

**THE INVISIBLE
NIGHT SCHOOL**

1
00:00:03,160 --> 00:00:00,470
[Music]

2
00:00:34,170 --> 00:00:03,170
foreign

3
00:00:42,709 --> 00:00:34,180
[Music]

4
00:00:42,719 --> 00:00:50,530
foreign

5
00:01:06,289 --> 00:01:03,950
[Music]

6
00:01:08,330 --> 00:01:06,299
good afternoon good morning good evening

7
00:01:10,190 --> 00:01:08,340
wherever you may be Across the Nation

8
00:01:12,649 --> 00:01:10,200
around the world I am Leah Prime

9
00:01:14,690 --> 00:01:12,659
broadcasting live thank you so much for

10
00:01:16,190 --> 00:01:14,700
joining the invisible night school on

11
00:01:17,510 --> 00:01:16,200
this Wednesday evening right before

12
00:01:19,310 --> 00:01:17,520
Thanksgiving

13
00:01:21,469 --> 00:01:19,320

whether you're with us live or catching

14

00:01:23,630 --> 00:01:21,479

us on a replay we are so glad that

15

00:01:25,789 --> 00:01:23,640

you're here the invisible night school

16

00:01:28,130 --> 00:01:25,799

is a small Consortium of researchers

17

00:01:30,490 --> 00:01:28,140

exploring a wide variety of numinous and

18

00:01:32,390 --> 00:01:30,500

Arcane subjects you can find us at the

19

00:01:34,010 --> 00:01:32,400

invisiblenightschool.com and go ahead

20

00:01:36,230 --> 00:01:34,020

and like share and subscribe to our

21

00:01:37,670 --> 00:01:36,240

Channel and please join our Discord uh

22

00:01:40,249 --> 00:01:37,680

there's a link included in the video

23

00:01:42,109 --> 00:01:40,259

description so tonight our very own

24

00:01:44,030 --> 00:01:42,119

Louis caitano will be leading a

25

00:01:47,990 --> 00:01:44,040

discussion on the evolution of complex

26

00:01:50,330 --> 00:01:48,000

life I will get him added to the stream

27

00:01:53,030 --> 00:01:50,340

and I'll also be welcoming of course one

28

00:01:57,830 --> 00:01:53,040

of our lovely co-hosts Campbell

29

00:01:58,850 --> 00:01:57,840

um this week Nick is on uh family Duty I

30

00:02:00,770 --> 00:01:58,860

guess

31

00:02:02,749 --> 00:02:00,780

um out doing things that normal social

32

00:02:04,850 --> 00:02:02,759

people do like spending time with his

33

00:02:07,429 --> 00:02:04,860

kid and going out to dinner which leaves

34

00:02:11,510 --> 00:02:07,439

the rest of us here to fill in the gaps

35

00:02:13,309 --> 00:02:11,520

and hopefully have a fruitful discussion

36

00:02:14,750 --> 00:02:13,319

um super excited to see you here tonight

37

00:02:16,490 --> 00:02:14,760

sways

38

00:02:17,930 --> 00:02:16,500

spooky

39

00:02:20,750 --> 00:02:17,940

Simon

40

00:02:22,070 --> 00:02:20,760

this is like who's who

41

00:02:23,750 --> 00:02:22,080

um Swank

42

00:02:25,490 --> 00:02:23,760

it's great to see some of our regulars

43

00:02:27,470 --> 00:02:25,500

show up week after week um it's really

44

00:02:29,869 --> 00:02:27,480

exciting to uh see a little bit of an

45

00:02:31,729 --> 00:02:29,879

audience start forming and building up a

46

00:02:33,410 --> 00:02:31,739

community associated with the show so

47

00:02:34,790 --> 00:02:33,420

super excited to see everyone here

48

00:02:36,410 --> 00:02:34,800

tonight

49

00:02:39,350 --> 00:02:36,420

yeah and I'm looking forward to this

50

00:02:41,630 --> 00:02:39,360

combo especially uh after last week with

51

00:02:45,470 --> 00:02:41,640

rather I think it spiraled into this

52

00:02:47,089 --> 00:02:45,480

perfectly and the in Louisiana your

53

00:02:49,970 --> 00:02:47,099

information that you were bringing to

54

00:02:51,650 --> 00:02:49,980

the table was so cool I kept kept on

55

00:02:53,030 --> 00:02:51,660

wanting to like hear more and more so

56

00:02:55,790 --> 00:02:53,040

this was excellent

57

00:02:57,650 --> 00:02:55,800

yeah the the general like viewer

58

00:02:59,869 --> 00:02:57,660

responds to Lisa's comments last week

59

00:03:01,850 --> 00:02:59,879

were overwhelmingly positive

60

00:03:03,710 --> 00:03:01,860

um and I think

61

00:03:06,949 --> 00:03:03,720

you know behind the scenes we've had

62

00:03:10,190 --> 00:03:06,959

conversations about opportunities to

63

00:03:13,009 --> 00:03:10,200

broaden the subjects we approach on the

64

00:03:17,030 --> 00:03:13,019

show both

65

00:03:20,089 --> 00:03:17,040

to draw on our individual interests more

66

00:03:23,750 --> 00:03:20,099

and also to avoid pidgin and Hauling

67

00:03:25,250 --> 00:03:23,760

ourselves as a UFO podcast I when I

68

00:03:27,470 --> 00:03:25,260

started this I remember thinking to

69

00:03:30,170 --> 00:03:27,480

myself that I wanted to make a UFO

70

00:03:32,210 --> 00:03:30,180

podcast for people who hate UFOs and I

71

00:03:35,390 --> 00:03:32,220

feel like the more we kind of brought it

72

00:03:38,630 --> 00:03:35,400

out and touch other interesting and uh

73

00:03:41,809 --> 00:03:38,640

numinous and complex subjects the more

74

00:03:44,630 --> 00:03:41,819

we're going to also cultivate a

75

00:03:47,630 --> 00:03:44,640

broader audience and and fan base that

76

00:03:50,589 --> 00:03:47,640

we can work with and learn from and grow

77

00:03:53,509 --> 00:03:50,599

with so I'm super excited about it

78

00:03:56,570 --> 00:03:53,519

and a lot of these subjects are

79

00:03:59,210 --> 00:03:56,580

interrelated in unexpected ways I

80

00:04:01,009 --> 00:03:59,220

certainly didn't realize how many

81

00:04:02,990 --> 00:04:01,019

different connections there are under

82

00:04:05,630 --> 00:04:03,000

the surface of a variety of these things

83

00:04:08,170 --> 00:04:05,640

like when I started looking at UFOs I

84

00:04:10,970 --> 00:04:08,180

ended up in uh you know

85

00:04:12,649 --> 00:04:10,980

magnetohydrodynamics physics papers and

86

00:04:15,229 --> 00:04:12,659

then on the other side of it the

87

00:04:17,569 --> 00:04:15,239

Consciousness studies and near-death

88

00:04:19,550 --> 00:04:17,579

experiences and things Who would know

89

00:04:22,370 --> 00:04:19,560

that those things can even conceptually

90

00:04:24,770 --> 00:04:22,380

go together until you dive into it

91

00:04:28,249 --> 00:04:24,780

right yeah

92

00:04:31,010 --> 00:04:28,259

good things I was gonna I was gonna ask

93

00:04:33,550 --> 00:04:31,020

how things are in um in your world's

94

00:04:35,749 --> 00:04:33,560

Campbell Lewis how are you guys doing

95

00:04:38,330 --> 00:04:35,759

yeah I'm doing well

96

00:04:41,930 --> 00:04:38,340

um yeah UFO stuff it's everybody's been

97

00:04:45,050 --> 00:04:41,940

kind of on a holding pattern until this

98

00:04:48,110 --> 00:04:45,060

big report comes out right so I've been

99

00:04:51,110 --> 00:04:48,120

waiting to see what people say seeing

100

00:04:54,110 --> 00:04:51,120

how the community is reacting to the

101
00:04:57,230 --> 00:04:54,120
delay it's kind of a quiet time now

102
00:04:59,330 --> 00:04:57,240
though I think and uh you're we're

103
00:05:01,550 --> 00:04:59,340
seeing that in the community of some

104
00:05:02,930 --> 00:05:01,560
little Rumbblings here and there uh Luis

105
00:05:04,909 --> 00:05:02,940
what have you been up to

106
00:05:07,370 --> 00:05:04,919
I've just been finishing some books that

107
00:05:08,870 --> 00:05:07,380
I've been reading including um one by

108
00:05:11,469 --> 00:05:08,880
Jason colavito

109
00:05:14,270 --> 00:05:11,479
I put a review of that on my channel

110
00:05:17,290 --> 00:05:14,280
this book here

111
00:05:20,510 --> 00:05:17,300
and talks about lovecraft's um you know

112
00:05:23,629 --> 00:05:20,520
impact on our ancient astronaut and

113
00:05:25,430 --> 00:05:23,639

other you know alternative archeology

114

00:05:27,950 --> 00:05:25,440

um tropes

115

00:05:29,150 --> 00:05:27,960

even though he was a complete atheist um

116

00:05:32,450 --> 00:05:29,160

I think it would have been actually

117

00:05:34,550 --> 00:05:32,460

horrified to see how much his ideas have

118

00:05:36,830 --> 00:05:34,560

been kind of used to promote

119

00:05:43,189 --> 00:05:36,840

pseudoscience

120

00:05:46,070 --> 00:05:43,199

it seems like a very timely read too

121

00:05:49,390 --> 00:05:46,080

because Graham Hancock just put out a

122

00:05:53,150 --> 00:05:49,400

series on Netflix I believe

123

00:05:55,550 --> 00:05:53,160

the ancient Apocalypse series

124

00:05:57,710 --> 00:05:55,560

yeah that talks about like uh Atlantis

125

00:05:59,689 --> 00:05:57,720

and other sort of anti-diluvian

126
00:06:01,909 --> 00:05:59,699
civilizations

127
00:06:04,010 --> 00:06:01,919
so

128
00:06:06,350 --> 00:06:04,020
colavita mentions that

129
00:06:09,230 --> 00:06:06,360
um it's interesting how you often get

130
00:06:12,230 --> 00:06:09,240
like a switch in between which theory is

131
00:06:14,029 --> 00:06:12,240
more popular ancient astronauts at times

132
00:06:16,990 --> 00:06:14,039
and then it switches to the Atlanta

133
00:06:19,310 --> 00:06:17,000
style myths

134
00:06:21,350 --> 00:06:19,320
it kind of goes into the re the social

135
00:06:23,029 --> 00:06:21,360
reasons why that might be in the book as

136
00:06:25,189 --> 00:06:23,039
well

137
00:06:27,170 --> 00:06:25,199
yeah call of duto's been a part of the

138
00:06:30,170 --> 00:06:27,180

game for a long time you said the

139

00:06:31,309 --> 00:06:30,180

publication date was 2005. yeah that was

140

00:06:32,390 --> 00:06:31,319

his first book

141

00:06:36,249 --> 00:06:32,400

right

142

00:06:39,409 --> 00:06:36,259

he was running a um uh chat uh or a

143

00:06:41,270 --> 00:06:39,419

forum online in the early 2000s about

144

00:06:43,550 --> 00:06:41,280

ancient Mysteries

145

00:06:45,230 --> 00:06:43,560

and he was kind of initially when he was

146

00:06:47,150 --> 00:06:45,240

like a teenager he believed a lot of

147

00:06:49,309 --> 00:06:47,160

that stuff but then he became more

148

00:06:51,590 --> 00:06:49,319

skeptical when he saw the logical

149

00:06:54,170 --> 00:06:51,600

contradictions and things like that and

150

00:06:56,270 --> 00:06:54,180

then he set up that web forum and then

151
00:06:57,409 --> 00:06:56,280
kind of compiled that together into the

152
00:07:00,770 --> 00:06:57,419
book

153
00:07:03,529 --> 00:07:00,780
mm-hmm I've uh encountered Jason

154
00:07:06,890 --> 00:07:03,539
colavito's work numerous times in my

155
00:07:10,309 --> 00:07:06,900
research on the UFO subject in general

156
00:07:12,830 --> 00:07:10,319
from an academic perspective he has done

157
00:07:15,650 --> 00:07:12,840
a significant amount of work on the

158
00:07:19,550 --> 00:07:15,660
history of the National Security State

159
00:07:23,510 --> 00:07:19,560
in relation to UFOs and the

160
00:07:26,029 --> 00:07:23,520
use of ancient astronaut theory uh by

161
00:07:29,689 --> 00:07:26,039
Foreign actor specifically former Soviet

162
00:07:32,330 --> 00:07:29,699
Union to try to destabilize the domestic

163
00:07:35,350 --> 00:07:32,340

United States population with propaganda

164

00:07:39,350 --> 00:07:35,360

strategies related to interestingly

165

00:07:41,350 --> 00:07:39,360

racist themes that colavito touches on

166

00:07:44,330 --> 00:07:41,360

frequently in these

167

00:07:47,029 --> 00:07:44,340

historical Works where you you know yeah

168

00:07:49,249 --> 00:07:47,039

exactly and you sort of say it so if

169

00:07:50,990 --> 00:07:49,259

since the ancient culture doesn't seem

170

00:07:53,510 --> 00:07:51,000

to have been capable of doing this from

171

00:07:55,730 --> 00:07:53,520

our perspective it must have been some

172

00:07:58,610 --> 00:07:55,740

kind of super civilization you know yeah

173

00:08:01,010 --> 00:07:58,620

the Soviets were actually notorious for

174

00:08:03,490 --> 00:08:01,020

trying to stir up racial Strife in the

175

00:08:10,010 --> 00:08:06,430

probably wasn't super hard right

176

00:08:12,890 --> 00:08:10,020

there already a lot of fractures in the

177

00:08:14,570 --> 00:08:12,900

society that they could exploit but yeah

178

00:08:16,309 --> 00:08:14,580

um ancient astronauts at least for a

179

00:08:18,409 --> 00:08:16,319

time was one of those

180

00:08:21,409 --> 00:08:18,419

things that they used and um some of

181

00:08:23,150 --> 00:08:21,419

those myths that the Soviets snuck in

182

00:08:26,029 --> 00:08:23,160

um actually made their way into Von

183

00:08:28,010 --> 00:08:26,039

daniken's books

184

00:08:30,650 --> 00:08:28,020

even though Von daniken is like a

185

00:08:33,170 --> 00:08:30,660

conservative anti-communist type it's

186

00:08:35,570 --> 00:08:33,180

kind of ironic that right you know

187

00:08:37,490 --> 00:08:35,580

Communist Regime intelligence service

188

00:08:40,070 --> 00:08:37,500

propaganda was

189

00:08:41,449 --> 00:08:40,080

you know making its way into his

190

00:08:44,029 --> 00:08:41,459

propaganda

191

00:08:46,810 --> 00:08:44,039

and he he wrote uh as a chariot of the

192

00:08:49,310 --> 00:08:46,820

Gods is that right

193

00:08:52,370 --> 00:08:49,320

and what was the basic premise of that I

194

00:08:54,710 --> 00:08:52,380

don't recall well he was actually deeply

195

00:08:57,050 --> 00:08:54,720

influenced by mourning of The Magicians

196

00:08:59,810 --> 00:08:57,060

and he was actually sued by Paul and

197

00:09:01,250 --> 00:08:59,820

bergier to actually cite them in future

198

00:09:03,829 --> 00:09:01,260

editions of the book

199

00:09:05,870 --> 00:09:03,839

but um he was basically I think it was

200

00:09:08,090 --> 00:09:05,880

just a scam for him because he was a

201
00:09:09,889 --> 00:09:08,100
Swiss hotelier and um he was embezzling

202
00:09:12,110 --> 00:09:09,899
money to like travel around the world

203
00:09:13,490 --> 00:09:12,120
but then he made that because he was

204
00:09:16,009 --> 00:09:13,500
like doing research

205
00:09:17,630 --> 00:09:16,019
so this is like a damn ski story that's

206
00:09:19,850 --> 00:09:17,640
what it reminds me yeah exactly it

207
00:09:23,030 --> 00:09:19,860
probably was inspired by adamsky in some

208
00:09:25,970 --> 00:09:23,040
of the contactees to an extent but um

209
00:09:27,949 --> 00:09:25,980
yeah um I mean he just his premise was

210
00:09:30,370 --> 00:09:27,959
that uh aliens had visited the Earth in

211
00:09:32,449 --> 00:09:30,380
Antiquity and uh influenced human

212
00:09:34,370 --> 00:09:32,459
cultural development

213
00:09:37,190 --> 00:09:34,380

um gave us the tools for building the

214

00:09:41,090 --> 00:09:37,200

pyramids Etc and maybe even engineered

215

00:09:45,889 --> 00:09:42,949

right I mean

216

00:09:47,889 --> 00:09:45,899

there's this swaths of

217

00:09:52,009 --> 00:09:47,899

ancient

218

00:09:54,550 --> 00:09:52,019

alien slash alternative history books

219

00:09:57,590 --> 00:09:54,560

that were coming out in the 60s and 70s

220

00:09:59,630 --> 00:09:57,600

that I think very much laid the

221

00:10:03,889 --> 00:09:59,640

foundation for many of the talking

222

00:10:06,370 --> 00:10:03,899

points we see today I think of worlds in

223

00:10:09,470 --> 00:10:06,380

collision by

224

00:10:10,790 --> 00:10:09,480

villikovsky yes I think that's his last

225

00:10:14,930 --> 00:10:10,800

name

226

00:10:17,690 --> 00:10:14,940

um Zechariah sitchin Von daniken adamski

227

00:10:20,210 --> 00:10:17,700

and of course then we see these talking

228

00:10:23,329 --> 00:10:20,220

points and Views being eternally

229

00:10:25,610 --> 00:10:23,339

recycled again and again

230

00:10:28,070 --> 00:10:25,620

Yeah by Hancock

