55:11,359

the definitions of these hypotheses

1402

00:55:16,309 --> 00:55:13,599

asymptotic burnout homeostatic awakening

1403

00:55:17,990 --> 00:55:16,319

and how this may constitute a novel uh

1404

00:55:20,150 --> 00:55:18,000

solution a resolution to the fermi

1405

00:55:21,990 --> 00:55:20,160

paradox i want to reiterate that this is

1406

00:55:24,470 --> 00:55:22,000

just a hypothesis we're not claiming

1407

00:55:26,309 --> 00:55:24,480

that this is necessarily true or fact

1408

00:55:28,470 --> 00:55:26,319

but just this is just adding another

1409

00:55:30,150 --> 00:55:28,480

idea to the table to spark discussion

1410

00:55:31,910 --> 00:55:30,160

and introspection especially about

1411

00:55:34,230 --> 00:55:31,920

whether or not we are on this kind of

1412

00:55:36,950 --> 00:55:34,240

trajectory and how we can determine if

1413

00:55:38,470 --> 00:55:36,960

we are and what to do if we find that we

1414

00:55:41,430 --> 00:55:38,480

actually are headed on a burnout

1415

00:55:43,670 --> 00:55:41,440

trajectory um i also want to just leave

1416

00:55:45,190 --> 00:55:43,680

you know you with this thought uh

1417

00:55:46,789 --> 00:55:45,200

because this session is titled the

1418

00:55:49,030 --> 00:55:46,799

future of life

1419

00:55:50,390 --> 00:55:49,040

that um you know if we look backwards at

1420

00:55:51,910 --> 00:55:50,400

the evolution of life we realize that

1421

00:55:54,470 --> 00:55:51,920

life has gone through many major

1422

00:55:55,990 --> 00:55:54,480

transitions and complexity organization

1423

00:55:57,430 --> 00:55:56,000

units of selection and information

1424

00:56:01,109 --> 00:55:57,440

processing and that we're going through

1425

00:56:02,950 --> 00:56:01,119

one right now and so it worries me a

1426

00:56:04,789 --> 00:56:02,960

little bit to talk about

1427

00:56:06,549 --> 00:56:04,799

extraterrestrial civilizations

1428

00:56:09,670 --> 00:56:06,559

colonizing the galaxy in this

1429

00:56:11,910 --> 00:56:09,680

unsustainable manner uh when you know

1430

00:56:13,589 --> 00:56:11,920

that's that's based on simply that

1431

00:56:16,069 --> 00:56:13,599

that's what you know our ancestors have

1432

00:56:18,789 --> 00:56:16,079

done here on our planet thank you very

1433

00:56:18,799 --> 00:56:24,230

awesome thank you

1434

00:56:33,750 --> 00:56:26,630

and our next presentation will be by cat

1435

00:56:38,789 --> 00:56:36,150

um hello i'm super excited to be here so

1436

00:56:41,030 --> 00:56:38,799

my name's kat gillen um i'm from durham

1437

00:56:42,789 --> 00:56:41,040

university i just started phd there

1438

00:56:44,870 --> 00:56:42,799

as part of a project called the eureka

1439

00:56:46,470 --> 00:56:44,880

project which stands for exploring

1440

00:56:47,910 --> 00:56:46,480

uncertainty and risk in contemporary

1441

00:56:48,870 --> 00:56:47,920

astrobiology

1442

00:56:50,230 --> 00:56:48,880

so

1443

00:56:52,390 --> 00:56:50,240

today i'm going to talk about the rather

1444

00:56:55,270 --> 00:56:52,400

salaciously named talk how to be a

1445

00:56:57,670 --> 00:56:55,280

rational astrobiologist so i will be

1446

00:56:59,430 --> 00:56:57,680

talking about a particular type of bias

1447

00:57:01,829 --> 00:56:59,440

exists widespread in the psychology of

1448

00:57:03,750 --> 00:57:01,839

reasoning so that's called my side bias

1449

00:57:05,829 --> 00:57:03,760

and i will discuss as there's evidence

1450

00:57:06,789 --> 00:57:05,839

that this might exist in astrobiology

1451  
00:57:09,030 --> 00:57:06,799  
and i'll discuss some of the

1452  
00:57:09,829 --> 00:57:09,040  
implications of this

1453  
00:57:15,750 --> 00:57:09,839  
so

1454  
00:57:17,670 --> 00:57:15,760  
inherently uncertain indicators of life

1455  
00:57:19,670 --> 00:57:17,680  
so even if you get the kind of smoking

1456  
00:57:22,710 --> 00:57:19,680  
gun bio signature like an oxygen methane

1457  
00:57:24,069 --> 00:57:22,720  
disequilibrium around a planet you still

1458  
00:57:26,309 --> 00:57:24,079  
wouldn't change your probability that

1459  
00:57:28,950 --> 00:57:26,319  
there's a life on that planet to 100

1460  
00:57:31,430 --> 00:57:28,960  
so there is a need for a mechanism for

1461  
00:57:32,950 --> 00:57:31,440  
updating your prior belief based on this

1462  
00:57:34,870 --> 00:57:32,960  
uncertain information and usually

1463  
00:57:36,870 --> 00:57:34,880

bayesian statistics is suggested to do

1464

00:57:37,829 --> 00:57:36,880

this and it's widely explored in the

1465

00:57:39,589 --> 00:57:37,839

literature

1466

00:57:40,950 --> 00:57:39,599

uh like the main benefit of this well

1467

00:57:42,870 --> 00:57:40,960

one of the main benefits is that if you

1468

00:57:45,430 --> 00:57:42,880

do follow bayesian statistics you'll be

1469

00:57:47,030 --> 00:57:45,440

protected from violating the axioms of

1470

00:57:49,270 --> 00:57:47,040

probability

1471

00:57:51,349 --> 00:57:49,280

so that's great but the question remains

1472

00:57:53,510 --> 00:57:51,359

of whether astrobiology biologists do

1473

00:57:55,910 --> 00:57:53,520

actually update their beliefs in

1474

00:57:57,190 --> 00:57:55,920

compliance with bayesian updating

1475

00:58:00,150 --> 00:57:57,200

so

1476  
00:58:02,470 --> 00:58:00,160  
in a paper release last year baines and

1477  
00:58:03,430 --> 00:58:02,480  
pakovsky attempted to answer just this

1478  
00:58:04,789 --> 00:58:03,440  
question

1479  
00:58:08,710 --> 00:58:04,799  
so

1480  
00:58:10,630 --> 00:58:08,720  
for the greaves at our paper detecting

1481  
00:58:12,549 --> 00:58:10,640  
phosphine in the cloud decks of venus

1482  
00:58:14,950 --> 00:58:12,559  
and so interestingly they sent out a

1483  
00:58:16,950 --> 00:58:14,960  
survey before the release of this paper

1484  
00:58:18,069 --> 00:58:16,960  
the grieves that our paper

1485  
00:58:20,230 --> 00:58:18,079  
asking

1486  
00:58:22,230 --> 00:58:20,240  
a bunch of astrobiologists and also

1487  
00:58:24,230 --> 00:58:22,240  
researchers in related fields what they

1488  
00:58:25,750 --> 00:58:24,240

thought the probability of finding life

1489

00:58:28,950 --> 00:58:25,760

on these five bodies were so we've got

1490

00:58:29,990 --> 00:58:28,960

enceladus europa mars titan and venus

1491

00:58:31,829 --> 00:58:30,000

and then that's what we've got in the

1492

00:58:33,190 --> 00:58:31,839

first survey there we've got the results

1493

00:58:34,789 --> 00:58:33,200

and then the paper came out and then

1494

00:58:36,470 --> 00:58:34,799

they sent out a second survey asking the

1495

00:58:38,230 --> 00:58:36,480

same question

1496

00:58:39,910 --> 00:58:38,240

so yeah we can see that there's a

1497

00:58:42,069 --> 00:58:39,920

statistically significant change for

1498

00:58:43,750 --> 00:58:42,079

venus uh just looking at the first

1499

00:58:45,910 --> 00:58:43,760

survey the respondents were super

1500

00:58:47,750 --> 00:58:45,920

skeptical at first

1501  
00:58:49,430 --> 00:58:47,760  
well nearly half of the respondents said

1502  
00:58:50,789 --> 00:58:49,440  
there was a zero percent chance and this

1503  
00:58:54,069 --> 00:58:50,799  
is kind of trickled up with the second

1504  
00:58:56,309 --> 00:58:54,079  
survey so there has been an update in uh

1505  
00:58:58,309 --> 00:58:56,319  
the respondent's probabilities for life

1506  
00:59:01,510 --> 00:58:58,319  
on venus presumably due to this paper

1507  
00:59:03,190 --> 00:59:01,520  
that's come out um so yeah is this a

1508  
00:59:04,630 --> 00:59:03,200  
bayesian update though can we can we say

1509  
00:59:06,150 --> 00:59:04,640  
this fits with it within a bayesian

1510  
00:59:08,230 --> 00:59:06,160  
model

1511  
00:59:10,789 --> 00:59:08,240  
so that's what they then explored in

1512  
00:59:12,789 --> 00:59:10,799  
this paper um and ultimately they

1513  
00:59:15,030 --> 00:59:12,799

concluded no so

1514

00:59:16,549 --> 00:59:15,040

yeah baines and pakovsky did a uh

1515