231

00:10:31,009 --> 00:10:28,080

um he was influenced by

232

00:10:33,170 --> 00:10:31,019

some what was a book by I think well

233

00:10:36,170 --> 00:10:33,180

different books but um Ignatius

234

00:10:38,050 --> 00:10:36,180

Donnelly's book about uh Atlantis and

235

00:10:41,030 --> 00:10:38,060

lemuria

236

00:10:44,350 --> 00:10:41,040

Donnelly was a I think he was a Indiana

237

00:10:47,269 --> 00:10:44,360

or Illinois Congressman in the

238

00:10:49,009 --> 00:10:47,279

1919th century

239

00:10:51,410 --> 00:10:49,019

um sort of around the time of blavatsky

240

00:10:53,509 --> 00:10:51,420

I think he actually influenced blavatsky

241

00:10:55,730 --> 00:10:53,519

as well because she also talked about

242

00:10:59,030 --> 00:10:55,740

like ancient civilizations and lost

243

00:11:01,009 --> 00:10:59,040

knowledge right yeah the the

244

00:11:03,110 --> 00:11:01,019

not only the ascended masters but like

245

00:11:05,530 --> 00:11:03,120

the seven root races and things like

246

00:11:07,790 --> 00:11:05,540

that right right yeah and lemurio

247

00:11:10,130 --> 00:11:07,800

Memoria yeah

248

00:11:11,810 --> 00:11:10,140

which is a big one actually um you see

249

00:11:13,790 --> 00:11:11,820

lemuria being mentioned again and again

250

00:11:17,210 --> 00:11:13,800

in the 20th century by various

251

00:11:18,889 --> 00:11:17,220

alternative archeology proponents but

252

00:11:21,170 --> 00:11:18,899

Hancock is like probably the most famous

253

00:11:24,230 --> 00:11:21,180

of the Atlantean

254

00:11:25,930 --> 00:11:24,240

um proponents he actually did dabble a

255

00:11:29,030 --> 00:11:25,940

little bit in ancient astronauts in the

256

00:11:31,790 --> 00:11:29,040

1990s like you know what Hogwart the guy

257

00:11:34,910 --> 00:11:31,800

with the the Martian face um oh Richard

258

00:11:37,730 --> 00:11:34,920

C Hoagland face on Mars science advisor

259

00:11:38,870 --> 00:11:37,740

to Walter Cronkite that was always well

260

00:11:41,389 --> 00:11:38,880

you claimed I don't even know if the guy

261

00:11:44,329 --> 00:11:41,399

has a high school diploma but no

262

00:11:48,170 --> 00:11:44,339

Hoagland is just full of crap but um

263

00:11:50,870 --> 00:11:48,180

he um he actually influenced uh Hancock

264

00:11:52,790 --> 00:11:50,880

for a while and Hancock was open to the

265

00:11:56,329 --> 00:11:52,800

idea that there may have been um ancient

266

00:11:58,370 --> 00:11:56,339

Martian civilizations but then he sort

267

00:11:59,750 --> 00:11:58,380

of let that go and then reverted back to

268

00:12:03,949 --> 00:11:59,760

the traditional

269

00:12:05,569 --> 00:12:03,959

um pure human Atlantis myths

270

00:12:09,250 --> 00:12:05,579

mm-hmm

271

00:12:12,730 --> 00:12:09,260

I my only encounter with Graham Hancock

272

00:12:16,069 --> 00:12:12,740

besides just the 1990s

273

00:12:17,930 --> 00:12:16,079

consumption of Art Bell like on a

274

00:12:19,449 --> 00:12:17,940

Perpetual basis

275

00:12:22,009 --> 00:12:19,459

um was I read his book super

276

00:12:23,329 --> 00:12:22,019

Supernatural a few years ago which is

277

00:12:25,430 --> 00:12:23,339

about

278

00:12:27,850 --> 00:12:25,440

um basically like mushroom Cults and

279

00:12:30,230 --> 00:12:27,860

fairies and the sort of perennialist

280

00:12:32,329 --> 00:12:30,240

associations of

281

00:12:34,370 --> 00:12:32,339

um hallucinogens and psychedelics and

282

00:12:35,990 --> 00:12:34,380

how they kind of tie into these numinous

283

00:12:38,870 --> 00:12:36,000

experiences

284

00:12:40,910 --> 00:12:38,880

um I not I say this without having an

285

00:12:43,730 --> 00:12:40,920

exhaustive familiarity with his Cannon

286

00:12:44,930 --> 00:12:43,740

but I thought it was an interesting book

287

00:12:46,730 --> 00:12:44,940

but

288

00:12:49,210 --> 00:12:46,740

um it also feels like it may be the one

289

00:12:52,190 --> 00:12:49,220

that is perhaps the most academically

290

00:12:55,069 --> 00:12:52,200

defensible compared to a lot of what

291

00:12:56,990 --> 00:12:55,079

other things he's been involved in yes I

292

00:12:59,090 --> 00:12:57,000

appreciate Brooke calling this out here

293

00:13:00,650 --> 00:12:59,100

Hoagland had an art bell pipeline he

294

00:13:02,269 --> 00:13:00,660

really did

295

00:13:04,009 --> 00:13:02,279

um showed up on the on the show

296

00:13:06,350 --> 00:13:04,019

constantly kind of the some of the best

297

00:13:08,930 --> 00:13:06,360

episodes were when Rick Richard Hoagland

298

00:13:11,389 --> 00:13:08,940

would be stuck across the debate table

299

00:13:13,910 --> 00:13:11,399

with someone that had actual science

300

00:13:17,810 --> 00:13:13,920

credentials and you had to listen

301
00:13:20,389 --> 00:13:17,820
to two people talk uh and debate I think

302
00:13:22,310 --> 00:13:20,399
there's an argument where or a debate

303
00:13:24,590 --> 00:13:22,320
show where he talked to like even Seth

304
00:13:25,370 --> 00:13:24,600
schostak at seti

305
00:13:27,110 --> 00:13:25,380
um

306
00:13:33,350 --> 00:13:27,120
which is like bringing a knife to a

307
00:13:37,610 --> 00:13:36,410
so I just um but before we jump into the

308
00:13:41,090 --> 00:13:37,620
complex

309
00:13:43,550 --> 00:13:41,100
life uh discussion which Lewis will be

310
00:13:45,230 --> 00:13:43,560
leading tonight so I'm just back from uh

311
00:13:48,769 --> 00:13:45,240
like a four day silent Meditation

312
00:13:51,650 --> 00:13:48,779
Retreat at a booze Center which was my

313
00:13:53,269 --> 00:13:51,660

first foray into this world and this

314

00:13:56,509 --> 00:13:53,279

experience

315

00:13:59,090 --> 00:13:56,519

um really fascinating extremely austere

316

00:14:01,490 --> 00:13:59,100

like 10 hours of silent meditation a day

317

00:14:02,990 --> 00:14:01,500

from when I arrived on campus on

318

00:14:06,110 --> 00:14:03,000

Thursday through when I departed Monday

319

00:14:08,569 --> 00:14:06,120

afternoon I didn't say a word except for

320

00:14:10,790 --> 00:14:08,579

about a five minute conversation with

321

00:14:13,730 --> 00:14:10,800

the retreat instructor where I talked

322

00:14:15,710 --> 00:14:13,740

about the genres and Robert burbella and

323

00:14:18,290 --> 00:14:15,720

access like acts like access

324

00:14:21,290 --> 00:14:18,300

concentration associated with meditation

325

00:14:24,110 --> 00:14:21,300

and

326

00:14:26,930 --> 00:14:24,120

it's it's interesting my I've been asked

327

00:14:28,129 --> 00:14:26,940

a lot about my experience and takeaways

328

00:14:29,870 --> 00:14:28,139

from it

329

00:14:34,430 --> 00:14:29,880

and

330

00:14:36,949 --> 00:14:34,440

processing

331

00:14:40,750 --> 00:14:36,959

um but I I

332

00:14:43,850 --> 00:14:40,760

would assess the time there is

333

00:14:46,730 --> 00:14:43,860

overwhelmingly good complicated in the

334

00:14:49,370 --> 00:14:46,740

sense that it is arduous and difficult

335

00:14:52,009 --> 00:14:49,380

to sit like that in intense meditation

336

00:14:52,910 --> 00:14:52,019

in a silent environment

337

00:14:54,889 --> 00:14:52,920

um

338

00:14:56,389 --> 00:14:54,899

and kind of

339

00:14:59,389 --> 00:14:56,399

um not just spend time like that

340

00:15:01,189 --> 00:14:59,399

internally but also the associated I

341

00:15:03,889 --> 00:15:01,199

would say ego unwinding that happens

342

00:15:06,470 --> 00:15:03,899

when you're in that kind of state

343

00:15:08,930 --> 00:15:06,480

um but like many other things in my life

344

00:15:11,030 --> 00:15:08,940

it falls squarely into type 2 fun where

345

00:15:13,009 --> 00:15:11,040

when I got in my car Monday afternoon I

346

00:15:15,350 --> 00:15:13,019

was like I'm never [\h__\h] do that again

347

00:15:17,090 --> 00:15:15,360

like this is awful I'm never doing it I

348

00:15:20,750 --> 00:15:17,100

can't wait to get home and then like

349

00:15:22,670 --> 00:15:20,760

last night like 36 hours later I was

350

00:15:24,710 --> 00:15:22,680

like man I really hope I get the chance

351

00:15:25,970 --> 00:15:24,720

to do this again soon this was really

352

00:15:27,590 --> 00:15:25,980

cool

353

00:15:29,750 --> 00:15:27,600

um and I can still feel some of the

354

00:15:31,850 --> 00:15:29,760

reverberations internally like my mind

355

00:15:35,389 --> 00:15:31,860

is much quieter

356

00:15:37,730 --> 00:15:35,399

um it certainly helped helps me feel

357

00:15:39,290 --> 00:15:37,740

much more confident in these sustained

358

00:15:40,370 --> 00:15:39,300

states of

359

00:15:42,769 --> 00:15:40,380

um

360

00:15:44,329 --> 00:15:42,779

internal attention I wasn't sure how I'd

361

00:15:46,430 --> 00:15:44,339

do sort of without the normal

362

00:15:49,069 --> 00:15:46,440

distractions

363

00:15:51,050 --> 00:15:49,079

um and socialization but it also made

364

00:15:53,389 --> 00:15:51,060

very clear to me that

365

00:15:55,430 --> 00:15:53,399

um working up to more sustained Retreat

366

00:15:58,250 --> 00:15:55,440

practices like 10 days or two weeks or

367

00:16:00,110 --> 00:15:58,260

even a month is much further down the

368

00:16:02,569 --> 00:16:00,120

road than I expected

369

00:16:05,870 --> 00:16:02,579

um but how a very cool experience

370

00:16:07,189 --> 00:16:05,880

overall how was it guided I was

371

00:16:08,870 --> 00:16:07,199

wondering about that

372

00:16:11,150 --> 00:16:08,880

um do you have to do sort of prep stuff

373

00:16:12,769 --> 00:16:11,160

in advance is it silent the entire time

374

00:16:14,629 --> 00:16:12,779

is somebody sort of talking instructing

375

00:16:17,090 --> 00:16:14,639

as everyone is silent how does that work

376

00:16:18,350 --> 00:16:17,100

it's it's a great question

377

00:16:21,410 --> 00:16:18,360

um

378

00:16:24,350 --> 00:16:21,420

so the typically these Retreats will

379

00:16:26,689 --> 00:16:24,360

have some kind of guiding subject and

380

00:16:30,170 --> 00:16:26,699

the the nature of this retreat was the

381

00:16:31,430 --> 00:16:30,180

Brahma vaharas which are those four kind

382

00:16:34,430 --> 00:16:31,440

of

383

00:16:38,210 --> 00:16:34,440

um cultivated States in Buddhism there's

384

00:16:41,689 --> 00:16:38,220

compassion loving kindness

385

00:16:45,350 --> 00:16:41,699

um sympathetic joy and equanimity

386

00:16:48,110 --> 00:16:45,360

and so we would have

387

00:16:51,230 --> 00:16:48,120

our own silent meditation without any

388

00:16:55,670 --> 00:16:51,240

sort of instructor involvement for about

389

00:16:58,670 --> 00:16:55,680

10 hours a day broken up with sitting

390

00:16:59,629 --> 00:16:58,680

and walking and there was no

391

00:17:02,629 --> 00:16:59,639

um

392

00:17:05,329 --> 00:17:02,639

no verbal communication at all we had a

393

00:17:07,850 --> 00:17:05,339

a bell that would get wrong at 30 minute

394

00:17:08,990 --> 00:17:07,860

increments so you could time and decide

395

00:17:10,490 --> 00:17:09,000

if you're going to stay on your pillow

396

00:17:13,370 --> 00:17:10,500

versus go for a walk

397

00:17:15,230 --> 00:17:13,380

but then in addition to the meditation

398

00:17:18,289 --> 00:17:15,240

sessions there would be

399

00:17:20,990 --> 00:17:18,299

excuse me four hours a day of Dharma

400

00:17:23,329 --> 00:17:21,000

talks which for the uninitiated Dharma

401
00:17:25,250 --> 00:17:23,339
talk is I think what a Christian would

402
00:17:27,110 --> 00:17:25,260
call like a homily like they would be a

403
00:17:28,429 --> 00:17:27,120
selection of readings from the poly

404
00:17:30,830 --> 00:17:28,439
Canon

405
00:17:32,870 --> 00:17:30,840
um well this particular retreat was not

406
00:17:35,930 --> 00:17:32,880
of a lineage

407
00:17:37,909 --> 00:17:35,940
um it was based on a lot of work of

408
00:17:40,250 --> 00:17:37,919
monastics in the Terra Vaden tradition

409
00:17:42,590 --> 00:17:40,260
which is a kind of very Orthodox in a

410
00:17:45,970 --> 00:17:42,600
sense it's very adherent to the

411
00:17:49,909 --> 00:17:45,980
um original Canon the poly Cannon

412
00:17:51,890 --> 00:17:49,919
and during the Dharma talks we would uh

413
00:17:54,049 --> 00:17:51,900

the instructor would speak to us

414

00:17:58,010 --> 00:17:54,059

typically we'd open with 15-minute

415

00:18:00,470 --> 00:17:58,020

silent practice then 30 to 45 minutes of

416

00:18:03,350 --> 00:18:00,480

discussion of particular excerpts from

417

00:18:04,669 --> 00:18:03,360

the poly Canon about

418

00:18:07,490 --> 00:18:04,679

um you know

419

00:18:11,930 --> 00:18:07,500

um loving kindness or Compassion or

420

00:18:13,010 --> 00:18:11,940

Equanimity or sympathetic joy and then

421

00:18:15,470 --> 00:18:13,020

um

422

00:18:17,870 --> 00:18:15,480

the the last part of the Dharma talk

423

00:18:20,750 --> 00:18:17,880

would typically be some kind of guided

424

00:18:22,190 --> 00:18:20,760

meditation so the instructor would sit

425

00:18:25,730 --> 00:18:22,200

in the front of the room we would be all

426

00:18:27,909 --> 00:18:25,740

on our pillows or on our chairs and she

427

00:18:32,090 --> 00:18:27,919

would

428

00:18:33,950 --> 00:18:32,100

in perfect meditation guiding voice tell

429

00:18:36,049 --> 00:18:33,960

us what we should think about what we

430

00:18:38,150 --> 00:18:36,059

should cultivate where we would feel it

431

00:18:40,250 --> 00:18:38,160

in our Soma like as an embodied

432

00:18:41,210 --> 00:18:40,260

experience

433

00:18:42,770 --> 00:18:41,220

um

434

00:18:44,750 --> 00:18:42,780

so that's that was really the only

435

00:18:46,970 --> 00:18:44,760

instruction provided

436

00:18:49,010 --> 00:18:46,980

for our silent Retreat time we could

437

00:18:52,430 --> 00:18:49,020

practice any kind of meditation we

438

00:18:56,450 --> 00:18:52,440

wanted so mindfulness Insight

439

00:18:58,789 --> 00:18:56,460

um genas meta I mostly focused on meta

440

00:19:01,370 --> 00:18:58,799

and trying to get into this some of the

441

00:19:02,690 --> 00:19:01,380

genres the first or second genre which

442

00:19:05,210 --> 00:19:02,700

is

443

00:19:08,090 --> 00:19:05,220

um considered like an altered state it's

444

00:19:12,130 --> 00:19:08,100

like a ecstatic kind of feeling

445

00:19:15,830 --> 00:19:12,140

um but I I will say too

446

00:19:18,710 --> 00:19:15,840

attending so I have the great Fortune of

447

00:19:21,350 --> 00:19:18,720

having a lot of time right now in my

448

00:19:25,130 --> 00:19:21,360

life so I do have the personal time to

449

00:19:27,470 --> 00:19:25,140

invest in meditation but from a group

450

00:19:28,970 --> 00:19:27,480

dynamic perspective I did find it very

451
00:19:30,830 --> 00:19:28,980
helpful to be in a group environment

452
00:19:33,049 --> 00:19:30,840
there's just a kind of different so like

453
00:19:35,630 --> 00:19:33,059
energy to the experience

454
00:19:38,450 --> 00:19:35,640
but I also found

455
00:19:40,549 --> 00:19:38,460
while excruciating like my hip flexors

456
00:19:42,529 --> 00:19:40,559
are still angry at me for sitting on

457
00:19:45,830 --> 00:19:42,539
that little pillow for

458
00:19:46,970 --> 00:19:45,840
30 hours or however many hours I did

459
00:19:49,430 --> 00:19:46,980
um

460
00:19:51,590 --> 00:19:49,440
it feels like this accelerated my

461
00:19:53,150 --> 00:19:51,600
practice in a substantial way in such a

462
00:19:55,669 --> 00:19:53,160
short period of time where it's much

463
00:19:58,010 --> 00:19:55,679

easier to access those States now when I

464

00:19:59,690 --> 00:19:58,020

sit down to meditate so it kind of in a

465

00:20:01,850 --> 00:19:59,700

sense was a jump start and you'll hear

466

00:20:03,950 --> 00:20:01,860

people report this sort of the

467

00:20:05,510 --> 00:20:03,960

conventional or standard hardcore

468

00:20:07,610 --> 00:20:05,520

introduction to meditation a lot of

469

00:20:10,130 --> 00:20:07,620

westerners have is through a goenka or

470

00:20:12,650 --> 00:20:10,140

vipassana Retreat which are these free

471

00:20:14,750 --> 00:20:12,660

10-day Retreats that are extremely

472

00:20:16,850 --> 00:20:14,760

austere same deal like eight to ten

473

00:20:19,510 --> 00:20:16,860

hours a day of meditation and they

474

00:20:22,250 --> 00:20:19,520

basically will kick-start your practice

475

00:20:24,010 --> 00:20:22,260

in a way that in theory will be a

476

00:20:27,890 --> 00:20:24,020

sustainable after

477

00:20:31,250 --> 00:20:27,900

the the retreat but I am

478

00:20:32,750 --> 00:20:31,260

it's in terms of I'm sorry I'm like

479

00:20:34,549 --> 00:20:32,760

totally going off on my like current

480

00:20:36,590 --> 00:20:34,559

special interest which is obviously

481

00:20:40,010 --> 00:20:36,600

meditation and Buddhism

482

00:20:42,169 --> 00:20:40,020

um but I I work with a pragmatic Dharma

483

00:20:43,789 --> 00:20:42,179

teacher right now so this is basically

484

00:20:45,470 --> 00:20:43,799

Buddhism without the supernatural

485

00:20:47,330 --> 00:20:45,480

elements it's just like almost like

486

00:20:49,970 --> 00:20:47,340

having a coach

487

00:20:51,289 --> 00:20:49,980

um but have I'm taking like a sweeping

488

00:20:53,210 --> 00:20:51,299

tour through a lot of the different

489

00:20:56,090 --> 00:20:53,220

lineages

490

00:20:59,029 --> 00:20:56,100

um before deciding if I even want to

491

00:21:02,990 --> 00:20:59,039

affiliate with one or associate with one

492

00:21:05,270 --> 00:21:03,000

um I'm especially drawn to ecstatic and

493

00:21:07,330 --> 00:21:05,280

mystical branches so I'm super

494

00:21:09,470 --> 00:21:07,340

interested in like Tantra and vatriana

495

00:21:11,090 --> 00:21:09,480

which is like more of the Tibetan

496

00:21:14,630 --> 00:21:11,100

tradition which has a lot of these like

497

00:21:17,090 --> 00:21:14,640

deities and art and kind of these more

498

00:21:19,010 --> 00:21:17,100

Arcane and occult in the sense of like

499

00:21:20,810 --> 00:21:19,020

hidden practices that can only be

500

00:21:22,610 --> 00:21:20,820

introduced to you by a particular

501
00:21:25,010 --> 00:21:22,620
teacher

502
00:21:26,930 --> 00:21:25,020
um but until I I think I've had a more

503
00:21:29,750 --> 00:21:26,940
holistic survey of these different

504
00:21:31,610 --> 00:21:29,760
schools some lineages like I'm just in

505
00:21:33,590 --> 00:21:31,620
the pragmatic School of just practicing

506
00:21:35,330 --> 00:21:33,600
and getting used to meditation and kind

507
00:21:36,890 --> 00:21:35,340
of learning the the nuts and bolts of

508
00:21:39,909 --> 00:21:36,900
the systems

509
00:21:44,149 --> 00:21:41,830
so

510
00:21:48,049 --> 00:21:44,159
it's a it's a good it's another good

511
00:21:50,090 --> 00:21:48,059
question so Kundalini Yoga as a thing is

512
00:21:52,370 --> 00:21:50,100
actually almost a proprietary kind of

513
00:21:55,970 --> 00:21:52,380

yoga that was developed

514

00:21:59,630 --> 00:21:55,980

um for practitioners it involves some

515

00:22:03,950 --> 00:21:59,640

breath work and some um like dynamic

516

00:22:06,230 --> 00:22:03,960

movements instead of like holds or poses

517

00:22:08,690 --> 00:22:06,240

um but Kundalini Yoga is a categorically

518

00:22:10,970 --> 00:22:08,700

distinct thing from Kundalini or like a

519

00:22:13,370 --> 00:22:10,980

Kundalini Awakening people do experience

520

00:22:16,789 --> 00:22:13,380

Kundalini Awakenings after practicing

521

00:22:19,130 --> 00:22:16,799

Kundalini Yoga but Kundalini Yoga is

522

00:22:21,409 --> 00:22:19,140

almost like a um it's almost like a

523

00:22:23,690 --> 00:22:21,419

brand name for this one particular style

524

00:22:27,409 --> 00:22:23,700

of yoga that was developed whereas

525

00:22:30,649 --> 00:22:27,419

Kundalini itself is this idea

526

00:22:32,270 --> 00:22:30,659

um of almost like Chi or like trapped

527

00:22:34,130 --> 00:22:32,280

energy and then these Awakening

528

00:22:35,630 --> 00:22:34,140

experiences which typically fall under

529

00:22:40,190 --> 00:22:35,640

the umbrella of like a spiritual

530

00:22:42,289 --> 00:22:40,200

emergence manifest in things like

531

00:22:46,850 --> 00:22:45,110

I would say like ecstatic states of

532

00:22:49,130 --> 00:22:46,860

bliss or Transcendence like classical

533

00:22:52,430 --> 00:22:49,140

mystical experiences

534

00:22:55,010 --> 00:22:52,440

um uh a sense of cognitive enhancement a

535

00:22:57,649 --> 00:22:55,020

sense of increased energy people report

536

00:22:59,210 --> 00:22:57,659

um it's intensely physical

537

00:23:01,010 --> 00:22:59,220

um and like people report everything

538

00:23:01,730 --> 00:23:01,020

from like

539

00:23:03,890 --> 00:23:01,740

um

540

00:23:05,690 --> 00:23:03,900

feeling like they are not in control of

541

00:23:07,310 --> 00:23:05,700

their bodies and assuming Creos are

542

00:23:09,409 --> 00:23:07,320

particular positions all the way through

543

00:23:11,330 --> 00:23:09,419

like people reporting spontaneous orgasm

544

00:23:13,570 --> 00:23:11,340

and stuff like that so like Kundalini

545

00:23:16,870 --> 00:23:13,580

Awakenings just become this kind of like

546

00:23:19,010 --> 00:23:16,880

waste-paced Waste Paper basket of

547

00:23:23,210 --> 00:23:19,020

experiences that people who happen to do

548

00:23:25,190 --> 00:23:23,220

yoga or meditation associate with uh

549

00:23:27,409 --> 00:23:25,200

the term Kundalini

550

00:23:30,049 --> 00:23:27,419

it's interesting that there are so many

551
00:23:32,810 --> 00:23:30,059
different effects that people report

552
00:23:34,789 --> 00:23:32,820
from the different practices and it

553
00:23:36,409 --> 00:23:34,799
reminds me of something that somebody I

554
00:23:38,029 --> 00:23:36,419
knew uh before they went to University

555
00:23:40,930 --> 00:23:38,039
was telling me about and then they went

556
00:23:43,490 --> 00:23:40,940
to University for uh Chiropractic

557
00:23:46,310 --> 00:23:43,500
and they were into sports a lot so they

558
00:23:48,830 --> 00:23:46,320
knew the functional benefits and uh when

559
00:23:50,930 --> 00:23:48,840
they were going into the Chiropractic I

560
00:23:53,270 --> 00:23:50,940
was telling them oh you know you have to

561
00:23:55,730 --> 00:23:53,280
be mindful there is that underlying

562
00:23:58,010 --> 00:23:55,740
philosophy that's sort of a little bit

563
00:24:00,110 --> 00:23:58,020

not based on the scientific method

564

00:24:02,210 --> 00:24:00,120

anything yeah and they they were like

565

00:24:04,130 --> 00:24:02,220

what do you like they had no idea what I

566

00:24:06,890 --> 00:24:04,140

was talking about a little bit offended

567

00:24:08,330 --> 00:24:06,900

because they had used it so much and it

568

00:24:10,070 --> 00:24:08,340

was this classic thing that we've talked

569

00:24:13,130 --> 00:24:10,080

about so many times that you can observe

570

00:24:16,070 --> 00:24:13,140

an effect but to attribute that effect

571

00:24:18,830 --> 00:24:16,080

to a particular cause is not necessarily

572

00:24:20,090 --> 00:24:18,840

true right so Chiropractic it's like the

573

00:24:21,529 --> 00:24:20,100

actual philosophy says that there's

574

00:24:23,810 --> 00:24:21,539

something called like inherent

575

00:24:26,149 --> 00:24:23,820

intelligence flowing through our bodies

576

00:24:27,770 --> 00:24:26,159

and that the channels of the inherent

577

00:24:29,870 --> 00:24:27,780

intelligence can be misaligned and stuff

578

00:24:31,730 --> 00:24:29,880

like that that's not based in anything

579

00:24:34,430 --> 00:24:31,740

scientific but

580

00:24:35,270 --> 00:24:34,440

through practicing the actual uh you

581

00:24:37,490 --> 00:24:35,280

know

582

00:24:40,010 --> 00:24:37,500

whatever process the modality of

583

00:24:41,570 --> 00:24:40,020

chiropractic medicine you produce these

584

00:24:43,549 --> 00:24:41,580

uh functional benefits that are very

585

00:24:45,710 --> 00:24:43,559

well established

586

00:24:49,549 --> 00:24:45,720

that makes me wonder if this is similar

587

00:24:52,490 --> 00:24:49,559

in in another life when I was

588

00:24:54,710 --> 00:24:52,500

um like basically a semi-pro strength

589

00:24:58,250 --> 00:24:54,720

athlete like regularly lifting

590

00:25:00,529 --> 00:24:58,260

um Computing there's of course

591

00:25:03,169 --> 00:25:00,539

um everyone who I would train with would

592

00:25:05,090 --> 00:25:03,179

also have a chiropractor and I I have

593

00:25:05,750 --> 00:25:05,100

never been to one

594

00:25:08,630 --> 00:25:05,760

um

595

00:25:11,330 --> 00:25:08,640

but my sense is that a very good

596

00:25:13,250 --> 00:25:11,340

chiropractor is effectively just a

597

00:25:14,570 --> 00:25:13,260

physical therapist in the sense that

598

00:25:16,190 --> 00:25:14,580

they're going to be doing very similar

599

00:25:18,710 --> 00:25:16,200

practices that a physical therapist

600

00:25:20,090 --> 00:25:18,720

would do but particularly in America I

601
00:25:22,310 --> 00:25:20,100
don't know what this is like in Canada

602
00:25:24,529 --> 00:25:22,320
but here if you go to chiropractor

603
00:25:27,590 --> 00:25:24,539
school I think you can call yourself a

604
00:25:30,169 --> 00:25:27,600
doctor which is obviously confers a

605
00:25:32,510 --> 00:25:30,179
degree of legitimacy onto this what is

606
00:25:35,690 --> 00:25:32,520
effectively a pseudoscientific healing

607
00:25:37,190 --> 00:25:35,700
modality or alternative healing modality

608
00:25:39,289 --> 00:25:37,200
whatever I don't like

609
00:25:40,970 --> 00:25:39,299
I know I understand that it works for

610
00:25:42,230 --> 00:25:40,980
people so I'm definitely not denigrating

611
00:25:43,130 --> 00:25:42,240
that

612
00:25:46,370 --> 00:25:43,140
um

613
00:25:48,169 --> 00:25:46,380

but also Insurance our private health

614

00:25:50,750 --> 00:25:48,179

insurance most insurance policies will

615

00:25:53,269 --> 00:25:50,760

cover chiropractic treatment

616

00:25:54,470 --> 00:25:53,279

um which between those two things I

617

00:25:57,470 --> 00:25:54,480

think

618

00:26:00,169 --> 00:25:57,480

um creates a legitimacy that at the root

619

00:26:02,570 --> 00:26:00,179

of this discipline or practice I

620

00:26:05,149 --> 00:26:02,580

candidly don't think exists but like the

621

00:26:07,010 --> 00:26:05,159

original like Orthodoxy of Chiropractic

622

00:26:08,870 --> 00:26:07,020

work is basically like you can crack

623

00:26:11,330 --> 00:26:08,880

your back and cure your allergies and

624

00:26:13,070 --> 00:26:11,340

stuff and yes it's um

625

00:26:15,409 --> 00:26:13,080

I think the way it's conventionally

626

00:26:18,110 --> 00:26:15,419

practiced now is a far cry from that but

627

00:26:20,570 --> 00:26:18,120

it still is not scientifically grounded

628

00:26:21,950 --> 00:26:20,580

in any meaningful sense I think that was

629

00:26:24,110 --> 00:26:21,960

a great point you just made about

630

00:26:26,450 --> 00:26:24,120

insurance and Licensing I actually

631

00:26:28,970 --> 00:26:26,460

worked in uh this Ontario provincially I

632

00:26:32,090 --> 00:26:28,980

worked at a healthcare licensing

633

00:26:33,890 --> 00:26:32,100

provincial regulator and it is exactly

634

00:26:36,470 --> 00:26:33,900

what you're talking about there are

635

00:26:37,510 --> 00:26:36,480

issues where for example uh health

636

00:26:42,769 --> 00:26:37,520

insurance

637

00:26:45,350 --> 00:26:42,779

will be uh provided through forced

638

00:26:47,990 --> 00:26:45,360

registration to certain Health Care

639

00:26:50,210 --> 00:26:48,000

practitioners so if you practice

640

00:26:52,130 --> 00:26:50,220

you know anything involving manipulation

641

00:26:53,930 --> 00:26:52,140

of the soft tissue yada yada then you

642

00:26:55,730 --> 00:26:53,940

have to register as a massage therapist

643

00:26:58,430 --> 00:26:55,740

but then you also have someone who's

644

00:27:00,350 --> 00:26:58,440

practicing something like Reiki doing

645

00:27:03,529 --> 00:27:00,360

those activities and they register as a

646

00:27:06,529 --> 00:27:03,539

massage therapist so the purpose of

647

00:27:07,789 --> 00:27:06,539

getting people to be licensed is not to

648

00:27:11,090 --> 00:27:07,799

give them

649

00:27:13,310 --> 00:27:11,100

um you know a sense of uh their thing

650

00:27:16,490 --> 00:27:13,320

they're doing being true it is to

651
00:27:18,769 --> 00:27:16,500
protect the public from potential harm

652
00:27:19,970 --> 00:27:18,779
so licensing is actually the reverse of

653
00:27:22,970 --> 00:27:19,980
how people usually think about it people

654
00:27:24,769 --> 00:27:22,980
are forced to be licensed in order to be

655
00:27:26,810 --> 00:27:24,779
insured to protect other people against

656
00:27:28,190 --> 00:27:26,820
possible harm they might cause it has

657
00:27:30,950 --> 00:27:28,200
nothing to do with like the legitimacy

658
00:27:33,529 --> 00:27:30,960
of the underlying act so that's sort of

659
00:27:37,190 --> 00:27:33,539
the sense I was trying to get at there

660
00:27:40,549 --> 00:27:37,200
um anyway uh I'd love to Pivot and maybe

661
00:27:42,230 --> 00:27:40,559
dive into our primary subject if uh yes

662
00:27:44,990 --> 00:27:42,240
it's okay with that I'm really excited

663
00:27:48,169 --> 00:27:45,000

for it yeah yeah let's do it

664

00:27:50,990 --> 00:27:48,179

um so Lewis sure

665

00:27:53,029 --> 00:27:51,000

folder yes share your share your folder

666

00:27:55,190 --> 00:27:53,039

and I was just gonna say that this is

667

00:27:56,330 --> 00:27:55,200

you know you just finished that book by

668

00:27:57,769 --> 00:27:56,340

Nick Lane

669

00:27:59,029 --> 00:27:57,779

um actually he read both of his books

670

00:28:01,250 --> 00:27:59,039

didn't you

671

00:28:03,110 --> 00:28:01,260

um latest uh books he's got other books

672

00:28:05,690 --> 00:28:03,120

I haven't gone into yet but I can talk

673

00:28:09,950 --> 00:28:05,700

some a little bit about those

674

00:28:14,049 --> 00:28:09,960

um those ones and um some other things

675

00:28:19,669 --> 00:28:17,570

little screen

676

00:28:22,909 --> 00:28:19,679

thank you

677

00:28:24,169 --> 00:28:22,919

also a big shout out to my parents who I

678

00:28:26,750 --> 00:28:24,179

think are tuning in for the first time

679

00:28:28,730 --> 00:28:26,760

tonight so I'll keep the Psychedelic

680

00:28:31,490 --> 00:28:28,740

chat too a minimum and just talk about

681

00:28:34,870 --> 00:28:31,500

the wholesome subject of evolutionary

682

00:28:40,070 --> 00:28:38,090

figure out a way to shoehorn it in here

683

00:28:42,470 --> 00:28:40,080

somehow

684

00:28:43,909 --> 00:28:42,480

like every week we've managed is that

685

00:28:45,409 --> 00:28:43,919