00:59:18,470 --> 00:59:16,559

principal components analysis which

1516

00:59:21,349 --> 00:59:18,480

we've got there in that graph

1517

00:59:22,950 --> 00:59:21,359

um basically they took a they took four

1518

00:59:25,829 --> 00:59:22,960

thousand combinations of prior

1519

00:59:28,549 --> 00:59:25,839

probabilities um to allow for this whole

1520

00:59:30,309 --> 00:59:28,559

range of different priors um and saw

1521

00:59:31,670 --> 00:59:30,319

whether any of those would fit within a

1522

00:59:34,150 --> 00:59:31,680

bayesian model for what the respondent

1523

00:59:36,150 --> 00:59:34,160

said and they found that no so the blue

1524

00:59:39,109 --> 00:59:36,160

dots they are the bayesian models and

1525

00:59:40,789 --> 00:59:39,119

the red dot there that is the um

1526  
00:59:42,069 --> 00:59:40,799  
what the respondents of the survey came

1527  
00:59:44,069 --> 00:59:42,079  
out as

1528  
00:59:45,829 --> 00:59:44,079  
okay so interestingly they did find that

1529  
00:59:48,150 --> 00:59:45,839  
if you artificially double the two

1530  
00:59:49,589 --> 00:59:48,160  
percent bin so i'll just go back like if

1531  
00:59:50,950 --> 00:59:49,599  
you look in the second survey the two

1532  
00:59:53,109 --> 00:59:50,960  
percent bin is that kind of orangey

1533  
00:59:55,109 --> 00:59:53,119  
yellow one then you do bump up the

1534  
00:59:57,670 --> 00:59:55,119  
results to within a bayesian regime but

1535  
00:59:58,870 --> 00:59:57,680  
uh this is just artificially done so

1536  
01:00:00,230 --> 00:59:58,880  
ultimately they found that the

1537  
01:00:03,430 --> 01:00:00,240  
respondents were not increasing their

1538  
01:00:05,109 --> 01:00:03,440

credence enough uh based on the the

1539

01:00:06,230 --> 01:00:05,119

apparent bio signature

1540

01:00:07,910 --> 01:00:06,240

so they concluded that they weren't

1541

01:00:10,150 --> 01:00:07,920

rational so that they weren't bayesian

1542

01:00:12,549 --> 01:00:10,160

but they were nonetheless rational

1543

01:00:14,630 --> 01:00:12,559

okay so this is something i would now

1544

01:00:15,430 --> 01:00:14,640

like to challenge just that second bit

1545

01:00:17,670 --> 01:00:15,440

so

1546

01:00:19,510 --> 01:00:17,680

um i propose instead that yeah indeed

1547

01:00:21,030 --> 01:00:19,520

the the astrobiologists did not fit

1548

01:00:22,549 --> 01:00:21,040

within a bayesian model but they might

1549

01:00:23,510 --> 01:00:22,559

instead have been exhibiting my side

1550

01:00:24,230 --> 01:00:23,520

bias

1551

01:00:26,710 --> 01:00:24,240

so

1552

01:00:27,829 --> 01:00:26,720

nice bias it is a well documented

1553

01:00:30,630 --> 01:00:27,839

phenomenon in the psychology of

1554

01:00:32,950 --> 01:00:30,640

reasoning it exists in many fields

1555

01:00:35,589 --> 01:00:32,960

and just in short if you're my side bias

1556

01:00:37,109 --> 01:00:35,599

then if your probabilities exist towards

1557

01:00:38,549 --> 01:00:37,119

the extreme so maybe you strongly

1558

01:00:40,630 --> 01:00:38,559

believe something or strongly don't

1559

01:00:42,309 --> 01:00:40,640

believe something then you will weigh

1560

01:00:44,150 --> 01:00:42,319

selectively weigh evidence so more

1561

01:00:45,750 --> 01:00:44,160

specifically if you really strongly

1562

01:00:47,349 --> 01:00:45,760

believe something and you hear evidence

1563

01:00:49,030 --> 01:00:47,359

that says otherwise then you'll see that

1564

01:00:51,109 --> 01:00:49,040

as a bad argument and you'll underweight

1565

01:00:52,549 --> 01:00:51,119

that evidence whereas if you get if you

1566

01:00:53,910 --> 01:00:52,559

hear evidence which confirms your

1567

01:00:55,430 --> 01:00:53,920

existing prior then you're going to

1568

01:00:57,750 --> 01:00:55,440

overweigh that evidence

1569

01:00:59,349 --> 01:00:57,760

and sort of double down on your beliefs

1570

01:01:01,349 --> 01:00:59,359

and then yeah if you just have 0.5

1571

01:01:03,030 --> 01:01:01,359

probability you won't exhibit my side

1572

01:01:04,950 --> 01:01:03,040

bias and it gets stronger towards the

1573

01:01:07,190 --> 01:01:04,960

extremes

1574

01:01:09,270 --> 01:01:07,200

so just looking back at the data then if

1575

01:01:12,230 --> 01:01:09,280

we just see how if this does indeed fit

1576  
01:01:14,150 --> 01:01:12,240  
more accurately fit the data so yeah we

1577  
01:01:15,990 --> 01:01:14,160  
can see with the first survey

1578  
01:01:17,910 --> 01:01:16,000  
the respondents were very

1579  
01:01:19,670 --> 01:01:17,920  
towards the extreme like

1580  
01:01:21,910 --> 01:01:19,680  
most people said zero or one percent

1581  
01:01:23,829 --> 01:01:21,920  
chance of finding life on venus and so

1582  
01:01:25,990 --> 01:01:23,839  
my side buyers will predict that if

1583  
01:01:28,230 --> 01:01:26,000  
these respondents hear information that

1584  
01:01:30,630 --> 01:01:28,240  
says otherwise they will instantly view

1585  
01:01:32,950 --> 01:01:30,640  
that information as a bad argument and

1586  
01:01:34,789 --> 01:01:32,960  
so won't incorporate that in a way that

1587  
01:01:35,750 --> 01:01:34,799  
bayesian statistics would compel that

1588  
01:01:37,030 --> 01:01:35,760

they do

1589

01:01:39,190 --> 01:01:37,040

so therefore they wouldn't increase

1590

01:01:41,670 --> 01:01:39,200

their credence enough which indeed was

1591

01:01:43,910 --> 01:01:41,680

what the banes and pikowsky paper uh

1592

01:01:47,190 --> 01:01:43,920

because paper showed so

1593

01:01:49,510 --> 01:01:47,200

that's great okay so if indeed uh

1594

01:01:50,789 --> 01:01:49,520

astrobiologists are exhibiting mice bias

1595

01:01:53,109 --> 01:01:50,799

what would be the undesirable

1596

01:01:55,270 --> 01:01:53,119

implications of this so the the main

1597

01:01:57,750 --> 01:01:55,280

concern with my side bias is that

1598

01:01:59,430 --> 01:01:57,760

updating is non-commutative so this just

1599

01:02:00,870 --> 01:01:59,440

means that if you it matters what order

1600

01:02:04,150 --> 01:02:00,880

you learn evidence in

1601  
01:02:06,069 --> 01:02:04,160  
so i've just got a sort of figure here

1602  
01:02:08,470 --> 01:02:06,079  
whereby say you start off with a

1603  
01:02:10,630 --> 01:02:08,480  
probability of 0.5 then you hear

1604  
01:02:12,150 --> 01:02:10,640  
information which bumps you up you will

1605  
01:02:13,910 --> 01:02:12,160  
then become biased against information

1606  
01:02:15,510 --> 01:02:13,920  
that's going to bring you back down so

1607  
01:02:17,589 --> 01:02:15,520  
if this was just a bayesian agent they

1608  
01:02:20,470 --> 01:02:17,599  
would end up back down at 0.5 for their

1609  
01:02:22,069 --> 01:02:20,480  
final posterior but yeah a my side bias

1610  
01:02:23,990 --> 01:02:22,079  
agent we get this divergence because

1611  
01:02:25,510 --> 01:02:24,000  
conversely if you heard the negative

1612  
01:02:26,630 --> 01:02:25,520  
information first you become biased

1613  
01:02:29,029 --> 01:02:26,640

against the information that brings you

1614

01:02:31,109 --> 01:02:29,039

back up so yeah you get this splitting

1615

01:02:33,349 --> 01:02:31,119

of views and it and it depends on what

1616

01:02:34,630 --> 01:02:33,359

order you hear your evidence in

1617

01:02:41,109 --> 01:02:34,640

so

1618

01:02:43,029 --> 01:02:41,119

was a lot of buzz about finding life on

1619

01:02:46,230 --> 01:02:43,039

mars and then the viking land mission

1620

01:02:49,029 --> 01:02:46,240

came back somewhat negative but then um

1621

01:02:51,750 --> 01:02:49,039

in 2006 there was this evidence that the

1622

01:02:53,349 --> 01:02:51,760

the tv gc ms experiments were not

1623

01:02:55,349 --> 01:02:53,359

actually sensitive enough to pick up on

1624

01:02:57,510 --> 01:02:55,359

some of the organic material so they had

1625

01:02:58,710 --> 01:02:57,520

like taken sample soils around earth

1626

01:03:00,870 --> 01:02:58,720

which are known to contain organic

1627

01:03:04,230 --> 01:03:00,880

material and it did not pick up on on

1628

01:03:05,990 --> 01:03:04,240

this so this should somewhat uh negate

1629

01:03:07,990 --> 01:03:06,000

some of the results from the land

1630

01:03:09,349 --> 01:03:08,000

emission but um

1631

01:03:10,789 --> 01:03:09,359

but yeah

1632

01:03:12,549 --> 01:03:10,799

agents might still be biased against

1633

01:03:14,309 --> 01:03:12,559

that so it is very important to just be

1634

01:03:15,829 --> 01:03:14,319

aware of these biases

1635

01:03:17,750 --> 01:03:15,839

in astrobiology particularly also

1636

01:03:19,349 --> 01:03:17,760

because in astrobiology you often can't

1637

01:03:21,270 --> 01:03:19,359

take repeat experiments

1638

01:03:22,470 --> 01:03:21,280

for the same data point so

1639

01:03:24,150 --> 01:03:22,480

you can get entrenched and it's

1640

01:03:26,150 --> 01:03:24,160

difficult to recover from initial bad

1641

01:03:27,430 --> 01:03:26,160

information

1642

01:03:29,589 --> 01:03:27,440

okay so

1643

01:03:32,069 --> 01:03:29,599

just to conclude so there exists

1644

01:03:34,870 --> 01:03:32,079

evidence astrobiologists like many other

1645

01:03:36,630 --> 01:03:34,880

researchers exhibit my side bias and so

1646

01:03:37,670 --> 01:03:36,640

this has some undesirable effects

1647

01:03:39,750 --> 01:03:37,680

predominantly due to the

1648

01:03:43,190 --> 01:03:39,760

non-commutativity of evidence

1649

01:03:44,950 --> 01:03:43,200

so that puts a bias on early evidence

1650

01:03:46,549 --> 01:03:44,960

and can lead to a lag in theory and

1651

01:03:48,630 --> 01:03:46,559

belief change

1652

01:03:50,230 --> 01:03:48,640

so yeah so in summary agents should

1653

01:03:53,750 --> 01:03:50,240

strive to comply with the orthodox

1654

01:03:55,430 --> 01:03:53,760

bayesian statistics wherever possible

1655

01:04:00,230 --> 01:03:55,440

and yep that was my talk thank you very

1656

01:04:02,470 --> 01:04:01,270

all right

1657

01:04:04,789 --> 01:04:02,480

i think we have

1658

01:04:07,190 --> 01:04:04,799

we have time for one question for cat

1659

01:04:08,950 --> 01:04:07,200

because she was so uh

1660

01:04:11,029 --> 01:04:08,960

does anyone have a question and i'd

1661

01:04:12,390 --> 01:04:11,039

invite the the panel folks to come up

1662

01:04:17,910 --> 01:04:12,400

and and join us while we take that

1663

01:04:23,430 --> 01:04:21,109

hi uh cole mathis uh santa fe institute

1664

01:04:25,990 --> 01:04:23,440

and arizona state university um really

1665

01:04:28,230 --> 01:04:26,000

interesting talk i'm curious about the

1666

01:04:30,870 --> 01:04:28,240

analysis that the bane's paper did on

1667

01:04:33,029 --> 01:04:30,880

the sort of bayesian update and

1668

01:04:35,510 --> 01:04:33,039

if they were looking at the beliefs of

1669

01:04:36,470 --> 01:04:35,520

the community or the individuals

1670

01:04:37,910 --> 01:04:36,480

and if they were looking at the

1671

01:04:39,430 --> 01:04:37,920

community were they

1672

01:04:40,950 --> 01:04:39,440

averaging the beliefs of the community

1673

01:04:42,789 --> 01:04:40,960

you're sort of stacking or if there's a

1674

01:04:45,349 --> 01:04:42,799

difference between those i realize it's

1675

01:04:47,430 --> 01:04:45,359

not your paper so yeah

1676

01:04:49,109 --> 01:04:47,440

yeah so i believe i believe that they

1677

01:04:51,109 --> 01:04:49,119

took an average as the community of the

1678

01:04:52,710 --> 01:04:51,119

community as a whole which is you know

1679

01:04:54,630 --> 01:04:52,720

you can't then extend that to saying

1680

01:04:56,390 --> 01:04:54,640

individuals aren't being

1681

01:04:58,309 --> 01:04:56,400

bayesian so yeah

1682

01:04:59,589 --> 01:04:58,319

that is a good point

1683

01:05:17,190 --> 01:04:59,599

okay

1684

01:05:22,470 --> 01:05:19,910

so a special thank you to to all of our

1685

01:05:23,910 --> 01:05:22,480

speakers who spoke very very quickly

1686

01:05:25,270 --> 01:05:23,920

so that we would have a little bit time

1687

01:05:26,789 --> 01:05:25,280

for some more

1688

01:05:29,349 --> 01:05:26,799

open discussion

1689

01:05:32,230 --> 01:05:29,359

the the motivation for this session was

1690

01:05:35,270 --> 01:05:32,240

this idea that as astrobiologists we say

1691

01:05:37,430 --> 01:05:35,280

that we study the origin extent and

1692

01:05:39,109 --> 01:05:37,440

future of life in the universe

1693

01:05:41,109 --> 01:05:39,119

and what exactly does it mean that we

1694

01:05:43,349 --> 01:05:41,119

study the future of life in the universe

1695

01:05:45,270 --> 01:05:43,359

what is the methodology behind that how

1696

01:05:47,510 --> 01:05:45,280

might we do that well

1697

01:05:49,430 --> 01:05:47,520

and so i've asked a few folks who have

1698

01:05:51,670 --> 01:05:49,440

been thinking about this for quite some

1699

01:05:53,829 --> 01:05:51,680

time to give us brief reflections but

1700

01:05:56,549 --> 01:05:53,839

then i would like to to open things up

1701

01:05:57,670 --> 01:05:56,559

to a broader discussion so we have we

1702

01:05:58,710 --> 01:05:57,680

have met

1703

01:06:02,309 --> 01:05:58,720

uh

1704

01:06:04,470 --> 01:06:02,319

carlos murray skull already we also have

1705

01:06:07,750 --> 01:06:04,480

lynn rosschild who is

1706

01:06:10,789 --> 01:06:07,760

in synthetic biology at ames and rocco

1707

01:06:14,069 --> 01:06:10,799

manchinelli who is editor for the

1708

01:06:15,190 --> 01:06:14,079

international journal of astrobiology

1709

01:06:17,029 --> 01:06:15,200

both of whom have been thinking

1710

01:06:18,950 --> 01:06:17,039

particularly hard on this question so

1711

01:06:21,990 --> 01:06:18,960

i'm going to start by asking our panel

1712

01:06:24,309 --> 01:06:22,000

to just very briefly say

1713

01:06:28,150 --> 01:06:24,319

what interests them about this question

1714

01:06:30,870 --> 01:06:28,160

and one example of really good work that

1715

01:06:32,789 --> 01:06:30,880

has been done on this in the past and

1716

01:06:34,630 --> 01:06:32,799

catherine remotely is on our panel as

1717

01:06:36,549 --> 01:06:34,640

well so i'll prep her as soon as they're

1718

01:06:39,190 --> 01:06:36,559

done we'll go to her

1719

01:06:40,309 --> 01:06:39,200

carlos hi yeah so

1720

01:06:41,670 --> 01:06:40,319

um

1721

01:06:43,349 --> 01:06:41,680

it's interesting to talk about the

1722

01:06:45,190 --> 01:06:43,359

future because one of the things that

1723

01:06:47,910 --> 01:06:45,200

interests me um

1724

01:06:50,710 --> 01:06:47,920

is thinking about uh life

1725

01:06:53,750 --> 01:06:50,720

as we don't know it right so universally

1726

01:06:55,190 --> 01:06:53,760

um i'm interested in in life elsewhere

1727

01:06:57,750 --> 01:06:55,200

um not

1728

01:06:58,630 --> 01:06:57,760

at any particular instance so i want to

1729

01:07:00,390 --> 01:06:58,640

uh

1730

01:07:01,750 --> 01:07:00,400

think in terms of

1731

01:07:04,150 --> 01:07:01,760

um

1732

01:07:05,589 --> 01:07:04,160

the entire range the entire lifespan

1733

01:07:08,069 --> 01:07:05,599

right um

1734

01:07:10,789 --> 01:07:08,079

examples of things that are do that are

1735

01:07:13,589 --> 01:07:10,799

going on now that i find particularly uh

1736

01:07:16,069 --> 01:07:13,599

insightful and interesting are

1737

01:07:17,750 --> 01:07:16,079

the work that our panelists are are

1738

01:07:19,990 --> 01:07:17,760

doing of course and and the work

1739

01:07:20,789 --> 01:07:20,000

actually several people in the audience

1740

01:07:22,549 --> 01:07:20,799

uh

1741

01:07:24,549 --> 01:07:22,559

um

1742

01:07:30,630 --> 01:07:24,559

uh

1743

01:07:33,670 --> 01:07:30,640

um

1744

01:07:34,710 --> 01:07:33,680

i think uh there's lots of people that

1745

01:07:35,910 --> 01:07:34,720

are really

1746

01:07:39,670 --> 01:07:35,920

interested

1747

01:07:42,870 --> 01:07:39,680

in um not just where life goes from here

1748

01:07:45,750 --> 01:07:42,880

but where life would go from dif like

1749

01:07:47,589 --> 01:07:45,760