sharing now

686

00:28:46,730 --> 00:28:45,419

um no so I'm gonna get you added to this

687

00:28:48,470 --> 00:28:46,740

room I'm going to get it added to the

688

00:28:49,970 --> 00:28:48,480

stream but what

689

00:28:52,730 --> 00:28:49,980

do you want to open up what you're going

690

00:28:54,890 --> 00:28:52,740

to share first oh yeah there we go you

691

00:28:57,649 --> 00:28:54,900

see that beautiful yeah let me get this

692

00:28:59,870 --> 00:28:57,659

out of here so I did initially have

693

00:29:02,029 --> 00:28:59,880

slides that I wanted to show but I think

694

00:29:03,769 --> 00:29:02,039

um the subject is just so Broad and

695

00:29:05,750 --> 00:29:03,779

complex that um

696

00:29:07,310 --> 00:29:05,760

well mirroring the actual subject itself

697

00:29:09,769 --> 00:29:07,320

that um

698

00:29:11,570 --> 00:29:09,779

I just uh didn't find it very economical

699

00:29:13,610 --> 00:29:11,580

I'll just have some

700

00:29:15,710 --> 00:29:13,620

notes next to me that I'll read and then

701
00:29:17,390 --> 00:29:15,720
just show some pictures to kind of guide

702
00:29:19,070 --> 00:29:17,400
the discussion and you guys can just

703
00:29:20,630 --> 00:29:19,080
jump in

704
00:29:23,630 --> 00:29:20,640
Okay so

705
00:29:26,930 --> 00:29:23,640
you see any any uh comments by the way

706
00:29:28,789 --> 00:29:26,940
guys you could just tell me now that the

707
00:29:32,149 --> 00:29:28,799
viewers are making

708
00:29:35,870 --> 00:29:32,159
um so this is going to be about a

709
00:29:39,649 --> 00:29:35,880
complexity of evolution in biological in

710
00:29:41,149 --> 00:29:39,659
the biosphere so complex organisms

711
00:29:42,710 --> 00:29:41,159
um and some of the implications for

712
00:29:44,149 --> 00:29:42,720
extraterrestrials

713
00:29:47,210 --> 00:29:44,159

I was going to talk a little bit about

714

00:29:49,789 --> 00:29:47,220

human intelligence and cognition

715

00:29:50,930 --> 00:29:49,799

and maybe also a bit about the Fermi

716

00:29:52,549 --> 00:29:50,940

paradox

717

00:29:54,010 --> 00:29:52,559

great so

718

00:29:57,830 --> 00:29:54,020

um life

719

00:30:00,289 --> 00:29:57,840

uh you know it's possibly widespread in

720

00:30:01,970 --> 00:30:00,299

the universe and you often hear the the

721

00:30:03,830 --> 00:30:01,980

claim that you know it's so the universe

722

00:30:05,570 --> 00:30:03,840

is so big that there has to be life out

723

00:30:08,450 --> 00:30:05,580

there although that's not necessarily

724

00:30:10,490 --> 00:30:08,460

true but let's say that there is life

725

00:30:12,950 --> 00:30:10,500

out there and it's common it does not

726

00:30:14,930 --> 00:30:12,960

mean that it's complex life in the sense

727

00:30:19,250 --> 00:30:14,940

of multicellular

728

00:30:21,769 --> 00:30:19,260

um life it's got you know varied tissues

729

00:30:24,350 --> 00:30:21,779

and organ systems or complex nervous

730

00:30:26,090 --> 00:30:24,360

systems and things like that it could be

731

00:30:27,470 --> 00:30:26,100

the case that most life in the universe

732

00:30:28,549 --> 00:30:27,480

is simply

733

00:30:32,630 --> 00:30:28,559

foreign

734

00:30:35,210 --> 00:30:32,640

like prokaryotic life on Earth so that

735

00:30:37,090 --> 00:30:35,220

is like bacteria and archaea those are

736

00:30:39,470 --> 00:30:37,100

multicellular sorry unicellular

737

00:30:42,350 --> 00:30:39,480

organisms that live on earth they're the

738

00:30:45,769 --> 00:30:42,360

oldest types of life and uh we are

739

00:30:47,029 --> 00:30:45,779

eukaryotes so animals plants protists

740

00:30:48,350 --> 00:30:47,039

fungi

741

00:30:51,350 --> 00:30:48,360

are

742

00:30:54,110 --> 00:30:51,360

uh eukaryotes okay

743

00:30:55,970 --> 00:30:54,120

so eukaryotes have got complex

744

00:30:59,090 --> 00:30:55,980

let me just show you this

745

00:31:03,169 --> 00:31:01,310

um we should put the links to the images

746

00:31:06,350 --> 00:31:03,179

by the way but I got these mostly from

747

00:31:08,570 --> 00:31:06,360

Wikipedia and I apologize for the dark

748

00:31:12,110 --> 00:31:08,580

background here because it's

749

00:31:14,149 --> 00:31:12,120

uh oh it's a transparent image right

750

00:31:16,430 --> 00:31:14,159

yeah but I'll just read you what is

751

00:31:18,590 --> 00:31:16,440

shown in here so this is the interior of

752

00:31:21,289 --> 00:31:18,600

a eukaryotic cell as we would find in

753

00:31:23,149 --> 00:31:21,299

our own bodies although we've got uh

754

00:31:25,850 --> 00:31:23,159

prokaryotes as well which help us do

755

00:31:28,549 --> 00:31:25,860

things like digest certain things which

756

00:31:31,370 --> 00:31:28,559

we can't do by ourselves so gut bacteria

757

00:31:33,289 --> 00:31:31,380

are still very important but eukaryotic

758

00:31:34,730 --> 00:31:33,299

cells have got these complex internal

759

00:31:38,389 --> 00:31:34,740

organelles

760

00:31:41,570 --> 00:31:38,399

which are uh enclosed by membranes so

761

00:31:44,690 --> 00:31:41,580

you see here the nucleus that's got

762

00:31:46,909 --> 00:31:44,700

um the most of the DNA in the cell which

763

00:31:49,190 --> 00:31:46,919

is locked in here

764

00:31:52,549 --> 00:31:49,200

um in the form of linear DNA so linear

765

00:31:54,070 --> 00:31:52,559

chromosomes whereas bacteria have got

766

00:31:56,750 --> 00:31:54,080

um circular

767

00:31:59,510 --> 00:31:56,760

chromosomes okay

768

00:32:00,529 --> 00:31:59,520

so this nucleus has got pores through

769

00:32:01,310 --> 00:32:00,539

which

770

00:32:03,889 --> 00:32:01,320

um

771

00:32:07,010 --> 00:32:03,899

messenger RNA passes out into the

772

00:32:09,590 --> 00:32:07,020

cytoplasm and the messenger RNA is

773

00:32:12,889 --> 00:32:09,600

basically a transcribed copy of the DNA

774

00:32:14,149 --> 00:32:12,899

and it's going to be used to translate

775

00:32:16,870 --> 00:32:14,159

um it's going to be translated into

776

00:32:18,950 --> 00:32:16,880

protein so proteins are

777

00:32:20,330 --> 00:32:18,960

macromolecules which we use for

778

00:32:22,310 --> 00:32:20,340

thousands of different things in our

779

00:32:24,710 --> 00:32:22,320

bodies and then you've got these other

780

00:32:27,169 --> 00:32:24,720

organelles like the rough endoplasmic

781

00:32:28,549 --> 00:32:27,179

reticulum the smooth endoplasmic

782

00:32:32,269 --> 00:32:28,559

reticulum

783

00:32:35,210 --> 00:32:32,279

the Golgi apparatus lysosomes

784

00:32:37,310 --> 00:32:35,220

um various vesicles and so these are

785

00:32:39,409 --> 00:32:37,320

like for processing proteins further or

786

00:32:41,750 --> 00:32:39,419

packaging materials sending them to

787

00:32:44,149 --> 00:32:41,760

different parts of the cell or breaking

788

00:32:46,750 --> 00:32:44,159

uh breaking apart certain molecules or

789

00:32:49,549 --> 00:32:46,760

toxins and stuff like that

790

00:32:51,830 --> 00:32:49,559

yeah yeah so they possess it sounds like

791

00:32:53,330 --> 00:32:51,840

basically a metabolic function are they

792

00:32:55,549 --> 00:32:53,340

preferred yeah well they're extremely

793

00:32:58,130 --> 00:32:55,559

important for a whole range of metabolic

794

00:33:00,470 --> 00:32:58,140

functions metabolism is just a whole

795

00:33:02,450 --> 00:33:00,480

range of chemical reactions taking place

796

00:33:05,510 --> 00:33:02,460

in our bodies

797

00:33:07,850 --> 00:33:05,520

um and the important thing here is that

798

00:33:10,430 --> 00:33:07,860

these organelles are not present in

799

00:33:12,230 --> 00:33:10,440

bacteria or archaea they are very

800

00:33:14,210 --> 00:33:12,240

structurally

801
00:33:16,250 --> 00:33:14,220
um simple compared to us although of

802
00:33:18,830 --> 00:33:16,260
course they're very complex in their own

803
00:33:21,009 --> 00:33:18,840
right but compared to us they're very

804
00:33:24,529 --> 00:33:21,019
simple now

805
00:33:27,529 --> 00:33:24,539
you were uh did you say that bacteria

806
00:33:31,009 --> 00:33:27,539
the chromosomes are actually circular

807
00:33:33,230 --> 00:33:31,019
whereas uh like hours are linear like

808
00:33:36,110 --> 00:33:33,240
the helical structure right

809
00:33:38,090 --> 00:33:36,120
distinct

810
00:33:40,669 --> 00:33:38,100
um yeah well it's helical in the sense

811
00:33:43,549 --> 00:33:40,679
that it's got the twisty ladder of DNA

812
00:33:45,049 --> 00:33:43,559
but yes you know it's just by linear I

813
00:33:47,450 --> 00:33:45,059

just mean it's got an end and a start

814

00:33:49,850 --> 00:33:47,460

and if you can you can in in principle

815

00:33:53,269 --> 00:33:49,860

just stretch it out into a long string

816

00:33:54,649 --> 00:33:53,279

now why why would it be circular in

817

00:33:57,889 --> 00:33:54,659

bacteria I've never heard of that that's

818

00:34:00,350 --> 00:33:57,899

really intriguing uh it could just be

819

00:34:04,310 --> 00:34:02,269

something that got frozen in evolution

820

00:34:08,210 --> 00:34:04,320

I'm not not actually sure why they do it

821

00:34:10,070 --> 00:34:08,220

differently to us okay yeah they they um

822

00:34:12,250 --> 00:34:10,080

they do actually engage in something

823

00:34:16,909 --> 00:34:12,260

called horizontal Gene transfer very

824

00:34:20,030 --> 00:34:17,530

um

825

00:34:22,369 --> 00:34:20,040

they basically copy out like little

826

00:34:25,430 --> 00:34:22,379

pieces of their DNA and swap with each

827

00:34:27,409 --> 00:34:25,440

other and they can use that to acquire

828

00:34:30,470 --> 00:34:27,419

you know resistance to drugs or to

829

00:34:32,329 --> 00:34:30,480

environmental changes very quickly

830

00:34:34,669 --> 00:34:32,339

um but we also engage in limited

831

00:34:35,869 --> 00:34:34,679

horizontal Gene transfer especially with

832

00:34:38,450 --> 00:34:35,879

viruses

833

00:34:40,730 --> 00:34:38,460

which can reverse transcribe into our

834

00:34:43,070 --> 00:34:40,740

genomes but yeah I'm not sure exactly

835

00:34:46,070 --> 00:34:43,080

why we have linear and they've got

836

00:34:49,190 --> 00:34:46,080

circular okay yeah

837

00:34:51,950 --> 00:34:49,200

um so when when I mention when I talk

838

00:34:54,409 --> 00:34:51,960

about complex life I really am referring

839

00:34:56,570 --> 00:34:54,419

to something which has got these sorts

840

00:34:58,550 --> 00:34:56,580

of complex organelles

841

00:35:00,230 --> 00:34:58,560

um and also mitochondria I'll get onto

842

00:35:02,570 --> 00:35:00,240

mitochondria in a second because that's

843

00:35:04,790 --> 00:35:02,580

really key sure

844

00:35:07,670 --> 00:35:04,800

um linear chromosomes

845

00:35:09,890 --> 00:35:07,680

um which have got homologous they've got

846

00:35:11,810 --> 00:35:09,900

homologous pairs so we've got 23 pairs

847

00:35:13,069 --> 00:35:11,820

of chromosomes

848

00:35:14,930 --> 00:35:13,079

um but other organisms have got

849

00:35:16,430 --> 00:35:14,940

different amounts

850

00:35:18,050 --> 00:35:16,440

different animals have got different

851
00:35:20,750 --> 00:35:18,060
numbers of chromosomes for example

852
00:35:23,450 --> 00:35:20,760
plants as well

853
00:35:25,490 --> 00:35:23,460
um multicellularity so many eukaryotes

854
00:35:27,109 --> 00:35:25,500
are multicellular that means that their

855
00:35:30,710 --> 00:35:27,119
bodies are composed of

856
00:35:32,690 --> 00:35:30,720
uh many cells often trillions so we've

857
00:35:34,790 --> 00:35:32,700
got trillions of eukaryotic cells in our

858
00:35:37,010 --> 00:35:34,800
bodies and they are organized into

859
00:35:39,650 --> 00:35:37,020
tissues and organ systems which have got

860
00:35:42,470 --> 00:35:39,660
specialized functions you know muscles

861
00:35:45,650 --> 00:35:42,480
nervous tissue Etc

862
00:35:49,190 --> 00:35:45,660
and so we don't find prokaryotic animals

863
00:35:51,650 --> 00:35:49,200

and why is that I think it has to do

864

00:35:55,430 --> 00:35:51,660

with energy so that is Nick Lanes

865

00:35:56,510 --> 00:35:55,440

um idea Nick Lane is the author of this

866

00:35:58,849 --> 00:35:56,520

book

867

00:36:00,470 --> 00:35:58,859

the vital question which everyone should

868

00:36:02,930 --> 00:36:00,480

read

869

00:36:06,230 --> 00:36:02,940

um energy Evolution and the origins of

870

00:36:08,750 --> 00:36:06,240

complex life and he's also written this

871

00:36:09,950 --> 00:36:08,760

other book recently it just came out

872

00:36:11,930 --> 00:36:09,960

this year

873

00:36:14,990 --> 00:36:11,940

oh this is Transformer or something

874

00:36:19,430 --> 00:36:15,000

right I thought I had it here but um it

875

00:36:23,690 --> 00:36:22,310

the Deep chemistry of life and death in

876

00:36:25,849 --> 00:36:23,700

this one he talks about the What's

877

00:36:27,829 --> 00:36:25,859

called the Krebs cycle or the citric

878

00:36:31,250 --> 00:36:27,839

acid cycle this is an important

879

00:36:33,589 --> 00:36:31,260

metabolic circuit in the cell and it's

880

00:36:35,150 --> 00:36:33,599

involved in um producing adenosine

881

00:36:37,310 --> 00:36:35,160

triphosphate which is the energy

882

00:36:39,109 --> 00:36:37,320

currency of the cell although there's

883

00:36:42,109 --> 00:36:39,119

another step after this which is more

884

00:36:44,329 --> 00:36:42,119

more important but um

885

00:36:46,730 --> 00:36:44,339

the way that this is often taught the

886

00:36:49,730 --> 00:36:46,740

Krebs cycle is often taught in

887

00:36:51,589 --> 00:36:49,740

introductory courses is um to just sort

888

00:36:53,810 --> 00:36:51,599

of brush over it and say that it's a

889

00:36:55,250 --> 00:36:53,820

step on the way to the electron

890

00:36:57,890 --> 00:36:55,260

transport chain

891

00:37:01,190 --> 00:36:57,900

but it's actually much more interesting

892

00:37:02,150 --> 00:37:01,200

and complex than that so the Krebs cycle

893

00:37:05,569 --> 00:37:02,160

um

894

00:37:09,050 --> 00:37:05,579

I'm having I'm having metabolism yeah

895

00:37:11,390 --> 00:37:09,060

I'm having flashbacks to my freshman

896

00:37:13,069 --> 00:37:11,400

year of high school taking biology I

897

00:37:14,810 --> 00:37:13,079

remember all of these terms I can't

898

00:37:17,510 --> 00:37:14,820

believe you haven't called mitochondria

899

00:37:20,510 --> 00:37:17,520

the PowerHouse of the cell yet oh I was

900

00:37:22,970 --> 00:37:20,520

gonna do that all right so sorry sorry

901
00:37:25,069 --> 00:37:22,980
to spoil it I can't wait I'm waiting

902
00:37:27,349 --> 00:37:25,079
with baited breath Lewis

903
00:37:30,050 --> 00:37:27,359
so the trans this book talks about

904
00:37:31,670 --> 00:37:30,060
cancer and how um the Krebs cycle can

905
00:37:34,910 --> 00:37:31,680
actually run in Reverse in certain

906
00:37:37,430 --> 00:37:34,920
conditions like in cancer cells

907
00:37:39,170 --> 00:37:37,440
um certain circuits within the Krebs

908
00:37:41,270 --> 00:37:39,180
cycle can actually go in reverse to the

909
00:37:44,690 --> 00:37:41,280
normal Direction although ironically

910
00:37:47,390 --> 00:37:44,700
what we think of the as the Krebs cycle

911
00:37:49,849 --> 00:37:47,400
um it's actually is itself the reverse

912
00:37:52,670 --> 00:37:49,859
of what initially evolved so like deep

913
00:37:55,910 --> 00:37:52,680

in the past when life was first arising

914