the the entire range of possible origins

1750

01:07:49,990 --> 01:07:47,599

so i'll just say that very quickly and

1751  
01:07:51,270 --> 01:07:50,000  
stuff it over to

1752  
01:07:52,390 --> 01:07:51,280  
uh lynn

1753  
01:07:53,270 --> 01:07:52,400  
thank you

1754  
01:07:53,990 --> 01:07:53,280  
um

1755  
01:08:07,430 --> 01:07:54,000  
i

1756  
01:08:09,670 --> 01:08:07,440  
we come from

1757  
01:08:10,789 --> 01:08:09,680  
and astrobiology i think at its core

1758  
01:08:13,029 --> 01:08:10,799  
really

1759  
01:08:15,430 --> 01:08:13,039  
it looks at that interaction between the

1760  
01:08:17,590 --> 01:08:15,440  
physical and the biological world and as

1761  
01:08:20,070 --> 01:08:17,600  
i was preparing last night i did

1762  
01:08:22,630 --> 01:08:20,080  
remember in one hard flash that i had

1763  
01:08:25,829 --> 01:08:22,640

been in a documentary with a very

1764

01:08:27,910 --> 01:08:25,839

cheerful title death of the earth

1765

01:08:31,269 --> 01:08:27,920

it was naked science it premiered march

1766

01:08:33,829 --> 01:08:31,279

11 2009 i played myself

1767

01:08:35,510 --> 01:08:33,839

and um one of the reviewers said it was

1768

01:08:37,590 --> 01:08:35,520

a depressing program on the basis of

1769

01:08:39,349 --> 01:08:37,600

which i firmly decided not to live

1770

01:08:41,669 --> 01:08:39,359

another few billion years as it's not

1771

01:08:43,430 --> 01:08:41,679

worth it and that was my father so they

1772

01:08:45,269 --> 01:08:43,440

got worse from there

1773

01:08:47,349 --> 01:08:45,279

anyway i cannot tell you how depressing

1774

01:08:49,110 --> 01:08:47,359

it is to have very cheerful people

1775

01:08:51,430 --> 01:08:49,120

calling from london at seven in the

1776

01:08:53,030 --> 01:08:51,440

morning saying exactly what year is all

1777

01:08:55,269 --> 01:08:53,040

life on earth going extinct dr

1778

01:08:57,749 --> 01:08:55,279

rothschild so let me give you just

1779

01:09:00,470 --> 01:08:57,759

quickly the the take home message there

1780

01:09:01,990 --> 01:09:00,480

and then end on an optimistic note

1781

01:09:03,910 --> 01:09:02,000

and that is i've always believed that

1782

01:09:06,229 --> 01:09:03,920

astrobiology really isn't the next five

1783

01:09:07,749 --> 01:09:06,239

or ten years it's a much longer time

1784

01:09:10,229 --> 01:09:07,759

scale because we are looking at

1785

01:09:12,229 --> 01:09:10,239

planetary phenomena that being said

1786

01:09:14,550 --> 01:09:12,239

climate change is occurring much more

1787

01:09:16,309 --> 01:09:14,560

quickly than we would have expected

1788

01:09:17,669 --> 01:09:16,319

and this involves not only changes in

1789

01:09:19,829 --> 01:09:17,679

the atmosphere and the temperature and

1790

01:09:22,470 --> 01:09:19,839

the rainfall but also ocean circulation

1791

01:09:25,189 --> 01:09:22,480

and so on we can always have your odd

1792

01:09:28,390 --> 01:09:25,199

event like a supernova or an impactor

1793

01:09:30,149 --> 01:09:28,400

showing up that we hadn't expected um we

1794

01:09:31,749 --> 01:09:30,159

could have things like life detection

1795

01:09:33,349 --> 01:09:31,759

we've got the robotics we've got other

1796

01:09:36,149 --> 01:09:33,359

you know sorts of things happening but

1797

01:09:39,430 --> 01:09:36,159

we have planetary factors even within

1798

01:09:42,550 --> 01:09:39,440

the next um thousand five thousand years

1799

01:09:44,630 --> 01:09:42,560

then you start to move to the 250 to 350

1800

01:09:46,709 --> 01:09:44,640

million year time zone and you're

1801  
01:09:47,749 --> 01:09:46,719  
starting to look at new super continents

1802  
01:09:49,430 --> 01:09:47,759  
which

1803  
01:09:51,030 --> 01:09:49,440  
changes climate dramatically and then a

1804  
01:09:53,110 --> 01:09:51,040  
breakup this you know these things

1805  
01:09:55,189 --> 01:09:53,120  
happen periodically

1806  
01:09:56,709 --> 01:09:55,199  
600 million years you're now starting to

1807  
01:09:59,990 --> 01:09:56,719  
talk about not having enough carbon

1808  
01:10:02,229 --> 01:10:00,000  
dioxide for c3 photosynthesis by a

1809  
01:10:04,310 --> 01:10:02,239  
billion years solar luminosity is about

1810  
01:10:05,990 --> 01:10:04,320  
10 percent higher the atmosphere becomes

1811  
01:10:08,390 --> 01:10:06,000  
a moist greenhouse

1812  
01:10:10,149 --> 01:10:08,400  
and then you get the big event of your

1813  
01:10:12,630 --> 01:10:10,159

biggest one of them all 1.5 billion

1814

01:10:14,070 --> 01:10:12,640

years death of all life on planet earth

1815

01:10:15,590 --> 01:10:14,080

and so you're not really going to care

1816

01:10:18,390 --> 01:10:15,600

that in two to three billion years

1817

01:10:21,189 --> 01:10:18,400

earth's magnetic dynamo may cause the um

1818

01:10:23,590 --> 01:10:21,199

the speeding loss of volatiles by two to

1819

01:10:24,550 --> 01:10:23,600

five million year billion years excuse

1820

01:10:26,470 --> 01:10:24,560

me the

1821

01:10:28,149 --> 01:10:26,480

moon is is continuing to go away from

1822

01:10:30,550 --> 01:10:28,159

the earth at about four centimeters a

1823

01:10:31,990 --> 01:10:30,560

year just slightly less may reach a

1824

01:10:34,070 --> 01:10:32,000

point where we've ended up with a more

1825

01:10:35,510 --> 01:10:34,080

chaotic obliquity but it's not going to

1826

01:10:37,910 --> 01:10:35,520

matter because life will already be

1827

01:10:40,149 --> 01:10:37,920

extinct and by 4 billion years earth

1828

01:10:42,070 --> 01:10:40,159

will be more extreme than present-day

1829

01:10:43,110 --> 01:10:42,080

venus which is a hellish place to begin

1830

01:10:45,990 --> 01:10:43,120

with

1831

01:10:48,070 --> 01:10:46,000

by 7.5 billion years the earth may well

1832

01:10:50,070 --> 01:10:48,080

be absorbed by the sun but it's already

1833

01:10:51,990 --> 01:10:50,080

going to be a red giant and before that

1834

01:10:53,590 --> 01:10:52,000

in about 5 billion years the andromeda

1835

01:10:55,510 --> 01:10:53,600

the milky way galaxies will start to

1836

01:10:57,910 --> 01:10:55,520

collide into these were my new

1837

01:11:01,350 --> 01:10:57,920

vocabulary words last night into the

1838

01:11:02,630 --> 01:11:01,360

milk omeda or milk dromeda they will it

1839

01:11:05,350 --> 01:11:02,640

will be called

1840

01:11:06,950 --> 01:11:05,360

but um at the risk of having the most

1841

01:11:09,430 --> 01:11:06,960

depressing talk that has ever been had

1842

01:11:11,669 --> 01:11:09,440

in apps icon i want to end on a positive

1843

01:11:13,430 --> 01:11:11,679

note and that is to go back to my

1844

01:11:15,830 --> 01:11:13,440

original point and that is that the

1845

01:11:18,229 --> 01:11:15,840

future of life is to some extent the

1846

01:11:20,630 --> 01:11:18,239

most important part of astrobiology

1847

01:11:22,709 --> 01:11:20,640

because we are here we care and we can

1848

01:11:25,189 --> 01:11:22,719

actually change this and this is going

1849

01:11:27,030 --> 01:11:25,199

to sound crazy but i actually don't

1850

01:11:28,470 --> 01:11:27,040

believe that any human is going to want

1851

01:11:30,830 --> 01:11:28,480

to be the last one to turn off the

1852

01:11:33,030 --> 01:11:30,840

lights that evolution works on

1853

01:11:35,030 --> 01:11:33,040

self-preservation so

1854

01:11:37,030 --> 01:11:35,040

um there's certainly the possibility of

1855

01:11:38,790 --> 01:11:37,040

going forward to other planets i

1856

01:11:40,790 --> 01:11:38,800

actually personally believe that we're

1857

01:11:43,110 --> 01:11:40,800

going to start to shift planet earth

1858

01:11:45,030 --> 01:11:43,120

maybe we'll have the technology to reset

1859

01:11:46,870 --> 01:11:45,040

the sun but maybe we'll just end up with

1860

01:11:49,910 --> 01:11:46,880

spaceship earth maybe we'll be picking

1861

01:11:52,070 --> 01:11:49,920

up our water from europa and

1862

01:11:54,070 --> 01:11:52,080

more organic carbon maybe some from

1863

01:11:56,070 --> 01:11:54,080

ceres on the way out to europa and then

1864

01:11:58,550 --> 01:11:56,080

on to enceladus and maybe we hang out

1865

01:12:00,950 --> 01:11:58,560

there until we reach the red giant phase

1866

01:12:03,189 --> 01:12:00,960

and so on and so forth so that we don't

1867

01:12:05,590 --> 01:12:03,199

um even have to worry ultimately if we

1868

01:12:07,189 --> 01:12:05,600

have the technology about the end of the

1869

01:12:09,590 --> 01:12:07,199

universe which will be either the big

1870

01:12:11,590 --> 01:12:09,600

crunch or the big riff depending upon

1871

01:12:13,669 --> 01:12:11,600

which um category you're in so i do

1872

01:12:15,910 --> 01:12:13,679

believe that we're sort of like a

1873

01:12:16,709 --> 01:12:15,920

christmas carol where um stooge at the

1874

01:12:19,270 --> 01:12:16,719

end

1875

01:12:21,590 --> 01:12:19,280

sees the future and he realizes he can

1876

01:12:22,790 --> 01:12:21,600

do something about it and people ask me

1877

01:12:24,950 --> 01:12:22,800

well how do you plan to do this

1878

01:12:28,070 --> 01:12:24,960

technologically and my answer is i can't

1879

01:12:30,950 --> 01:12:28,080

solve all the problems for mankind but i

1880

01:12:32,630 --> 01:12:30,960

do believe firmly that we will do

1881

01:12:34,790 --> 01:12:32,640

everything we can for technological

1882

01:12:36,229 --> 01:12:34,800

solutions because it's just not in life

1883

01:12:38,310 --> 01:12:36,239

as a whole and certainly not in

1884

01:12:42,470 --> 01:12:38,320

humankind to be the one to turn out the

1885

01:12:42,480 --> 01:12:45,350

thank you

1886

01:12:50,950 --> 01:12:48,229

well i'm gonna take

1887

01:12:54,229 --> 01:12:50,960

not necessarily a happier turn uh from

1888

01:12:57,030 --> 01:12:54,239

what lynn said but a shorter term

1889

01:12:59,669 --> 01:12:57,040

sort of time on what lynn did say and

1890

01:13:02,310 --> 01:12:59,679

that is i think that

1891

01:13:05,430 --> 01:13:02,320

the future of life has been given short

1892

01:13:07,430 --> 01:13:05,440

shrift in the astrobiology community we

1893

01:13:09,910 --> 01:13:07,440

don't hear much about it especially the

1894

01:13:12,070 --> 01:13:09,920

future of life on here on earth we hear

1895

01:13:13,830 --> 01:13:12,080

about okay we're going to go to mars or

1896

01:13:16,310 --> 01:13:13,840

we're going to make settlements out

1897

01:13:18,950 --> 01:13:16,320

there sometime in the future

1898

01:13:20,950 --> 01:13:18,960

but what about today what about what's

1899

01:13:23,990 --> 01:13:20,960

happening today in the future of life

1900

01:13:25,790 --> 01:13:24,000

today i think we can all say all right

1901

01:13:28,070 --> 01:13:25,800

that we all know that what is

1902

01:13:29,030 --> 01:13:28,080

astrobiology astrobiology brings

1903

01:13:30,070 --> 01:13:29,040

together

1904

01:13:32,550 --> 01:13:30,080

the

1905

01:13:35,750 --> 01:13:32,560

various different different disciplines

1906

01:13:37,830 --> 01:13:35,760

and we date it we gather data and i

1907

01:13:40,630 --> 01:13:37,840

think one of the things that is critical

1908

01:13:42,630 --> 01:13:40,640

to astrobiology and understanding

1909

01:13:44,830 --> 01:13:42,640

astrobiology in life is that

1910

01:13:47,590 --> 01:13:44,840

astrobiology is

1911

01:13:50,790 --> 01:13:47,600

really inextricable the study of

1912

01:13:52,950 --> 01:13:50,800

astrobiology and life is

1913

01:13:54,790 --> 01:13:52,960

the study of the environment and life

1914

01:13:56,870 --> 01:13:54,800

together in other words

1915

01:13:58,709 --> 01:13:56,880

life and its evolution

1916

01:14:01,590 --> 01:13:58,719

and changing environments are

1917

01:14:04,070 --> 01:14:01,600

inextricably entwined together

1918

01:14:06,310 --> 01:14:04,080

all right so since we know that

1919

01:14:08,229 --> 01:14:06,320

then what what can we do to really study

1920

01:14:10,630 --> 01:14:08,239

it and we haven't really done much to

1921

01:14:12,070 --> 01:14:10,640

study it all together and i think right

1922

01:14:14,790 --> 01:14:12,080

now

1923

01:14:17,189 --> 01:14:14,800

without being too depressing is a great

1924

01:14:19,430 --> 01:14:17,199

time in which to actually study this

1925

01:14:20,390 --> 01:14:19,440

together because right now we are going

1926

01:14:23,110 --> 01:14:20,400

through

1927

01:14:24,870 --> 01:14:23,120

rapid global climate change i think we

1928

01:14:28,470 --> 01:14:24,880

can all agree upon that

1929

01:14:31,830 --> 01:14:28,480

and so if we have this rapid global

1930

01:14:33,189 --> 01:14:31,840

climate change we have several fields

1931

01:14:35,590 --> 01:14:33,199

of

1932

01:14:37,830 --> 01:14:35,600

biological systems that we're studying

1933

01:14:40,310 --> 01:14:37,840

that look at what's going on with

1934

01:14:43,750 --> 01:14:40,320

species species extinction changes in

1935

01:14:45,830 --> 01:14:43,760

habitats changes in niches through time

1936

01:14:47,750 --> 01:14:45,840

that one of the things we should do

1937

01:14:49,510 --> 01:14:47,760

and we were asked actually to say what

1938

01:14:51,270 --> 01:14:49,520

should we do about studying the future

1939

01:14:53,669 --> 01:14:51,280

of life one of the things we should do

1940

01:14:56,790 --> 01:14:53,679

is we should bring together global

1941

01:14:59,590 --> 01:14:56,800

climate change modeling and the modeling

1942

01:15:01,990 --> 01:14:59,600

that's done at the ecological ecosystem

1943

01:15:04,630 --> 01:15:02,000

level so that we can un really

1944

01:15:05,430 --> 01:15:04,640

understand better what's going on

1945

01:15:08,070 --> 01:15:05,440

with

1946

01:15:10,950 --> 01:15:08,080

how the environment and life is changing

1947

01:15:13,270 --> 01:15:10,960

for the future so it involves not just

1948

01:15:15,830 --> 01:15:13,280

modeling but it involves gathering real

1949

01:15:17,990 --> 01:15:15,840

data to feed into those models so we

1950

01:15:20,950 --> 01:15:18,000

have some idea not only what's going on

1951

01:15:23,590 --> 01:15:20,960

in the future of what we what we may be

1952

01:15:24,950 --> 01:15:23,600

able to do to actually take control of

1953

01:15:27,990 --> 01:15:24,960

it again

1954

01:15:29,430 --> 01:15:28,000

i once once heard a talk

1955

01:15:31,110 --> 01:15:29,440

several years ago

1956

01:15:32,149 --> 01:15:31,120

that someone said

1957

01:15:36,310 --> 01:15:32,159

uh

1958

01:15:37,189 --> 01:15:36,320

the life on earth began as a microbial

1959

01:15:39,910 --> 01:15:37,199

world

1960

01:15:42,229 --> 01:15:39,920

we have now gone through

1961

01:15:45,270 --> 01:15:42,239

several changes and evolutionary

1962

01:15:47,350 --> 01:15:45,280

processes where we have multicellularity

1963

01:15:50,550 --> 01:15:47,360

we have a diversity of life that's

1964

01:15:52,950 --> 01:15:50,560

almost unbelievable however

1965

01:15:55,030 --> 01:15:52,960

with global climate change

1966

01:15:57,510 --> 01:15:55,040

and the changing environment and the

1967

01:16:00,709 --> 01:15:57,520

changing solar system we are destined to

1968

01:16:03,189 --> 01:16:00,719

become a microbial world again

1969

01:16:05,669 --> 01:16:03,199

if you look at what lynn said and we do

1970

01:16:08,229 --> 01:16:05,679

take some of these changes and we do

1971

01:16:09,270 --> 01:16:08,239

something about them maybe we will stop

1972

01:16:12,390 --> 01:16:09,280

becoming

1973

01:16:14,870 --> 01:16:12,400

a microbial world again

1974

01:16:17,510 --> 01:16:14,880

the other thing i would say is that

1975

01:16:19,189 --> 01:16:17,520

is that i think now

1976

01:16:21,750 --> 01:16:19,199

now is the time

1977

01:16:24,229 --> 01:16:21,760

for us to really understand

1978

01:16:26,790 --> 01:16:24,239

what happens and we can take this data

1979

01:16:29,669 --> 01:16:26,800

with global climate change and modeling

1980

01:16:31,270 --> 01:16:29,679