00:37:58,010 --> 00:37:55,920

probably in hydrothermal vents

915

00:37:59,450 --> 00:37:58,020

um the Krebs cycle or something like it

916

00:38:01,490 --> 00:37:59,460

was actually going in the opposite

917

00:38:03,589 --> 00:38:01,500

direction to what we usually associate

918

00:38:05,450 --> 00:38:03,599

with a Krebs cycle so he goes into all

919

00:38:08,210 --> 00:38:05,460

that sort of stuff in his book

920

00:38:10,790 --> 00:38:08,220

very very complex book I think it does

921

00:38:13,490 --> 00:38:10,800

as well as any anybody can to sort of

922

00:38:15,230 --> 00:38:13,500

make it accessible to a popular audience

923

00:38:17,990 --> 00:38:15,240

although you know you'll definitely

924

00:38:21,170 --> 00:38:18,000

struggle in Parts with this book

925

00:38:23,450 --> 00:38:21,180

and the other one a vital question

926

00:38:26,030 --> 00:38:23,460

yeah what is uh Nick Lane's uh

927

00:38:28,910 --> 00:38:26,040

background uh who is this guy he's a

928

00:38:31,430 --> 00:38:28,920

British biochemist and bioenergeticist

929

00:38:33,530 --> 00:38:31,440

so he studies on how thermodynamics

930

00:38:36,770 --> 00:38:33,540

plays into the question of what is life

931

00:38:37,870 --> 00:38:36,780

excellent and um he's got different

932

00:38:40,370 --> 00:38:37,880

um

933

00:38:41,870 --> 00:38:40,380

uh experiments going on in his lab

934

00:38:43,670 --> 00:38:41,880

different people look at different

935

00:38:46,190 --> 00:38:43,680

things including the origins of the

936

00:38:48,470 --> 00:38:46,200

genetic code and also metabolism which

937

00:38:50,870 --> 00:38:48,480

is very interested in he actually thinks

938

00:38:52,310 --> 00:38:50,880

that metabolism became before the

939

00:38:53,450 --> 00:38:52,320

genetic code

940

00:38:58,430 --> 00:38:53,460

so

941

00:39:00,470 --> 00:38:58,440

this is I've heard um and I'm really at

942

00:39:02,810 --> 00:39:00,480

the edge of my experience and knowledge

943

00:39:05,089 --> 00:39:02,820

here talking about this but I heard an

944

00:39:08,270 --> 00:39:05,099

interview with Bobby azarian who was

945

00:39:10,730 --> 00:39:08,280

talking very similarly about the role of

946

00:39:12,410 --> 00:39:10,740

energetic systems and evolution and the

947

00:39:15,050 --> 00:39:12,420

creation of life and then I also think

948

00:39:17,150 --> 00:39:15,060

this is something David Deutsch talks

949

00:39:20,810 --> 00:39:17,160

about as well

950

00:39:22,970 --> 00:39:20,820

yeah um super fascinating and compelling

951
00:39:26,210 --> 00:39:22,980
and I think it's becoming increasingly

952
00:39:27,910 --> 00:39:26,220
well appreciated because up until now

953
00:39:30,530 --> 00:39:27,920
um people have thought more in terms of

954
00:39:33,530 --> 00:39:30,540
self-replicating molecules you know the

955
00:39:35,630 --> 00:39:33,540
genetic uh information and how that

956
00:39:37,670 --> 00:39:35,640
evolved and they see that as like the

957
00:39:40,250 --> 00:39:37,680
the key to life but in fact it could

958
00:39:43,430 --> 00:39:40,260
have been metabolism which was the key

959
00:39:45,770 --> 00:39:43,440
and um genetics came afterwards not that

960
00:39:48,290 --> 00:39:45,780
genetics is unimportant but um in terms

961
00:39:50,450 --> 00:39:48,300
of the chronology of how life got

962
00:39:52,310 --> 00:39:50,460
started on Earth it could well have been

963
00:39:55,790 --> 00:39:52,320

that metabolic systems were the first

964

00:39:58,370 --> 00:39:55,800

ones and what is uh metabolism just in a

965

00:40:00,349 --> 00:39:58,380

very basic way metabolism is a whole

966

00:40:03,230 --> 00:40:00,359

series of chemical reactions taking

967

00:40:05,930 --> 00:40:03,240

place in an organism to produce

968

00:40:08,870 --> 00:40:05,940

um carbon carbon-based molecules so

969

00:40:11,390 --> 00:40:08,880

so-called organic molecules and it

970

00:40:13,670 --> 00:40:11,400

involves combining molecules to make

971

00:40:14,930 --> 00:40:13,680

larger ones or breaking them down to

972

00:40:17,329 --> 00:40:14,940

extract energy

973

00:40:19,430 --> 00:40:17,339

and there's also energy metabolism which

974

00:40:22,730 --> 00:40:19,440

is the production of adenosine

975

00:40:25,430 --> 00:40:22,740

triphosphate or ATP which is the energy

976

00:40:27,109 --> 00:40:25,440

currency of the cell so some of that

977

00:40:28,490 --> 00:40:27,119

energy currency is produced by

978

00:40:31,370 --> 00:40:28,500

glycolysis

979

00:40:33,530 --> 00:40:31,380

uh some is produced by the Krebs cycle

980

00:40:35,390 --> 00:40:33,540

which I just mentioned

981

00:40:39,050 --> 00:40:35,400

I think I have a

982

00:40:41,270 --> 00:40:39,060

I thought oh here is a Krebs cycle sorry

983

00:40:44,930 --> 00:40:41,280

again apologies for the dark background

984

00:40:47,210 --> 00:40:44,940

but this is a very complex series of um

985

00:40:49,190 --> 00:40:47,220

events uh you know different molecules

986

00:40:51,230 --> 00:40:49,200

are being used as intermediates and then

987

00:40:53,690 --> 00:40:51,240

you get products you do get some

988

00:40:55,790 --> 00:40:53,700

adenosine triphosphate from this

989

00:40:57,890 --> 00:40:55,800

but then I'm going to show you another

990

00:41:00,950 --> 00:40:57,900

step called the electron transport chain

991

00:41:01,849 --> 00:41:00,960

which is producing most of the ATP in

992

00:41:05,569 --> 00:41:01,859

the cell

993

00:41:10,490 --> 00:41:05,579

in the um eukaryotic cell because

994

00:41:13,310 --> 00:41:10,500

um bacteria do not have uh mitochondria

995

00:41:14,870 --> 00:41:13,320

so you get this sort of circle this why

996

00:41:18,170 --> 00:41:14,880

it's called the cycle is because you

997

00:41:20,390 --> 00:41:18,180

start with acetyl coenzyme a and then

998

00:41:22,670 --> 00:41:20,400

that's going to react with oxaloacetate

999

00:41:25,130 --> 00:41:22,680

to produce citrate and then you're going

1000

00:41:28,010 --> 00:41:25,140

to get some water and other byproducts

1001
00:41:29,510 --> 00:41:28,020
along the way things being combined

1002
00:41:31,609 --> 00:41:29,520
um and

1003
00:41:33,530 --> 00:41:31,619
there's also like other circuits within

1004
00:41:37,010 --> 00:41:33,540
this which are involved in biosynthesis

1005
00:41:38,990 --> 00:41:37,020
of um important biochemicals but

1006
00:41:41,510 --> 00:41:39,000
ultimately the way that this is taught a

1007
00:41:44,170 --> 00:41:41,520
lot of the time is just to focus on the

1008
00:41:47,329 --> 00:41:44,180
the role of this plays in ATP production

1009
00:41:49,310 --> 00:41:47,339
and it sort of ignores how other

1010
00:41:51,290 --> 00:41:49,320
molecules are being made

1011
00:41:54,050 --> 00:41:51,300
and um there's a sort of a tension at

1012
00:41:56,690 --> 00:41:54,060
the heart of the Krebs cycle because you

1013
00:41:59,390 --> 00:41:56,700

can shunt off some of these products for

1014

00:42:01,630 --> 00:41:59,400

biosynthesis but then that eats into the

1015

00:42:04,490 --> 00:42:01,640

ATP production or you can

1016

00:42:05,930 --> 00:42:04,500

prioritize ATP at the expense of

1017

00:42:09,170 --> 00:42:05,940

biosynthesis

1018

00:42:10,910 --> 00:42:09,180

and some of these um circuits this is

1019

00:42:12,410 --> 00:42:10,920

very simplified but there are it's sort

1020

00:42:14,329 --> 00:42:12,420

of like a roundabout you know like when

1021

00:42:15,770 --> 00:42:14,339

you're driving in a city you get it you

1022

00:42:17,690 --> 00:42:15,780

get to a roundabout and there's like

1023

00:42:18,710 --> 00:42:17,700

different Lanes within that

1024

00:42:20,450 --> 00:42:18,720

um

1025

00:42:22,910 --> 00:42:20,460

some of those circuits can actually run

1026
00:42:25,370 --> 00:42:22,920
in Reverse under certain conditions

1027
00:42:27,050 --> 00:42:25,380
and uh we see that in different kinds of

1028
00:42:30,170 --> 00:42:27,060
bacteria and also in cancer

1029
00:42:31,849 --> 00:42:30,180
interestingly oh interesting yep yeah

1030
00:42:34,849 --> 00:42:31,859
that's something that Nick Lane devotes

1031
00:42:36,470 --> 00:42:34,859
many chapters to in his book so this

1032
00:42:38,990 --> 00:42:36,480
this like

1033
00:42:41,150 --> 00:42:39,000
um metabolic cycle or process it's

1034
00:42:42,589 --> 00:42:41,160
pretty con it's consistent life form to

1035
00:42:45,710 --> 00:42:42,599
life form

1036
00:42:49,910 --> 00:42:45,720
um yeah it's pretty standard

1037
00:42:51,349 --> 00:42:49,920
mm-hmm yeah it's highly conserved but

1038
00:42:52,310 --> 00:42:51,359

there are some little differences here

1039

00:42:54,230 --> 00:42:52,320

and there

1040

00:42:55,190 --> 00:42:54,240

right and

1041

00:42:57,170 --> 00:42:55,200

um

1042

00:42:59,150 --> 00:42:57,180

I want to go back to something you

1043

00:43:01,010 --> 00:42:59,160

mentioned earlier which is the

1044

00:43:06,349 --> 00:43:01,020

geothermal vents I know this is a little

1045

00:43:11,089 --> 00:43:09,349

this is a alkaline behold

1046

00:43:14,390 --> 00:43:11,099

yeah I was hoping you could talk a

1047

00:43:16,190 --> 00:43:14,400

little bit about that and where it where

1048

00:43:20,270 --> 00:43:16,200

and how it factors into this whole

1049

00:43:23,030 --> 00:43:20,280

conversation of Life emergence yeah so

1050

00:43:25,370 --> 00:43:23,040

this this structure here is a

1051
00:43:28,010 --> 00:43:25,380
hydrothermal vent it's a specific type

1052
00:43:30,109 --> 00:43:28,020
of hydrothermal vent it's an alkaline

1053
00:43:31,490 --> 00:43:30,119
vent there's also the black smokers

1054
00:43:33,829 --> 00:43:31,500
which have gotten a bit more press

1055
00:43:35,150 --> 00:43:33,839
because they're more dramatic

1056
00:43:37,250 --> 00:43:35,160
um and they're also probably important

1057
00:43:39,650 --> 00:43:37,260
to an extent in the origin of Life

1058
00:43:41,569 --> 00:43:39,660
question but Nick Lane thinks that these

1059
00:43:44,630 --> 00:43:41,579
are really these ones are really the

1060
00:43:46,849 --> 00:43:44,640
important ones is that a crystallization

1061
00:43:50,450 --> 00:43:46,859
process occurring there Louise

1062
00:43:52,010 --> 00:43:50,460
it's a serpentinization process uh I

1063
00:43:54,349 --> 00:43:52,020

think it's similar to crystallization

1064

00:43:56,710 --> 00:43:54,359

you get these minerals kind of building

1065

00:43:59,150 --> 00:43:56,720

on each other and you get these

1066

00:44:01,010 --> 00:43:59,160

microporous structures which are really

1067

00:44:03,410 --> 00:44:01,020

key now

1068

00:44:05,089 --> 00:44:03,420

um so you can see these things are huge

1069

00:44:07,270 --> 00:44:05,099

um this is called uh

1070

00:44:11,329 --> 00:44:07,280

Crystal City or something

1071

00:44:13,430 --> 00:44:11,339

they gave the nickname I think in the

1072

00:44:14,690 --> 00:44:13,440

the Atlantic Ocean but you find them

1073

00:44:16,250 --> 00:44:14,700

deep in the sea

1074

00:44:19,550 --> 00:44:16,260

cool um

1075

00:44:23,089 --> 00:44:19,560

so the reason that these are important

1076

00:44:28,390 --> 00:44:25,849

you get these microporous structures

1077

00:44:36,109 --> 00:44:28,400

which um are acting is basically

1078

00:44:38,930 --> 00:44:37,069

oh

1079

00:44:40,849 --> 00:44:38,940

it's kind of I guess it's sort of

1080

00:44:41,930 --> 00:44:40,859

similar to Coral in a way but the

1081

00:44:44,990 --> 00:44:41,940

important thing is you get these little

1082

00:44:48,650 --> 00:44:45,000

cavities which separate

1083

00:44:51,470 --> 00:44:48,660

um the alkaline fluid in the vents from

1084

00:44:52,970 --> 00:44:51,480

the surrounding sea water which is more

1085

00:44:55,069 --> 00:44:52,980

acidic

1086

00:44:56,930 --> 00:44:55,079

because you know water absorbs carbon

1087

00:44:59,329 --> 00:44:56,940

dioxide from the atmosphere

1088

00:45:03,050 --> 00:44:59,339

and so there's a differential

1089

00:45:05,630 --> 00:45:03,060

um in between the the outside and the

1090

00:45:07,910 --> 00:45:05,640

inside of these little pores and that

1091

00:45:09,410 --> 00:45:07,920

facilitates proton Extrusion and

1092

00:45:12,050 --> 00:45:09,420

electron flow

1093

00:45:14,510 --> 00:45:12,060

okay which is something that we find in

1094

00:45:17,990 --> 00:45:14,520

ourselves and that's you know this

1095

00:45:20,630 --> 00:45:18,000

process uh provides energy for

1096

00:45:22,790 --> 00:45:20,640

um biosynthesis and we do find in his

1097

00:45:25,309 --> 00:45:22,800

experiments in his lab that you can get

1098

00:45:27,589 --> 00:45:25,319

certain um biochemicals

1099

00:45:30,950 --> 00:45:27,599

um organic molecules forming

1100

00:45:34,430 --> 00:45:30,960

by having like laminar flow across these

1101
00:45:36,170 --> 00:45:34,440
um pores and having a pH difference as

1102
00:45:39,230 --> 00:45:36,180
well you can get the build up of a

1103
00:45:42,230 --> 00:45:39,240
surprising number of Bio bio molecules

1104
00:45:44,870 --> 00:45:42,240
which are also the intermediates of the

1105
00:45:48,109 --> 00:45:44,880
Krebs cycle so you can get very

1106
00:45:50,510 --> 00:45:48,119
rudimentary um Krebs cycle Style

1107
00:45:52,609 --> 00:45:50,520
processes going on and that's without

1108
00:45:54,050 --> 00:45:52,619
genetics that's the important thing as

1109
00:45:56,690 --> 00:45:54,060
well but you don't need a genetic code

1110
00:45:57,470 --> 00:45:56,700
to get this process going

1111
00:45:59,990 --> 00:45:57,480
um

1112
00:46:01,910 --> 00:46:00,000
I I brought up Brook's comment here that

1113
00:46:04,069 --> 00:46:01,920

there's a snail with an iron shell that

1114

00:46:07,370 --> 00:46:04,079

lives in volcanoes nature is wild

1115

00:46:08,809 --> 00:46:07,380

creative and anti-entropic

1116

00:46:10,970 --> 00:46:08,819

um which

1117

00:46:14,030 --> 00:46:10,980

when we talk about this or listening to

1118

00:46:17,329 --> 00:46:14,040

talk about this what is so fascinating

1119

00:46:19,910 --> 00:46:17,339

to me is that these we're you're

1120

00:46:23,150 --> 00:46:19,920

describing an environment that

1121

00:46:26,390 --> 00:46:23,160

in any sense that we understand is

1122

00:46:28,609 --> 00:46:26,400

extremely hostile to life it's yeah deep

1123

00:46:31,550 --> 00:46:28,619

underwater it's

1124

00:46:35,210 --> 00:46:31,560

there's no light there's no Oxygen it's

1125

00:46:37,609 --> 00:46:35,220

highly basic or alkaline

1126

00:46:39,410 --> 00:46:37,619

um but we still get these extremely

1127

00:46:42,410 --> 00:46:39,420

strange creatures that live down at

1128

00:46:44,329 --> 00:46:42,420

those depths and then also as you're

1129

00:46:46,730 --> 00:46:44,339

talking about this is you know where

1130

00:46:48,589 --> 00:46:46,740

people theorize that life began

1131

00:46:51,410 --> 00:46:48,599

yeah um and I just think that

1132

00:46:53,510 --> 00:46:51,420

juxtaposition is so fascinating uh

1133

00:46:55,130 --> 00:46:53,520

between these kind of weird deep sea

1134

00:46:58,670 --> 00:46:55,140

creatures that you find down there and

1135

00:46:59,690 --> 00:46:58,680

then also this notion that it is

1136

00:47:02,690 --> 00:46:59,700

um

1137

00:47:05,390 --> 00:47:02,700

primordial like yes what may have

1138

00:47:07,790 --> 00:47:05,400

started at all and that's also a good