of ecosystems and bring it together to

1981

01:16:34,229 --> 01:16:31,280

really

1982

01:16:35,669 --> 01:16:34,239

set a course and a path that will not

1983

01:16:37,430 --> 01:16:35,679

lead to

1984

01:16:39,510 --> 01:16:37,440

our extinction

1985

01:16:41,750 --> 01:16:39,520

with that i will end

1986

01:16:43,750 --> 01:16:41,760

excellent and a couple quick words from

1987

01:16:46,229 --> 01:16:43,760

catherine uh and then we'll we'll open

1988

01:16:49,430 --> 01:16:46,239

things up

1989

01:16:51,510 --> 01:16:49,440

hey yeah i will keep it quick um

1990

01:16:53,990 --> 01:16:51,520

so yeah i'm not worried about the 1.5

1991

01:16:55,350 --> 01:16:54,000

million your horizon or the milk drama

1992

01:16:57,030 --> 01:16:55,360

personally just because my brain is not

1993

01:16:59,030 --> 01:16:57,040

large enough um lynn's brain is way

1994

01:17:01,750 --> 01:16:59,040

bigger than mine um i do worry about the

1995

01:17:03,510 --> 01:17:01,760

near future issues um like rosabo was

1996

01:17:05,990 --> 01:17:03,520

just discussing and of course um the

1997

01:17:07,669 --> 01:17:06,000

importance of adaptation and resilience

1998

01:17:10,070 --> 01:17:07,679

what i there's kind of one thing that i

1999

01:17:12,870 --> 01:17:10,080

can add a little bit um to what raka was

2000

01:17:15,110 --> 01:17:12,880

just saying with which i firmly agree

2001

01:17:16,390 --> 01:17:15,120

i'm very concerned about biodiversity

2002

01:17:18,950 --> 01:17:16,400

collapse because that's something that

2003

01:17:20,470 --> 01:17:18,960

we haven't seen before on the scale that

2004

01:17:22,229 --> 01:17:20,480

we are

2005

01:17:24,390 --> 01:17:22,239

seeing and but i do take some

2006

01:17:26,790 --> 01:17:24,400

consolation in the archaeological work

2007

01:17:29,590 --> 01:17:26,800

which shows humanity's long history of

2008

01:17:32,390 --> 01:17:29,600

resilience and adaptation to local

2009

01:17:34,310 --> 01:17:32,400

um climate catastrophes and

2010

01:17:36,709 --> 01:17:34,320

so i think you know we we do have this

2011

01:17:39,510 --> 01:17:36,719

this capacity within us and i think that

2012

01:17:41,990 --> 01:17:39,520

it um is is some consolation whether or

2013

01:17:43,669 --> 01:17:42,000

not um we're able to coordinate on the

2014

01:17:45,750 --> 01:17:43,679

kind of global scales that are are

2015

01:17:46,630 --> 01:17:45,760

necessary you know remains to be seen

2016

01:17:48,310 --> 01:17:46,640

but

2017

01:17:50,229 --> 01:17:48,320

um

2018

01:17:51,990 --> 01:17:50,239

anyway interest interesting days ahead

2019

01:17:54,310 --> 01:17:52,000

one thing i i would just add though to

2020

01:17:57,430 --> 01:17:54,320

that is that i'm i'm not sanguine about

2021

01:18:00,390 --> 01:17:57,440

um the kind of planet b plans or

2022

01:18:03,430 --> 01:18:00,400

or thought uh stream that that runs

2023

01:18:04,470 --> 01:18:03,440

through some um space-based

2024

01:18:07,430 --> 01:18:04,480

um

2025

01:18:09,669 --> 01:18:07,440

biology work it's uh it's it's a source

2026

01:18:11,750 --> 01:18:09,679

of some concern to me i'm not sure that

2027

01:18:14,310 --> 01:18:11,760

um you know the idea of a backup plan

2028

01:18:17,270 --> 01:18:14,320

with humans off world is um

2029

01:18:19,750 --> 01:18:17,280

particularly viable and uh i worry about

2030

01:18:21,669 --> 01:18:19,760

it diverting attention away from uh the

2031

01:18:22,950 --> 01:18:21,679

approximate concerns right now um i

2032

01:18:24,790 --> 01:18:22,960

would love to hear a couple things from

2033

01:18:26,550 --> 01:18:24,800

lucas if he has anything to add as well

2034

01:18:27,590 --> 01:18:26,560

as from before

2035

01:18:28,470 --> 01:18:27,600

thank you

2036

01:18:31,350 --> 01:18:28,480

um

2037

01:18:32,790 --> 01:18:31,360

so i i think just sort of to to wrap up

2038

01:18:34,550 --> 01:18:32,800

what people have said

2039

01:18:36,709 --> 01:18:34,560

there's a whole lot of passion about

2040

01:18:38,229 --> 01:18:36,719

what we should do in this area

2041

01:18:40,310 --> 01:18:38,239

and hopefully

2042

01:18:42,630 --> 01:18:40,320

cat's talk has convinced us all that the

2043

01:18:44,790 --> 01:18:42,640

more passionate we feel about something

2044

01:18:45,830 --> 01:18:44,800

the harder it is for us to be rational

2045

01:18:48,550 --> 01:18:45,840

about it

2046

01:18:51,830 --> 01:18:48,560

and i think that as astrobiologists as

2047

01:18:53,910 --> 01:18:51,840

people who really are committed to this

2048

01:18:56,790 --> 01:18:53,920

study of what it means to be alive at

2049

01:18:59,030 --> 01:18:56,800

the intersection of chemistry biology

2050

01:19:01,910 --> 01:18:59,040

geology astronomy

2051

01:19:03,910 --> 01:19:01,920

including the uh the natural so

2052

01:19:06,390 --> 01:19:03,920

including the social sciences and the

2053

01:19:08,870 --> 01:19:06,400

humanities inputs as well

2054

01:19:10,950 --> 01:19:08,880

that we are in a unique place to speak

2055

01:19:13,350 --> 01:19:10,960

on this question of what we can do now

2056

01:19:15,270 --> 01:19:13,360

and exactly the nature of the problem

2057

01:19:17,350 --> 01:19:15,280

the extent to which we can do that

2058

01:19:19,990 --> 01:19:17,360

dispassionately i think will be

2059

01:19:23,189 --> 01:19:20,000

reflected in the extent to which we are

2060

01:19:24,870 --> 01:19:23,199

trusted by the general public to do so

2061

01:19:26,310 --> 01:19:24,880

and so i think that we have a particular

2062

01:19:28,070 --> 01:19:26,320

obligation

2063

01:19:29,750 --> 01:19:28,080

to tie together

2064

01:19:31,590 --> 01:19:29,760

really the the science and other

2065

01:19:33,590 --> 01:19:31,600

academic insights we can bring to the

2066

01:19:35,430 --> 01:19:33,600

problem so the reason that that i'm

2067

01:19:38,709 --> 01:19:35,440

really committed to this is i think that

2068

01:19:42,070 --> 01:19:38,719

that we have not only the the talents

2069

01:19:43,590 --> 01:19:42,080

but the the platform to speak publicly

2070

01:19:46,790 --> 01:19:43,600

and with that comes a great

2071

01:19:48,790 --> 01:19:46,800

responsibility to be mindful of exactly

2072

01:19:50,550 --> 01:19:48,800

where information is coming from when

2073

01:19:52,470 --> 01:19:50,560

it's coming from the social sciences

2074

01:19:54,550 --> 01:19:52,480

when it is being driven by the astronomy

2075

01:19:55,990 --> 01:19:54,560

when it's being driven by the biology

2076

01:19:59,750 --> 01:19:56,000

and sometimes when it's been being

2077

01:20:00,790 --> 01:19:59,760

driven by our own personal biases

2078

01:20:02,070 --> 01:20:00,800

so

2079

01:20:04,229 --> 01:20:02,080

i am sure there are people in the

2080

01:20:06,790 --> 01:20:04,239

audience who would love to make a

2081

01:20:09,189 --> 01:20:06,800

comment uh we have a short period of

2082

01:20:11,510 --> 01:20:09,199

time so please uh connect with people

2083

01:20:13,669 --> 01:20:11,520

around you and try and make uh a brief

2084

01:20:16,390 --> 01:20:13,679

comment if you can so we can get input

2085

01:20:19,910 --> 01:20:16,400

from a lot of people please

2086

01:20:23,990 --> 01:20:21,910

and that is there is nothing that we

2087

01:20:25,990 --> 01:20:24,000

should be more passionate about than the

2088

01:20:28,070 --> 01:20:26,000

future of humanity

2089

01:20:29,990 --> 01:20:28,080

um we should be passionate about a field

2090

01:20:34,229 --> 01:20:30,000

it's the individual solutions that we

2091

01:20:36,149 --> 01:20:34,239

need to be rational true i totally agree

2092

01:20:37,990 --> 01:20:36,159

please hi michael schaible georgia

2093

01:20:40,470 --> 01:20:38,000

institute technology the very

2094

01:20:41,910 --> 01:20:40,480

interesting uh talks and and statements

2095

01:20:42,790 --> 01:20:41,920

by all of you uh i was wondering if you

2096

01:20:44,310 --> 01:20:42,800

could

2097

01:20:47,149 --> 01:20:44,320

briefly

2098

01:20:49,510 --> 01:20:47,159

comment on what you think is the role of

2099

01:20:53,669 --> 01:20:49,520

astrobiology in moving forward

2100

01:20:55,270 --> 01:20:53,679

anti-colonial and inclusive exploration

2101

01:21:01,350 --> 01:20:55,280

that's probably

2102

01:21:04,870 --> 01:21:03,590

um

2103

01:21:06,550 --> 01:21:04,880

it's

2104

01:21:08,870 --> 01:21:06,560

that's an interesting one for which i

2105

01:21:12,470 --> 01:21:08,880

was not prepared um

2106

01:21:16,229 --> 01:21:12,480

i would say i mean any science has that

2107

01:21:19,510 --> 01:21:16,239

kind of capacity to um to contribute to

2108

01:21:21,510 --> 01:21:19,520

uh the colonial initiatives and and to

2109

01:21:23,510 --> 01:21:21,520

and to inclusion it's a lot of it is as

2110

01:21:27,189 --> 01:21:23,520

you know is is just in terms of how do

2111

01:21:28,550 --> 01:21:27,199

you practice um your own science

2112

01:21:30,709 --> 01:21:28,560

how do you

2113

01:21:33,189 --> 01:21:30,719

interact with those directly around you

2114

01:21:35,910 --> 01:21:33,199

i guess one thing i would say and i

2115

01:21:37,270 --> 01:21:35,920

alluded to this a little bit is that

2116

01:21:38,950 --> 01:21:37,280

in terms of our

2117

01:21:40,390 --> 01:21:38,960

kind of big

2118

01:21:41,430 --> 01:21:40,400

narratives

2119

01:21:43,350 --> 01:21:41,440

about

2120

01:21:45,110 --> 01:21:43,360

um because again astrobiology does quite

2121

01:21:47,270 --> 01:21:45,120

often invoke sort of you know the big

2122

01:21:49,030 --> 01:21:47,280

story of humanity on earth and our

2123

01:21:51,430 --> 01:21:49,040

social evolution and things like that i

2124

01:21:52,629 --> 01:21:51,440

think you know if we can be really

2125

01:21:54,709 --> 01:21:52,639

mindful

2126

01:21:56,550 --> 01:21:54,719

that in the standard versions most of

2127

01:21:57,350 --> 01:21:56,560

humanity is left out

2128

01:22:00,629 --> 01:21:57,360

um

2129

01:22:08,550 --> 01:22:00,639

or

2130

01:22:10,870 --> 01:22:08,560

are deeply colonial and really not very

2131

01:22:12,950 --> 01:22:10,880

inclusive and that we can do better so i

2132

01:22:14,629 --> 01:22:12,960

think that that's one way um you know

2133

01:22:16,870 --> 01:22:14,639

obviously again as an anthropologist i

2134

01:22:20,629 --> 01:22:16,880

would say that that we could do a better

2135

01:22:23,510 --> 01:22:20,639

job of weaving these bigger more

2136

01:22:25,270 --> 01:22:23,520

inclusive pictures into our ideas of you

2137

01:22:27,830 --> 01:22:25,280

know who humans are where we've been and

2138

01:22:29,830 --> 01:22:27,840

where we're going that's um that's kind

2139

01:22:32,149 --> 01:22:29,840

of the two suggestions that i have also

2140

01:22:34,790 --> 01:22:32,159

i'll stop now all right great question i

2141

01:22:36,790 --> 01:22:34,800

think if anyone can have the global

2142

01:22:39,350 --> 01:22:36,800

perspective and from deep time it should

2143

01:22:41,110 --> 01:22:39,360

be us so uh so hopefully that's what we

2144

01:22:42,870 --> 01:22:41,120

can find and that's one of the reasons

2145

01:22:45,030 --> 01:22:42,880

that i care so deeply about these ascent

2146

01:22:48,550 --> 01:22:45,040

narratives which don't really match up

2147

01:22:49,830 --> 01:22:48,560

with the global perspective uh lynn

2148

01:22:51,830 --> 01:22:49,840

what i'd like to do is tie that in with

2149

01:22:54,550 --> 01:22:51,840

rosalva and chris mckay's talk earlier

2150

01:22:56,629 --> 01:22:54,560

that the the most extreme environments

2151

01:22:58,310 --> 01:22:56,639

on the earth today are the ones where it

2152

01:23:00,390 --> 01:22:58,320

tends to be the most marginalized people

2153

01:23:03,350 --> 01:23:00,400

but there are canaries for the future

2154

01:23:04,950 --> 01:23:03,360

and so um in our own work you know doing

2155

01:23:06,550 --> 01:23:04,960

field work in in places like the rift

2156

01:23:08,310 --> 01:23:06,560

valley in africa and so we've tried to

2157

01:23:10,310 --> 01:23:08,320

bring in the local communities because

2158

01:23:12,550 --> 01:23:10,320

they're the ones that have their finger

2159

01:23:13,430 --> 01:23:12,560

on the pulse of the change

2160

01:23:15,750 --> 01:23:13,440

please

2161

01:23:18,149 --> 01:23:15,760

thank you for the inspiring panel and so

2162

01:23:19,750 --> 01:23:18,159

in 1937 rene descartes said i think

2163

01:23:23,270 --> 01:23:19,760

therefore i

2164

01:23:25,510 --> 01:23:23,280

and in the 1880s uh auguste rodon the

2165

01:23:27,030 --> 01:23:25,520

artist from france created a sculpture

2166

01:23:29,030 --> 01:23:27,040

called the thinker you might have seen

2167

01:23:30,950 --> 01:23:29,040

that very very famous worldwide so i'm

2168

01:23:32,870 --> 01:23:30,960

curious with this interdisciplinary

2169

01:23:36,310 --> 01:23:32,880

field here

2170

01:23:39,590 --> 01:23:36,320

instead of looking at rocks and cells

2171

01:23:41,430 --> 01:23:39,600

and enzymes to what extent are we

2172

01:23:42,709 --> 01:23:41,440

challenging ourselves to examine

2173

01:23:44,870 --> 01:23:42,719

ourselves

2174

01:23:46,229 --> 01:23:44,880

and how we philosophically think about

2175

01:23:48,390 --> 01:23:46,239

our feet on the ground in the

2176

01:23:51,350 --> 01:23:48,400

environment our soma how we think about

2177

01:23:53,189 --> 01:23:51,360

who we are not only philosophically but

2178

01:23:54,550 --> 01:23:53,199

psychophysiology

2179

01:23:56,390 --> 01:23:54,560

okay because if we're going to inquire

2180

01:23:58,470 --> 01:23:56,400

about what is earth out in the universe

2181

01:24:00,790 --> 01:23:58,480

or in other parts of the planet

2182

01:24:01,750 --> 01:24:00,800

how are we coming from where we are at

2183

01:24:03,750 --> 01:24:01,760

itself

2184

01:24:05,270 --> 01:24:03,760

so i'm curious for the panel but anyone

2185

01:24:06,950 --> 01:24:05,280

else in the room who's asking questions

2186

01:24:09,669 --> 01:24:06,960

like that i'm curious about that

2187

01:24:12,189 --> 01:24:09,679

um i i'm going to say come play with us

2188

01:24:14,870 --> 01:24:12,199

at social and conceptual issues in

2189

01:24:16,950 --> 01:24:14,880

astrobiology uh because we are all about

2190

01:24:18,310 --> 01:24:16,960

that question and i think catherine and

2191

01:24:20,310 --> 01:24:18,320

i would would both

2192

01:24:21,830 --> 01:24:20,320

love to talk with you more about that

2193

01:24:24,550 --> 01:24:21,840

it's a great question that has

2194

01:24:28,830 --> 01:24:24,560

biological uh components that aren't

2195

01:24:33,030 --> 01:24:28,840

differentiable uh from the psychological

2196

01:24:34,950 --> 01:24:33,040

components please hi tessa fisher asu um

2197

01:24:36,390 --> 01:24:34,960

so michael wong already touched on this

2198

01:24:38,070 --> 01:24:36,400

a bit but

2199

01:24:39,430 --> 01:24:38,080

it something i've always noticed

2200

01:24:41,189 --> 01:24:39,440

especially someone coming from

2201

01:24:43,350 --> 01:24:41,199

background oncology is there's an

2202

01:24:45,830 --> 01:24:43,360

assumption in astrobiology that

2203

01:24:48,229 --> 01:24:45,840

civilizations are growth oriented

2204

01:24:50,550 --> 01:24:48,239

um and i don't know we can make that

2205

01:24:52,149 --> 01:24:50,560

assumption because well even in our own

2206

01:24:54,149 --> 01:24:52,159

human history a lot of cultures have

2207

01:24:55,750 --> 01:24:54,159

been growth oriented many have not and

2208

01:24:58,149 --> 01:24:55,760

in particular the

2209

01:25:00,470 --> 01:24:58,159

current setup of our economy which in

2210

01:25:02,149 --> 01:25:00,480

which growth is integral is a very

2211

01:25:03,830 --> 01:25:02,159

recent development only within the last

2212

01:25:06,149 --> 01:25:03,840

few hundred years

2213

01:25:07,030 --> 01:25:06,159

so can we really

2214

01:25:08,629 --> 01:25:07,040

you know

2215

01:25:11,350 --> 01:25:08,639