1139

00:47:09,470 --> 00:47:07,800
point in terms of thinking about

1140

00:47:11,870 --> 00:47:09,480
um xenobiology

1141

00:47:13,430 --> 00:47:11,880
which is specifically alien life

1142

00:47:15,470 --> 00:47:13,440
um

1143

00:47:16,609 --> 00:47:15,480
in terms of like what are the conditions

1144

00:47:19,069 --> 00:47:16,619
in the universe where you could

1145

00:47:20,930 --> 00:47:19,079
potentially find life we're finding life

1146

00:47:23,510 --> 00:47:20,940
you know existing in environments that

1147

00:47:25,970 --> 00:47:23,520
we had previously thought uninhabitable

1148

00:47:27,410 --> 00:47:25,980
and that could you know increase the

1149

00:47:30,770 --> 00:47:27,420
range of environments Across the

1150

00:47:33,069 --> 00:47:30,780
Universe where we could look for life

1151
00:47:35,870 --> 00:47:33,079
so we have a question here from figure

1152
00:47:39,230 --> 00:47:35,880
Louis does science contemplate other

1153
00:47:42,069 --> 00:47:39,240
possible life forms we haven't seen yet

1154
00:47:44,750 --> 00:47:42,079
so for example is it possible to have

1155
00:47:47,210 --> 00:47:44,760
non-carbon-based life forms if so what

1156
00:47:49,309 --> 00:47:47,220
would they be made of as an alternative

1157
00:47:51,890 --> 00:47:49,319
an alternative to carbon is silicon

1158
00:47:54,109 --> 00:47:51,900
which has got similar

1159
00:47:56,390 --> 00:47:54,119
behaves somewhat similarly to carbon

1160
00:47:58,790 --> 00:47:56,400
although it's not as versatile

1161
00:48:01,910 --> 00:47:58,800
so that's one

1162
00:48:04,190 --> 00:48:01,920
um but a Campbell I think he talked last

1163
00:48:05,870 --> 00:48:04,200

time about some research which is being

1164

00:48:08,569 --> 00:48:05,880

done with plasma where you could get

1165

00:48:12,230 --> 00:48:08,579

yeah self-replicating patterns or

1166

00:48:15,770 --> 00:48:12,240

structures in plasma yeah uh sideovich

1167

00:48:18,829 --> 00:48:15,780

doctor uh I think uh the side of it

1168

00:48:21,170 --> 00:48:18,839

she's from the uh physics lab in Saint

1169

00:48:23,089 --> 00:48:21,180

Petersburg Russia National Academy of

1170

00:48:25,809 --> 00:48:23,099

Sciences there he has a published paper

1171

00:48:29,210 --> 00:48:25,819

in 2007

1172

00:48:32,569 --> 00:48:29,220

new uh physics journal I think it was uh

1173

00:48:36,829 --> 00:48:32,579

and it describes experiments in the lab

1174

00:48:39,670 --> 00:48:36,839

and he talks about how plasma structures

1175

00:48:41,569 --> 00:48:39,680

the fourth state of matter ionized

1176

00:48:45,109 --> 00:48:41,579

aerosols and things like that that's

1177

00:48:49,069 --> 00:48:45,119

structured plasmas uh fulfill all of the

1178

00:48:52,190 --> 00:48:49,079

basic definitional criteria for living

1179

00:48:54,770 --> 00:48:52,200

things now it specifies that doesn't

1180

00:48:57,349 --> 00:48:54,780

mean that the plasma structures are

1181

00:48:58,490 --> 00:48:57,359

alive what it means is that the

1182

00:49:00,710 --> 00:48:58,500

definition

1183

00:49:02,930 --> 00:49:00,720

is met and therefore maybe we should

1184

00:49:04,670 --> 00:49:02,940

change the definition or you know maybe

1185

00:49:07,010 --> 00:49:04,680

we should look at what it means to be

1186

00:49:08,630 --> 00:49:07,020

alive but uh yeah that there are

1187

00:49:11,329 --> 00:49:08,640

published physics papers that indicate

1188

00:49:15,829 --> 00:49:11,339

that uh plasma structures can uh fulfill

1189

00:49:20,809 --> 00:49:17,690

yeah those are the two ones I can think

1190

00:49:22,670 --> 00:49:20,819

of silicon based life and something like

1191

00:49:24,290 --> 00:49:22,680

what you're talking about Campbell I

1192

00:49:25,670 --> 00:49:24,300

think there are some other ones

1193

00:49:28,250 --> 00:49:25,680

um

1194

00:49:29,990 --> 00:49:28,260

I mean it's probably related also to the

1195

00:49:31,849 --> 00:49:30,000

question of how life got started because

1196

00:49:34,550 --> 00:49:31,859

there's different hypotheses including

1197

00:49:36,170 --> 00:49:34,560

the RNA World hypothesis

1198

00:49:38,750 --> 00:49:36,180

um potentially like there's life out

1199

00:49:41,930 --> 00:49:38,760

there which uses RNA instead of DNA as

1200

00:49:42,829 --> 00:49:41,940

its main genetic substrate

1201

00:49:46,010 --> 00:49:42,839

um

1202

00:49:47,930 --> 00:49:46,020

there could also be life which

1203

00:49:49,490 --> 00:49:47,940

they could like potentially they could

1204

00:49:51,650 --> 00:49:49,500

be plant animals

1205

00:49:53,990 --> 00:49:51,660

like a photosynthesizing animals

1206

00:49:55,970 --> 00:49:54,000

although that's probably not a very

1207

00:49:57,530 --> 00:49:55,980

efficient way to gather your energy if

1208

00:49:59,450 --> 00:49:57,540

you're an animal

1209

00:50:02,210 --> 00:49:59,460

um there are some symbiotic bacteria um

1210

00:50:04,069 --> 00:50:02,220

algae which live in some snails and they

1211

00:50:07,309 --> 00:50:04,079

do something kind of intermediate with

1212

00:50:07,970 --> 00:50:07,319

that they derive some benefits from each

1213

00:50:10,670 --> 00:50:07,980

other

1214

00:50:12,770 --> 00:50:10,680

but there's no full-blown photosynthetic

1215

00:50:15,770 --> 00:50:12,780

animal that we know of so that's a

1216

00:50:17,510 --> 00:50:15,780

potential alien life form as well well

1217

00:50:18,589 --> 00:50:17,520

this is something I was uh sort of

1218

00:50:20,210 --> 00:50:18,599

thinking about from what you were

1219

00:50:22,849 --> 00:50:20,220

talking about Louise like the chemical

1220

00:50:25,309 --> 00:50:22,859

uh biochemical reactions and stuff like

1221

00:50:27,710 --> 00:50:25,319

that yeah to like I was wondering to

1222

00:50:30,890 --> 00:50:27,720

what extent those chemical reactions do

1223

00:50:32,390 --> 00:50:30,900

occur uh just purely in nature uh you

1224

00:50:34,190 --> 00:50:32,400

know and you know we could say that all

1225

00:50:36,650 --> 00:50:34,200

of this is purely mechanistic obviously

1226
00:50:38,329 --> 00:50:36,660
but independent of what we would ascribe

1227
00:50:41,569 --> 00:50:38,339
a living thing like I know that there

1228
00:50:43,370 --> 00:50:41,579
are organic molecules that are found in

1229
00:50:44,809 --> 00:50:43,380
uh like comets and stuff like that

1230
00:50:46,849 --> 00:50:44,819
doesn't mean that living things created

1231
00:50:49,549 --> 00:50:46,859
those molecules but they uh they exist

1232
00:50:51,170 --> 00:50:49,559
out there and uh just one other little

1233
00:50:53,270 --> 00:50:51,180
thing is that I when I was looking at

1234
00:50:54,890 --> 00:50:53,280
the definition of life like what a

1235
00:50:56,390 --> 00:50:54,900
living thing is in relation to this

1236
00:50:58,250 --> 00:50:56,400
plasma stuff trying to figure out what

1237
00:51:00,770 --> 00:50:58,260
the heck they're talking about what I

1238
00:51:04,069 --> 00:51:00,780

found was that the definition of living

1239

00:51:07,069 --> 00:51:04,079

thing has been changed over and over and

1240

00:51:09,230 --> 00:51:07,079

over again in relation frequently to

1241

00:51:11,809 --> 00:51:09,240

microscope technology technology because

1242

00:51:14,510 --> 00:51:11,819

each subsequent technological

1243

00:51:18,470 --> 00:51:14,520

advancement it is that no known

1244

00:51:20,030 --> 00:51:18,480

mechanism of X size could be producing

1245

00:51:21,410 --> 00:51:20,040

the definitional criteria of life and

1246

00:51:24,170 --> 00:51:21,420

then you make a better microscope and

1247

00:51:26,990 --> 00:51:24,180

then a smaller again it's uh it's isn't

1248

00:51:29,809 --> 00:51:27,000

it like Von luenhook who found cells for

1249

00:51:32,390 --> 00:51:29,819

the first time with the microscope that

1250

00:51:35,690 --> 00:51:32,400

we are like deep in the annals of Leah's

1251

00:51:37,910 --> 00:51:35,700

high school biology knowledge

1252

00:51:39,530 --> 00:51:37,920

um but right yeah and he called

1253

00:51:41,390 --> 00:51:39,540

themselves because they were like monk

1254

00:51:43,730 --> 00:51:41,400

cells or monks quarters yeah anyway

1255

00:51:45,349 --> 00:51:43,740

right oh yeah remember the first like uh

1256

00:51:47,630 --> 00:51:45,359

one of the first scientists I've found

1257

00:51:49,549 --> 00:51:47,640

like bacteria and stuff I remember in

1258

00:51:51,049 --> 00:51:49,559

his notes he uh I believe it was a

1259

00:51:54,290 --> 00:51:51,059

Scottish scientist he described them as

1260

00:51:57,109 --> 00:51:54,300

we beasties everywhere he's like they're

1261

00:52:03,230 --> 00:52:00,170

but you mentioned um the uh things on

1262

00:52:04,370 --> 00:52:03,240

comets and outer space Campbell which is

1263

00:52:07,370 --> 00:52:04,380

important for something called

1264

00:52:09,829 --> 00:52:07,380

panspermia this is the idea that life

1265

00:52:11,390 --> 00:52:09,839

was Seated on Earth or at least the the

1266

00:52:14,569 --> 00:52:11,400

precursors of life may have been

1267

00:52:17,210 --> 00:52:14,579

provided by meteorites or comets

1268

00:52:19,609 --> 00:52:17,220

and so we do find a lot of a lot of

1269

00:52:20,990 --> 00:52:19,619

these uh by organic molecules out in

1270

00:52:22,190 --> 00:52:21,000

space but that doesn't mean that there's

1271

00:52:24,950 --> 00:52:22,200

anything

1272

00:52:27,530 --> 00:52:24,960

that life originated there but it is

1273

00:52:29,750 --> 00:52:27,540

possible that um the sprinkling of life

1274

00:52:33,349 --> 00:52:29,760

or the transfer sorry not life the um

1275

00:52:35,930 --> 00:52:33,359

the sprinkling of organic material uh in

1276

00:52:38,030 --> 00:52:35,940

other words hydrocarbons from space may

1277

00:52:40,849 --> 00:52:38,040

have um contributed to

1278

00:52:43,370 --> 00:52:40,859

life on Earth are developing some people

1279

00:52:44,630 --> 00:52:43,380

also think that um life on Earth came

1280

00:52:48,290 --> 00:52:44,640

from Mars

1281

00:52:51,349 --> 00:52:48,300

by hitching a ride on a um meteorite and

1282

00:52:53,150 --> 00:52:51,359

that Mars is like the Genesis site uh

1283

00:52:55,750 --> 00:52:53,160

but that's still a controversial

1284

00:52:58,309 --> 00:52:55,760

uh view obviously

1285

00:53:00,470 --> 00:52:58,319

does that not push the question back

1286

00:53:02,450 --> 00:53:00,480

again it does yeah exactly

1287

00:53:05,990 --> 00:53:02,460

yeah oh yeah you'd have to explain how

1288

00:53:11,150 --> 00:53:06,000

the Martians uh arose there's

1289

00:53:13,250 --> 00:53:11,160

um do is is someone who has professional

1290

00:53:16,670 --> 00:53:13,260

and intellectual exposure to these

1291

00:53:19,730 --> 00:53:16,680

subjects is the panspermia hypothesis

1292

00:53:23,510 --> 00:53:19,740

taken seriously in any sense is it

1293

00:53:26,990 --> 00:53:23,520

entertained cool Nick Lanes is not

1294

00:53:30,770 --> 00:53:27,000

credited however uh but it is it is a

1295

00:53:34,790 --> 00:53:32,750

we have a question from the audience

1296

00:53:37,970 --> 00:53:34,800

member here the Earth are we alive maybe

1297

00:53:40,849 --> 00:53:37,980

life is an illusion no we are we are all

1298

00:53:43,490 --> 00:53:40,859

trapped in YouTube samsara right now

1299

00:53:45,589 --> 00:53:43,500

engaging in the Eternal cycle of death

1300

00:53:47,809 --> 00:53:45,599

and rebirth but if we get enough

1301

00:53:49,910 --> 00:53:47,819

subscribers eventually we'll be freed

1302

00:53:52,130 --> 00:53:49,920

from this and enter I don't know Super

1303

00:53:53,210 --> 00:53:52,140

Chat Nirvana

1304

00:53:55,069 --> 00:53:53,220

um

1305

00:53:57,770 --> 00:53:55,079

that is a good question it's something

1306

00:54:00,230 --> 00:53:57,780

that I have uh begun to increasingly

1307

00:54:03,589 --> 00:54:00,240

think about the more I dive into the

1308

00:54:06,589 --> 00:54:03,599

nature of uh what it means to be alive

1309

00:54:09,170 --> 00:54:06,599

and when you try to nail it down it does

1310

00:54:11,210 --> 00:54:09,180

appear to be a little bit slippery uh it

1311

00:54:15,109 --> 00:54:11,220

gets away from me a little bit the the

1312

00:54:16,670 --> 00:54:15,119

question of life and what living is is a

1313

00:54:19,790 --> 00:54:16,680

little bit different

1314

00:54:21,349 --> 00:54:19,800

um so Nick Lane talks about whether it

1315

00:54:23,770 --> 00:54:21,359

might be better to talk about what is

1316

00:54:26,990 --> 00:54:23,780

living instead of what is life

1317

00:54:29,450 --> 00:54:27,000

so living is a dynamic process which

1318

00:54:31,370 --> 00:54:29,460

involves disequilibrium with the

1319

00:54:34,190 --> 00:54:31,380

environment and the dissipation of heat

1320

00:54:36,109 --> 00:54:34,200

and disorder and you can think about it

1321

00:54:38,750 --> 00:54:36,119

in terms of a dynamic thermodynamic

1322

00:54:41,270 --> 00:54:38,760

process and then there it's more

1323

00:54:43,549 --> 00:54:41,280

concrete because you can talk about

1324

00:54:45,589 --> 00:54:43,559

um that you're converting something with

1325

00:54:47,809 --> 00:54:45,599

high or low entropy to something with

1326

00:54:50,510 --> 00:54:47,819

high entropy and you're buying off

1327

00:54:52,150 --> 00:54:50,520

your complexity by adding disorder to

1328

00:54:54,530 --> 00:54:52,160

the environment so that's a very

1329

00:54:55,970 --> 00:54:54,540

mechanistic and

1330

00:54:58,250 --> 00:54:55,980

um you know strict kind of definition

1331

00:55:01,309 --> 00:54:58,260

whereas if you're asking what is life

1332

00:55:04,809 --> 00:55:01,319

many things which are

1333

00:55:07,130 --> 00:55:04,819

supposedly alive then they're not doing

1334

00:55:09,349 --> 00:55:07,140

many of the things which we often

1335

00:55:11,210 --> 00:55:09,359

attribute to them so something doesn't

1336

00:55:14,329 --> 00:55:11,220

have to be reproducing in order to be

1337

00:55:16,010 --> 00:55:14,339

alive something can

1338

00:55:18,370 --> 00:55:16,020

um you know viruses are often not

1339

00:55:20,750 --> 00:55:18,380

thought of as being alive but they do

1340

00:55:22,910 --> 00:55:20,760

reproduce and so it gets a little bit

1341

00:55:24,950 --> 00:55:22,920

fuzzy there and also when we're thinking

1342

00:55:27,710 --> 00:55:24,960

about the origin of life like exactly

1343

00:55:30,290 --> 00:55:27,720

what point can we say that it jumped

1344

00:55:33,049 --> 00:55:30,300

from being non-life to life maybe that's

1345

00:55:34,430 --> 00:55:33,059

just a useless question anyway

1346

00:55:36,890 --> 00:55:34,440

and that's

1347

00:55:38,630 --> 00:55:36,900

um audience member Brooke asked didn't

1348

00:55:40,670 --> 00:55:38,640

someone create DNA just using

1349

00:55:43,270 --> 00:55:40,680

electricity and water like life was a

1350

00:55:45,829 --> 00:55:43,280

broadest frequency that life will like

1351

00:55:48,470 --> 00:55:45,839

oh broadcast frequency that life will

1352

00:55:49,250 --> 00:55:48,480

appear where it can yeah I've heard that

1353

00:55:52,490 --> 00:55:49,260

too

1354

00:55:55,370 --> 00:55:52,500

um but Lewis like you've said it's a

1355

00:55:58,609 --> 00:55:55,380

question if it can even be answered of

1356

00:55:59,270 --> 00:55:58,619

pinpointing this crossover from