should we be

2216

01:25:12,870 --> 01:25:11,360

using that as our guiding assumption

2217

01:25:14,950 --> 01:25:12,880

especially if we're looking about deep

2218

01:25:16,390 --> 01:25:14,960

time you know i don't want to say we

2219

01:25:18,229 --> 01:25:16,400

should be eating the rich but we should

2220

01:25:20,950 --> 01:25:18,239

be eating the rich

2221

01:25:23,510 --> 01:25:20,960

we we tend to extrapolate from 1850 to

2222

01:25:25,270 --> 01:25:23,520

1950 growth patterns

2223

01:25:27,189 --> 01:25:25,280

infinitely into the future which is very

2224

01:25:28,950 --> 01:25:27,199

interesting choice why we picked that

2225

01:25:31,189 --> 01:25:28,960

period but that's the period of

2226

01:25:33,189 --> 01:25:31,199

exponential growth that tends to be

2227

01:25:35,270 --> 01:25:33,199

projected please

2228

01:25:36,950 --> 01:25:35,280

yeah hi jacob hugh mr blue marble space

2229

01:25:39,030 --> 01:25:36,960

so i would not be doing my job if i

2230

01:25:41,270 --> 01:25:39,040

didn't bring up techno signatures here

2231

01:25:44,149 --> 01:25:41,280

i'm fully sympathetic to this idea that

2232

01:25:45,910 --> 01:25:44,159

that the future of earth is one of the

2233

01:25:48,550 --> 01:25:45,920

understudied of the three goals of

2234

01:25:50,950 --> 01:25:48,560

astrobiology and i'm encouraged that

2235

01:25:52,709 --> 01:25:50,960

nasa in particular and other agencies

2236

01:25:54,870 --> 01:25:52,719

are taking and private agencies are

2237

01:25:57,030 --> 01:25:54,880

taking the search for techno signatures

2238

01:25:59,990 --> 01:25:57,040

seriously and that's a great

2239

01:26:02,229 --> 01:26:00,000

intersection for the future of life and

2240

01:26:04,310 --> 01:26:02,239

the future of life on earth and in the

2241

01:26:05,669 --> 01:26:04,320

search for life elsewhere you know a lot

2242

01:26:08,310 --> 01:26:05,679

of study people have been doing this

2243

01:26:09,669 --> 01:26:08,320

implicitly you project from earth today

2244

01:26:11,110 --> 01:26:09,679

as to what kind of things might be

2245

01:26:13,189 --> 01:26:11,120

detectable for the future so i think

2246

01:26:14,790 --> 01:26:13,199

just keep thinking about this because

2247

01:26:16,790 --> 01:26:14,800

this is a good application to keep

2248

01:26:18,550 --> 01:26:16,800

getting more of these future of life on

2249

01:26:19,910 --> 01:26:18,560

earth ideas out into the astrobiology

2250

01:26:21,910 --> 01:26:19,920

community

2251

01:26:24,470 --> 01:26:21,920

awesome thank you and i would say you

2252

01:26:26,070 --> 01:26:24,480

know how do we move that from implicit

2253

01:26:29,030 --> 01:26:26,080

beliefs about the future of

2254

01:26:31,030 --> 01:26:29,040

civilizations to explicit beliefs about

2255

01:26:34,070 --> 01:26:31,040

the future of civilizations how can we

2256

01:26:37,830 --> 01:26:34,080

use methodologies like perhaps

2257

01:26:40,629 --> 01:26:37,840

michaels and cats to move us forward

2258

01:26:44,149 --> 01:26:40,639

into being clear about what information

2259

01:26:46,629 --> 01:26:44,159

is driving our predictions i know carlos

2260

01:26:48,709 --> 01:26:46,639

had a question i i mean i have a thought

2261

01:26:51,350 --> 01:26:48,719

on that which actually uh gets the

2262

01:26:53,270 --> 01:26:51,360

question that i had um so you you

2263

01:26:55,430 --> 01:26:53,280

brought up social a little while ago

2264

01:26:57,830 --> 01:26:55,440

last social not this one but the one in

2265

01:27:01,990 --> 01:26:57,840

2020 there was a a

2266

01:27:04,070 --> 01:27:02,000

speech by um robert kennedy iii who was

2267

01:27:06,149 --> 01:27:04,080

not that robert kennedy but he was

2268

01:27:08,870 --> 01:27:06,159

talking about um

2269

01:27:11,110 --> 01:27:08,880

the kinds of drives that it would take

2270

01:27:12,950 --> 01:27:11,120

to get a spacecraft

2271

01:27:15,030 --> 01:27:12,960

uh out of the solar system and the

2272

01:27:16,470 --> 01:27:15,040

amount of energy in the the the fusion

2273

01:27:19,270 --> 01:27:16,480

reactions that you would need and

2274

01:27:21,750 --> 01:27:19,280

apparently the limiting factor is boron

2275

01:27:23,750 --> 01:27:21,760

which i you know you'll have to go to

2276

01:27:25,990 --> 01:27:23,760

that paper for the the evidence on it

2277

01:27:28,950 --> 01:27:26,000

but but it turns out we are running out

2278

01:27:30,149 --> 01:27:28,960

of boron on this planet within this

2279

01:27:31,270 --> 01:27:30,159

generation

2280

01:27:35,270 --> 01:27:31,280

so

2281

01:27:36,709 --> 01:27:35,280

maybe

2282

01:27:39,189 --> 01:27:36,719

we won't be able to take the vast

2283

01:27:40,709 --> 01:27:39,199

majority of bodies uh

2284

01:27:42,470 --> 01:27:40,719

out of this uh

2285

01:27:44,629 --> 01:27:42,480

this solar system but we might be able

2286

01:27:47,910 --> 01:27:44,639

to send technology that that might be

2287

01:27:47,920 --> 01:27:53,590

any last words from uh lynn or rocco

2288

01:27:57,030 --> 01:27:55,189

i definitely want to thank you for

2289

01:27:59,270 --> 01:27:57,040

having this panel and for having this

2290

01:28:02,070 --> 01:27:59,280

session because it's something again i

2291

01:28:03,990 --> 01:28:02,080

feel passionate that that it should

2292

01:28:05,669 --> 01:28:04,000

well it is in many ways the most

2293

01:28:08,390 --> 01:28:05,679

important part about astrobiology

2294

01:28:11,030 --> 01:28:08,400

because it's us living forward and i i

2295

01:28:13,189 --> 01:28:11,040

regret for not having mentioned the near

2296

01:28:15,189 --> 01:28:13,199

future and the potential for using

2297

01:28:18,310 --> 01:28:15,199

synthetic biology to help getting us off

2298

01:28:19,590 --> 01:28:18,320

planet but that being said um again

2299

01:28:21,110 --> 01:28:19,600

thank you for running this because i

2300

01:28:23,189 --> 01:28:21,120

think it's brought up a lot of issues

2301

01:28:24,310 --> 01:28:23,199

that that people should be aware of in

2302

01:28:26,950 --> 01:28:24,320

this community

2303

01:28:30,790 --> 01:28:29,030

one last comment and that is

2304

01:28:32,790 --> 01:28:30,800

i just want to reiterate that i think

2305

01:28:34,629 --> 01:28:32,800

that there have been few publications in

2306

01:28:36,470 --> 01:28:34,639

the area of the future of life

2307

01:28:39,270 --> 01:28:36,480

especially the future of life on earth

2308

01:28:42,470 --> 01:28:39,280

and where it's going and what we may do

2309

01:28:43,830 --> 01:28:42,480

to study it and as the editor-in-chief

2310

01:28:45,910 --> 01:28:43,840

of the international journal of

2311

01:28:48,870 --> 01:28:45,920

astrobiology i'm going to make a plug

2312

01:28:50,149 --> 01:28:48,880

for the journal and also a sales pitch

2313

01:28:52,390 --> 01:28:50,159

saying that

2314

01:28:54,709 --> 01:28:52,400

those of you in the audience or those of

2315

01:28:56,390 --> 01:28:54,719

you who know other people out there who

2316

01:28:58,709 --> 01:28:56,400

are interested in this field who would

2317

01:29:01,590 --> 01:28:58,719

like to write an opinion piece

2318

01:29:02,390 --> 01:29:01,600

or a review or even something that has

2319

01:29:03,430 --> 01:29:02,400

some

2320

01:29:07,590 --> 01:29:03,440

basic

2321

01:29:09,590 --> 01:29:07,600

research in it and data or models uh

2322

01:29:11,590 --> 01:29:09,600

please come and talk to me because those

2323

01:29:14,550 --> 01:29:11,600

are the kinds of papers i think that

2324

01:29:17,189 --> 01:29:14,560

spell the future for astrobiology and i

2325

01:29:19,350 --> 01:29:17,199

would like the journal to be part of it

2326

01:29:20,310 --> 01:29:19,360

so i welcome you to come and talk to me

2327

01:29:22,149 --> 01:29:20,320

please

2328

01:29:26,390 --> 01:29:22,159

thank you

2329

01:29:28,390 --> 01:29:26,400

the people joining us uh online and

2330

01:29:30,790 --> 01:29:28,400

thank you for coming hopefully we will