1357

00:56:05,030 --> 00:55:59,280

um

1358

00:56:09,530 --> 00:56:05,040

the DNA components yeah onto some kind

1359

00:56:14,450 --> 00:56:12,829

yeah I mean DNA I think uh the viewer

1360

00:56:17,030 --> 00:56:14,460

was thinking about the milieuri

1361

00:56:20,210 --> 00:56:17,040

experiments which were done in the 50s

1362

00:56:23,690 --> 00:56:20,220

and they were you were basically running

1363

00:56:26,569 --> 00:56:23,700

um gas with different compounds through

1364

00:56:29,329 --> 00:56:26,579

um electricity to simulate lightning and

1365

00:56:31,130 --> 00:56:29,339

then you get some biomolecules forming

1366

00:56:33,410 --> 00:56:31,140

although some of the assumptions were

1367

00:56:35,150 --> 00:56:33,420

wrong but then they they did it under

1368

00:56:36,410 --> 00:56:35,160

different atmospheric conditions and you

1369

00:56:39,470 --> 00:56:36,420

still got some

1370

00:56:40,970 --> 00:56:39,480

important biomolecules DNA is a little

1371

00:56:41,809 --> 00:56:40,980

bit more complex

1372

00:56:43,730 --> 00:56:41,819

um

1373

00:56:47,089 --> 00:56:43,740

and there's different hypotheses about

1374

00:56:49,390 --> 00:56:47,099

how DNA got started but I think that I

1375

00:56:53,150 --> 00:56:49,400

favor the the

1376

00:56:55,609 --> 00:56:53,160

metabolism first idea first of all you

1377

00:56:58,309 --> 00:56:55,619

need some sort of engine of metabolism

1378

00:57:02,150 --> 00:56:58,319

to even produce something like DNA like

1379

00:57:04,910 --> 00:57:02,160

many intermediate steps and um

1380

00:57:07,130 --> 00:57:04,920

you know people have often I think maybe

1381

00:57:09,710 --> 00:57:07,140

Richard Dawkins with his selfish Gene

1382

00:57:11,750 --> 00:57:09,720

idea has had an inordinate influence on

1383

00:57:15,049 --> 00:57:11,760

biology because he talks about

1384

00:57:17,450 --> 00:57:15,059

self-replicating molecules like floating

1385

00:57:19,309 --> 00:57:17,460

around in the sea and then

1386

00:57:20,690 --> 00:57:19,319

you know it's not really explained how

1387

00:57:24,650 --> 00:57:20,700

that

1388

00:57:27,290 --> 00:57:24,660

think you need something like a

1389

00:57:28,910 --> 00:57:27,300

hydrothermal van to get the engine

1390

00:57:32,510 --> 00:57:28,920

started and then you can get more

1391

00:57:36,770 --> 00:57:34,609

anyway I'm being very simplistic here

1392

00:57:38,750 --> 00:57:36,780

but um that's basically kind of the

1393

00:57:41,450 --> 00:57:38,760

outlines of of that

1394

00:57:47,210 --> 00:57:44,510

um let me just mention uh mitochondria

1395

00:57:49,190 --> 00:57:47,220

since you did Leah

1396

00:57:53,750 --> 00:57:49,200

the PowerHouse of the cell right here

1397

00:57:56,630 --> 00:57:53,760

front and center yep so these are um

1398

00:57:58,309 --> 00:57:56,640

found in eukaryotic cells some

1399

00:58:00,010 --> 00:57:58,319

eukaryotic cells have got thousands of

1400

00:58:02,390 --> 00:58:00,020

these and other ones have got only

1401

00:58:04,309 --> 00:58:02,400

dozens or a few hundred depends on the

1402

00:58:05,750 --> 00:58:04,319

function of the cell so you find a lot

1403

00:58:09,170 --> 00:58:05,760

of these in muscle cells because they

1404

00:58:11,690 --> 00:58:09,180

need a lot of uh they need to produce a

1405

00:58:12,349 --> 00:58:11,700

lot of ATP but

1406

00:58:15,290 --> 00:58:12,359

um

1407

00:58:19,430 --> 00:58:15,300

these are actually they they came from

1408

00:58:22,150 --> 00:58:19,440

bacteria so what happened was that

1409

00:58:25,309 --> 00:58:22,160

um deep in the past one of the archaea

1410

00:58:27,470 --> 00:58:25,319

engulfed a bacteria

1411

00:58:29,690 --> 00:58:27,480

so the archaea are another type of

1412

00:58:31,549 --> 00:58:29,700

prokaryotic cell and then you've got the

1413

00:58:33,670 --> 00:58:31,559

other domain of the prokaryote called

1414

00:58:36,950 --> 00:58:33,680

the bacteria so there was an

1415

00:58:39,589 --> 00:58:36,960

endosymbiosis where a bacterium was

1416

00:58:43,430 --> 00:58:39,599

engulfed by an archaeon and then it

1417

00:58:46,309 --> 00:58:43,440

eventually evolved into mitochondria

1418

00:58:51,230 --> 00:58:46,319

okay so these um have got their own DNA

1419

00:58:53,089 --> 00:58:51,240

only a relative handful of genes but um

1420

00:58:56,089 --> 00:58:53,099

what's going on here is that you've got

1421

00:58:58,730 --> 00:58:56,099

this outer membrane okay and this inner

1422

00:59:01,490 --> 00:58:58,740

membrane which is very invaginated it's

1423

00:59:04,130 --> 00:59:01,500

very convoluted in order to increase the

1424

00:59:06,890 --> 00:59:04,140

surface area and there on the surface

1425

00:59:09,710 --> 00:59:06,900

area of that inner membrane you've got a

1426

00:59:13,910 --> 00:59:09,720

series of channel proteins which are

1427

00:59:16,250 --> 00:59:13,920

shunting electrons and sending them to

1428

00:59:19,190 --> 00:59:16,260

in our case oxygen molecules which are

1429

00:59:21,230 --> 00:59:19,200

the electron acceptors and then

1430

00:59:23,390 --> 00:59:21,240

ultimately powering the production of

1431

00:59:26,210 --> 00:59:23,400

adenosine triphosphate which is the

1432

00:59:28,030 --> 00:59:26,220

energy currency of the cell so let me

1433

00:59:32,450 --> 00:59:28,040

just show you um what the electron

1434

00:59:37,130 --> 00:59:34,190

um and by the way the citric acid cycle

1435

00:59:39,470 --> 00:59:37,140

is also taking place in the mitochondria

1436

00:59:44,150 --> 00:59:39,480

but the electron transport chain is

1437

00:59:48,349 --> 00:59:44,990

um

1438

00:59:50,390 --> 00:59:48,359

bloody oh here it is

1439

00:59:52,609 --> 00:59:50,400

yeah so this is the electron transport

1440

00:59:55,490 --> 00:59:52,619

chain okay so here's here's the outer

1441

00:59:57,170 --> 00:59:55,500

membrane of the mitochondria here is the

1442

00:59:59,990 --> 00:59:57,180

inner membrane that I showed you the

1443

01:00:03,170 --> 01:00:00,000

invaginated one and then you've got this

1444

01:00:05,089 --> 01:00:03,180

nadh which is an electron donor

1445

01:00:08,809 --> 01:00:05,099

it was formed from the breakdown of

1446

01:00:11,329 --> 01:00:08,819

glucose or other food molecules so we

1447

01:00:13,609 --> 01:00:11,339

get our glucose from eating plant matter

1448

01:00:16,730 --> 01:00:13,619

or animal matter and then it gets broken

1449

01:00:19,250 --> 01:00:16,740

down and we get some nadh which is

1450

01:00:20,770 --> 01:00:19,260

contributing electrons so the electrons

1451

01:00:24,230 --> 01:00:20,780

are being shunted

1452

01:00:26,030 --> 01:00:24,240

across these surface proteins these are

1453

01:00:29,930 --> 01:00:26,040

proteins these blue ones which are

1454

01:00:32,569 --> 01:00:29,940

embedded into the in a membrane okay

1455

01:00:35,630 --> 01:00:32,579

so the electrons are going like that

1456

01:00:38,750 --> 01:00:35,640

sent along and then um eventually

1457

01:00:42,470 --> 01:00:38,760

recombined here with oxygen and uh

1458

01:00:46,370 --> 01:00:42,480

hydrogen super you know produce water

1459

01:00:49,010 --> 01:00:46,380

but as they're being shunted along uh h

1460

01:00:51,710 --> 01:00:49,020

plus which is just free protons are

1461

01:00:53,930 --> 01:00:51,720

being extruded through the protein okay

1462

01:00:56,210 --> 01:00:53,940

so they're coming up they're not

1463

01:00:57,950 --> 01:00:56,220

combining with the electron

1464

01:01:00,349 --> 01:00:57,960

uh because the electrons just going this

1465

01:01:02,809 --> 01:01:00,359

way and um but they're going through a

1466

01:01:04,670 --> 01:01:02,819

separate Channel within the protein and

1467

01:01:06,650 --> 01:01:04,680

they're accumulating up here so you're

1468

01:01:09,230 --> 01:01:06,660

getting this electrical charge

1469

01:01:10,010 --> 01:01:09,240

difference between this side and this

1470

01:01:12,230 --> 01:01:10,020

side

1471

01:01:13,910 --> 01:01:12,240

and it's actually a very powerful charge

1472

01:01:14,510 --> 01:01:13,920

difference

1473

01:01:16,910 --> 01:01:14,520

um

1474

01:01:19,430 --> 01:01:16,920

and so the only way these can come back

1475

01:01:21,710 --> 01:01:19,440

down is to go through this other protein

1476

01:01:23,569 --> 01:01:21,720

which is the ATP synthase

1477

01:01:26,390 --> 01:01:23,579

this is actually a turbine it actually

1478

01:01:30,049 --> 01:01:26,400

spins so as the protons come back down

1479

01:01:32,870 --> 01:01:30,059

they spin uh it causes this to spin and

1480

01:01:34,609 --> 01:01:32,880

then that combines adenosine diphosphate

1481

01:01:36,230 --> 01:01:34,619

with a free phosphate and then that

1482

01:01:38,630 --> 01:01:36,240

forms ATP

1483

01:01:41,030 --> 01:01:38,640

right and so that's really the engine

1484

01:01:42,890 --> 01:01:41,040

for most of the ATP production in our

1485

01:01:45,410 --> 01:01:42,900

cells and that's taking place in the

1486

01:01:47,990 --> 01:01:45,420

mitochondria now this also gets onto

1487

01:01:51,109 --> 01:01:48,000

something that Nick Lane uh details in

1488

01:01:55,130 --> 01:01:51,119

especially vital the vital question book

1489

01:01:57,170 --> 01:01:55,140

which is why is it that um life stayed

1490

01:02:01,069 --> 01:01:57,180

so simple for so long

1491

01:02:02,809 --> 01:02:01,079

okay so this is a timeline of the Earth

1492

01:02:04,910 --> 01:02:02,819

um you've probably seen representation

1493

01:02:06,950 --> 01:02:04,920

of this before

1494

01:02:08,829 --> 01:02:06,960

so this is showing um you know the

1495

01:02:12,289 --> 01:02:08,839

origin of the earth probably about

1496

01:02:14,630 --> 01:02:12,299

4.5-ish billion years ago and then water

1497

01:02:16,730 --> 01:02:14,640

and then Luca is the last Universal

1498

01:02:18,950 --> 01:02:16,740

common ancestor so that's the ancestor

1499

01:02:22,370 --> 01:02:18,960

of all life probably a rose in those

1500

01:02:24,230 --> 01:02:22,380

hydrothermal vents and um

1501
01:02:26,750 --> 01:02:24,240
most of the surface of the Earth was

1502
01:02:28,849 --> 01:02:26,760
covered in water back then earliest

1503
01:02:30,589 --> 01:02:28,859
fossils that we find

1504
01:02:31,910 --> 01:02:30,599
um and the late heavy bombardment

1505
01:02:35,150 --> 01:02:31,920
meteorites

1506
01:02:36,770 --> 01:02:35,160
single-celled life definitely by here it

1507
01:02:39,289 --> 01:02:36,780
exists

1508
01:02:41,809 --> 01:02:39,299
and then um earliest oxygen in the

1509
01:02:42,770 --> 01:02:41,819
atmosphere so you get some

1510
01:02:45,650 --> 01:02:42,780
um

1511
01:02:47,990 --> 01:02:45,660
photosynthesis evolving so that's using

1512
01:02:49,010 --> 01:02:48,000
light from the sun in order to produce

1513
01:02:51,710 --> 01:02:49,020

sugar

1514

01:02:54,710 --> 01:02:51,720

and then um it's it's also expelling

1515

01:02:57,170 --> 01:02:54,720

oxygen as a waste product but that would

1516

01:02:58,670 --> 01:02:57,180

later on build up very significantly in

1517

01:03:00,650 --> 01:02:58,680

the atmosphere

1518

01:03:03,589 --> 01:03:00,660

and then you would get aerobic

1519

01:03:04,789 --> 01:03:03,599

respiration evolving which uses O₂ as

1520

01:03:10,190 --> 01:03:04,799

the electron

1521

01:03:13,490 --> 01:03:10,200

transport chain

1522

01:03:16,069 --> 01:03:13,500

okay so here you've got O₂

1523

01:03:18,410 --> 01:03:16,079

the electron wants to go to the O₂

1524

01:03:20,270 --> 01:03:18,420

that's the most efficient electron

1525

01:03:23,510 --> 01:03:20,280

acceptor that we know of but there are

1526

01:03:25,190 --> 01:03:23,520

other ones which life used before oxygen

1527

01:03:27,250 --> 01:03:25,200

built up in the atmosphere and some

1528

01:03:31,069 --> 01:03:27,260

organisms still use those alternative

1529

01:03:37,130 --> 01:03:33,730

um so

1530

01:03:40,910 --> 01:03:37,140

photosynthesis and then um very

1531

01:03:43,849 --> 01:03:40,920

very kind of took like billions of years

1532

01:03:45,530 --> 01:03:43,859

for eukaryotes to arise okay and that

1533

01:03:47,930 --> 01:03:45,540

was probably because of the Union of

1534

01:03:51,289 --> 01:03:47,940

that archaeon and that bacterian uh

1535

01:03:53,569 --> 01:03:51,299

bacteria and then um that produced um

1536

01:03:56,270 --> 01:03:53,579

evolved into mitochondria in our cells

1537

01:03:57,530 --> 01:03:56,280

that bacteria so why did that take so

1538

01:04:00,530 --> 01:03:57,540

long

1539

01:04:05,150 --> 01:04:00,540

uh well probably because it was very a

1540

01:04:10,190 --> 01:04:05,160

very unlikely event for one thing yeah

1541

01:04:12,770 --> 01:04:10,200

the mitochondria in our cells that

1542

01:04:15,950 --> 01:04:12,780

the endosymbiosis that led to that

1543

01:04:18,289 --> 01:04:15,960

probably only happened once so there are

1544

01:04:21,950 --> 01:04:18,299

actually many um endosymbioses between

1545

01:04:23,930 --> 01:04:21,960

bacteria and prokaryotes but they do not

1546

01:04:26,210 --> 01:04:23,940

lead to mitochondria

1547

01:04:28,910 --> 01:04:26,220

and so that evolution of mitochondria

1548

01:04:30,650 --> 01:04:28,920

probably just happened once

1549

01:04:32,750 --> 01:04:30,660

and that is what really allowed

1550

01:04:35,690 --> 01:04:32,760

eukaryotes to become

1551

01:04:38,690 --> 01:04:35,700

uh complex because that gives you more

1552

01:04:41,329 --> 01:04:38,700

internal energy okay

1553

01:04:43,450 --> 01:04:41,339

um prokaryotes tend to be very limited

1554

01:04:46,970 --> 01:04:43,460

in size they tend to be very very small

1555

01:04:49,730 --> 01:04:46,980

and the reason is that they do their

1556

01:04:53,510 --> 01:04:49,740

electron transport chain on their plasma

1557

01:04:59,270 --> 01:04:55,430

um because they don't have any internal

1558

01:05:02,329 --> 01:04:59,280

mitochondria so that places a limit on

1559

01:05:04,549 --> 01:05:02,339

how big you can get and if you have them

1560

01:05:06,470 --> 01:05:04,559

internally then that allows you to do

1561

01:05:09,170 --> 01:05:06,480

more things okay

1562

01:05:11,750 --> 01:05:09,180

so the things that eukaryotes do such as

1563

01:05:14,150 --> 01:05:11,760

you know being multicellular which also

1564

01:05:17,210 --> 01:05:14,160

took a long time by the way

1565

01:05:18,890 --> 01:05:17,220

um sexual reproduction probably evolved

1566

01:05:20,690 --> 01:05:18,900

around there

1567

01:05:23,630 --> 01:05:20,700

um and many other things that eukaryotes

1568

01:05:25,670 --> 01:05:23,640

can do that prokaryotes cannot do

1569

01:05:28,730 --> 01:05:25,680

so mitochondria are really at the center

1570

01:05:31,069 --> 01:05:28,740

of that and it's probably the case that

1571

01:05:32,870 --> 01:05:31,079

there was an energetic barrier you have

1572

01:05:35,329 --> 01:05:32,880

to have mitochondria in order to get

1573

01:05:38,650 --> 01:05:35,339

much more complex because if you think

1574

01:05:41,390 --> 01:05:38,660

about it prokaryotes they're very very

1575

01:05:43,849 --> 01:05:41,400

biochemically diverse so it can't just

1576

01:05:45,950 --> 01:05:43,859

be because of information there has to

1577

01:05:49,309 --> 01:05:45,960

be some sort of extra con constraint

1578

01:05:50,809 --> 01:05:49,319

which limited the um evolution of

1579

01:05:53,630 --> 01:05:50,819

complexity so that was probably

1580

01:05:56,210 --> 01:05:53,640

availability

1581

01:05:57,430 --> 01:05:56,220

any questions

1582

01:06:00,109 --> 01:05:57,440

um I was thinking about okay so

1583

01:06:03,890 --> 01:06:00,119

mitochondria I know that

1584

01:06:08,089 --> 01:06:03,900

those are related in some way to uh

1585

01:06:10,309 --> 01:06:08,099

inheriting genetics from the maternal

1586

01:06:13,549 --> 01:06:10,319

line is that right yeah exactly yeah

1587

01:06:16,010 --> 01:06:13,559

okay and there are a variety of genetic

1588

01:06:17,870 --> 01:06:16,020

disorders that I'm aware of in

1589

01:06:20,630 --> 01:06:17,880

especially in

1590

01:06:22,490 --> 01:06:20,640

um small populations and isolated

1591

01:06:26,270 --> 01:06:22,500

populations so I know for example in

1592

01:06:28,250 --> 01:06:26,280

Iceland in um uh and in some other

1593

01:06:31,250 --> 01:06:28,260

populations they've done these studies

1594

01:06:32,990 --> 01:06:31,260

based on the genetic diseases being a

1595

01:06:36,529 --> 01:06:33,000

higher prevalence based on mitochondria

1596

01:06:39,309 --> 01:06:36,539

now like uh do you know why is it that

1597

01:06:42,289 --> 01:06:39,319

why is it that some DNA is contained in

1598

01:06:43,849 --> 01:06:42,299

mitochondria and like why are they the

1599

01:06:47,150 --> 01:06:43,859

two sets like what is going on there

1600

01:06:49,190 --> 01:06:47,160

like yeah yeah so the electron transport

1601
01:06:52,490 --> 01:06:49,200
chain you've got these proteins which

1602
01:06:55,069 --> 01:06:52,500
are encoded by genes because proteins

1603
01:06:57,890 --> 01:06:55,079
are encoded by genes

1604
01:06:59,930 --> 01:06:57,900
um and many of those genes are present

1605
01:07:02,930 --> 01:06:59,940
in the nucleus of the eukaryotic cell

1606
01:07:05,690 --> 01:07:02,940
and some some of them a relative handful

1607
01:07:09,710 --> 01:07:05,700
are encoded by the mitochondria's own

1608
01:07:12,190 --> 01:07:09,720
genome okay now I think um mitochondria

1609
01:07:15,950 --> 01:07:12,200
they've only got like 30 or so genes

1610
01:07:19,670 --> 01:07:15,960
whereas the eukaryotic the the nuclear

1611
01:07:22,609 --> 01:07:19,680
DNA has got um thousands okay over 20

1612
01:07:24,529 --> 01:07:22,619
000. so it seems to be according to Nick

1613
01:07:27,770 --> 01:07:24,539

Lane it seems to be the case that you

1614

01:07:29,750 --> 01:07:27,780

need a minimum amount of genes that stay

1615

01:07:33,529 --> 01:07:29,760

behind in the mitochondria because they

1616

01:07:35,510 --> 01:07:33,539

need to carefully coordinate

1617

01:07:38,750 --> 01:07:35,520

um the actions of the electron transport

1618

01:07:41,450 --> 01:07:38,760

chain so you need those wow okay yeah

1619

01:07:42,950 --> 01:07:41,460

minimum genome just to stay behind to do

1620

01:07:45,470 --> 01:07:42,960

some critical things which have to be

1621

01:07:46,809 --> 01:07:45,480

done quickly

1622

01:07:49,970 --> 01:07:46,819

damn okay

1623

01:07:52,250 --> 01:07:49,980

mitochondrial DNA I think is what's used

1624

01:07:53,630 --> 01:07:52,260

for

1625

01:07:57,410 --> 01:07:53,640

um

1626

01:07:59,990 --> 01:07:57,420

tracing lineage I feel like that's what

1627

01:08:02,349 --> 01:08:00,000

I've heard when you hear about how

1628

01:08:05,990 --> 01:08:02,359

gungus Khan

1629

01:08:06,890 --> 01:08:06,000

has millions and millions of Offspring

1630

01:08:09,650 --> 01:08:06,900

or

1631

01:08:11,450 --> 01:08:09,660

um you know the the matrilineal line can

1632

01:08:14,089 --> 01:08:11,460

be traced back because it's uh

1633

01:08:18,829 --> 01:08:14,099

exclusively inherits it's passed on by

1634

01:08:22,189 --> 01:08:18,839

uh in the egg cells okay and um

1635

01:08:24,050 --> 01:08:22,199

or virtually Never by um the sperm so

1636

01:08:25,490 --> 01:08:24,060

you can trace back the matrilineal line

1637

01:08:28,010 --> 01:08:25,500

there's also something you might might

1638

01:08:29,870 --> 01:08:28,020

have heard of called mitochondria or Eve

1639

01:08:32,809 --> 01:08:29,880

which oh yeah

1640

01:08:36,110 --> 01:08:32,819

um one of our audience members just

1641

01:08:37,729 --> 01:08:36,120

mentioned mitochondrial eve

1642

01:08:40,809 --> 01:08:37,739

so it does not mean that she was the

1643

01:08:44,150 --> 01:08:40,819

first woman it just means that the the

1644

01:08:46,189 --> 01:08:44,160

mitochondrial DNA which exists today can

1645

01:08:49,130 --> 01:08:46,199

be traced back to her

1646

01:08:50,870 --> 01:08:49,140

um so yeah I mean interesting thing

1647

01:08:52,669 --> 01:08:50,880

about the fact that some of the

1648

01:08:54,169 --> 01:08:52,679

mitochondria some of the genes are still

1649

01:08:57,289 --> 01:08:54,179

in the mitochondria is that you can get

1650

01:09:01,189 --> 01:08:57,299

incompatibilities between the nuclear

1651
01:09:03,410 --> 01:09:01,199
and mitochondrial DNA so in the electron

1652
01:09:05,930 --> 01:09:03,420
transport chain these proteins have to

1653
01:09:09,050 --> 01:09:05,940
be pretty much perfectly placed

1654
01:09:10,910 --> 01:09:09,060
and even the iron sulfur clusters within

1655
01:09:13,550 --> 01:09:10,920
them which are involved in the shunting

1656
01:09:16,669 --> 01:09:13,560
of the electrons uh Within These um

1657
01:09:18,890 --> 01:09:16,679
proteins also have to be you know within

1658
01:09:21,829 --> 01:09:18,900
angstroms of diff of distance they have

1659
01:09:24,590 --> 01:09:21,839
to be very very precisely placed if

1660
01:09:27,410 --> 01:09:24,600
there is any incompatibility between the

1661
01:09:29,930 --> 01:09:27,420
mitochondrial DNA and the nuclear DNA

1662
01:09:32,150 --> 01:09:29,940
you can get you know these being

1663
01:09:34,669 --> 01:09:32,160

sub-optimal and then uh you don't

1664

01:09:37,309 --> 01:09:34,679

produce enough ATP and animals can

1665

01:09:39,289 --> 01:09:37,319

actually abort their fetuses when um

1666

01:09:41,150 --> 01:09:39,299

they're not good enough so like when

1667

01:09:43,930 --> 01:09:41,160

they're electron transport chains are

1668

01:09:46,669 --> 01:09:43,940

not sufficient for their ecological

1669

01:09:49,430 --> 01:09:46,679

requirements they can just spontaneously

1670

01:09:51,709 --> 01:09:49,440

abort the fetus you know you know to

1671

01:09:54,050 --> 01:09:51,719

avoid not putting any more resources

1672

01:09:58,010 --> 01:09:54,060

into that so the bar like there's some

1673

01:10:00,470 --> 01:09:58,020

sort of automatic mechanism that can uh

1674

01:10:02,689 --> 01:10:00,480

tell the efficiency essentially that's

1675

01:10:06,350 --> 01:10:02,699

so interesting I think I think little

1676

01:10:11,090 --> 01:10:06,360

buddy and little buddy's sister Minnie

1677

01:10:13,490 --> 01:10:11,100

are yes expressing their enthusiasm for

1678

01:10:16,729 --> 01:10:13,500

this evening's show

1679

01:10:18,709 --> 01:10:16,739

um so we got a question uh from Mitch a

1680

01:10:21,970 --> 01:10:18,719

here cellular material is the hardware

1681

01:10:27,890 --> 01:10:25,790

uh cellular material so I guess that's

1682

01:10:29,870 --> 01:10:27,900

like the hardware and I guess genetics

1683

01:10:30,950 --> 01:10:29,880

and DNA would be the software right

1684

01:10:33,229 --> 01:10:30,960

right

1685

01:10:37,250 --> 01:10:35,630

um although interestingly

1686

01:10:40,010 --> 01:10:37,260

RNA

1687

01:10:42,050 --> 01:10:40,020

um is thought by some scientists to have

1688

01:10:44,689 --> 01:10:42,060

been the original

1689

01:10:46,610 --> 01:10:44,699

um sort of important molecule because

1690

01:10:48,530 --> 01:10:46,620

it's got

1691

01:10:50,330 --> 01:10:48,540

some things it does well which is

1692

01:10:52,790 --> 01:10:50,340

similar to protein and something similar

1693

01:10:54,229 --> 01:10:52,800

to DNA but it's not as good as either

1694

01:10:56,510 --> 01:10:54,239

one

1695

01:10:57,770 --> 01:10:56,520

um but we still use RNA as an

1696

01:11:00,830 --> 01:10:57,780

intermediate

1697

01:11:03,350 --> 01:11:00,840

um you know transcribing DNA messages

1698

01:11:06,590 --> 01:11:03,360

messages into RNA messages and then

1699

01:11:09,169 --> 01:11:06,600

Translating that into protein so it's

1700

01:11:11,030 --> 01:11:09,179

still an intermediate that we use

1701

01:11:13,610 --> 01:11:11,040

um but yeah there is that interesting

1702

01:11:17,090 --> 01:11:13,620

sort of Hardware software distinction

1703

01:11:20,030 --> 01:11:17,100

but probably the hardware Evolved first

1704

01:11:22,490 --> 01:11:20,040

okay and we have this question here from

1705

01:11:24,590 --> 01:11:22,500

fig is it conceivable that DNA and

1706

01:11:27,110 --> 01:11:24,600

mitochondria can be manipulated with

1707

01:11:29,870 --> 01:11:27,120

crispr and what kind of chimeras can

1708

01:11:33,590 --> 01:11:29,880

conceivably be created

1709

01:11:35,510 --> 01:11:33,600

yeah yeah crisp is very powerful

1710

01:11:41,810 --> 01:11:35,520

um

1711

01:11:48,350 --> 01:11:44,330

I guess it's in principle it's possible

1712

01:11:50,450 --> 01:11:48,360

to increase ATP production

1713

01:11:52,550 --> 01:11:50,460

um in mitochondria using something like

1714

01:11:53,630 --> 01:11:52,560

crispr but you also have to take into

1715

01:11:55,130 --> 01:11:53,640

account

1716

01:11:56,689 --> 01:11:55,140

um the interaction between the

1717

01:11:58,970 --> 01:11:56,699

mitochondrial

1718

01:12:00,530 --> 01:11:58,980

and the nuclear DNA

1719

01:12:02,750 --> 01:12:00,540

so you know you probably can't just

1720

01:12:05,390 --> 01:12:02,760

change one thing because there's a very

1721

01:12:07,250 --> 01:12:05,400

delicate balance you have to strike

1722

01:12:10,550 --> 01:12:07,260

um

1723

01:12:12,530 --> 01:12:10,560

and we we have a uh another super

1724

01:12:15,669 --> 01:12:12,540

important question here where is the dog

1725

01:12:17,930 --> 01:12:15,679

barking coming from OMG

1726

01:12:22,550 --> 01:12:17,940

from from my house

1727

01:12:22,560 --> 01:12:25,189

all right

1728

01:12:25,199 --> 01:12:29,870

got that sorted out

1729

01:12:34,850 --> 01:12:31,010

um

1730

01:12:37,970 --> 01:12:34,860

just getting back to something you said

1731

01:12:40,370 --> 01:12:37,980

Campbell um like in Iceland or wherever

1732

01:12:43,010 --> 01:12:40,380

there are there are certainly population

1733

01:12:46,669 --> 01:12:43,020

clusters which experience more

1734

01:12:47,350 --> 01:12:46,679

diseases which are based on

1735

01:12:49,669 --> 01:12:47,360

um

1736

01:12:53,090 --> 01:12:49,679

potential incompatibilities between

1737

01:12:54,110 --> 01:12:53,100

mitochondrial nuclear DNA

1738

01:12:57,050 --> 01:12:54,120

um

1739

01:12:58,910 --> 01:12:57,060

so you can get the sorts of population

1740

01:13:00,410 --> 01:12:58,920

different population frequencies of

1741

01:13:01,669 --> 01:13:00,420

those diseases

1742

01:13:12,169 --> 01:13:01,679

um

1743

01:13:14,930 --> 01:13:12,179

animals are very complex obviously they

1744

01:13:18,110 --> 01:13:14,940

move around a lot many animals have got

1745

01:13:20,149 --> 01:13:18,120

mobile life stages other ones some of

1746

01:13:22,490 --> 01:13:20,159

them have got um sessile life stages

1747

01:13:24,590 --> 01:13:22,500

like um tunicates

1748

01:13:26,930 --> 01:13:24,600

they kind of latch onto the sea floor

1749

01:13:28,970 --> 01:13:26,940

and they stay there as adults but um

1750

01:13:32,510 --> 01:13:28,980

most animals can move around

1751

01:13:35,030 --> 01:13:32,520

um for most of their life cycle and

1752

01:13:36,890 --> 01:13:35,040

this is an animal right here

1753

01:13:39,890 --> 01:13:36,900

cephalopod

1754

01:13:42,950 --> 01:13:39,900

hey he was on the show last week

1755

01:13:44,750 --> 01:13:42,960

yeah well they're being more I'm pleased

1756

01:13:47,090 --> 01:13:44,760

to say that they've been more um thought

1757

01:13:48,890 --> 01:13:47,100

about in science fiction as like the

1758

01:13:49,970 --> 01:13:48,900

kind of archetype for what aliens might

1759

01:13:52,450 --> 01:13:49,980

be like

1760

01:13:54,530 --> 01:13:52,460

have you notice

1761

01:13:56,750 --> 01:13:54,540

yes well I think

1762

01:13:59,510 --> 01:13:56,760

um right and that

1763

01:14:01,610 --> 01:13:59,520

is I think in response to broader

1764

01:14:03,709 --> 01:14:01,620
recognition of the cognitive and

1765

01:14:06,350 --> 01:14:03,719
Consciousness capabilities of the

1766

01:14:08,330 --> 01:14:06,360
cephalopods exactly they're very

1767

01:14:11,870 --> 01:14:08,340
intelligent and they've got a high

1768

01:14:13,790 --> 01:14:11,880
degree of dexterity with their limbs uh

1769

01:14:15,590 --> 01:14:13,800
but the the amazing thing is that their

1770

01:14:17,689 --> 01:14:15,600
nervous systems and the complexity of

1771

01:14:20,330 --> 01:14:17,699
the nervous systems at least are

1772

01:14:22,610 --> 01:14:20,340
convergently evolved from out so they

1773

01:14:23,930 --> 01:14:22,620
did not come from a common ancestor I

1774

01:14:26,270 --> 01:14:23,940
mean if you go back far enough that's

1775

01:14:28,130 --> 01:14:26,280
really fascinating but the yeah the

1776

01:14:31,250 --> 01:14:28,140

brains are not from a common ancestor

1777

01:14:33,649 --> 01:14:31,260

they're independently derived as other

1778

01:14:36,350 --> 01:14:33,659

eyes they've actually got better eyes

1779

01:14:37,970 --> 01:14:36,360

than we do but they're very very similar

1780

01:14:38,630 --> 01:14:37,980

to ours

1781

01:14:43,610 --> 01:14:38,640

um

1782

01:14:47,090 --> 01:14:43,620

consideration which is convergent

1783

01:14:48,350 --> 01:14:47,100

evolution which is the independent

1784

01:14:51,110 --> 01:14:48,360

um

1785

01:14:53,510 --> 01:14:51,120

evolution of traits in response to

1786

01:14:55,790 --> 01:14:53,520

similar environmental pressures okay

1787

01:14:58,250 --> 01:14:55,800

here's um

1788

01:15:00,550 --> 01:14:58,260

Simon Conway Morris who was a very big

1789

01:15:03,530 --> 01:15:00,560

advocate of um the importance of

1790

01:15:05,209 --> 01:15:03,540

convergent evolution

1791

01:15:07,189 --> 01:15:05,219

okay the underlying reason for

1792

01:15:09,649 --> 01:15:07,199

convergence seems to be that all

1793

01:15:11,990 --> 01:15:09,659

organisms are under constant scrutiny by

1794

01:15:14,090 --> 01:15:12,000

natural selection and are also subject

1795

01:15:16,130 --> 01:15:14,100

to the constraints of the physical and

1796

01:15:18,350 --> 01:15:16,140

chemical factors that severely limit the

1797

01:15:21,229 --> 01:15:18,360

action of all inhabitants of the

1798

01:15:23,870 --> 01:15:21,239

biosphere put simply conversion shows

1799

01:15:26,890 --> 01:15:23,880

that in a real world not all things are

1800

01:15:32,149 --> 01:15:29,149

to me

1801

01:15:34,550 --> 01:15:32,159

he he thinks that um he's a he's a

1802

01:15:37,010 --> 01:15:34,560

serious Scientist by the way but um yeah

1803

01:15:39,830 --> 01:15:37,020

he um

1804

01:15:43,070 --> 01:15:39,840

he makes a big uh claim which is that

1805

01:15:45,229 --> 01:15:43,080

probably extraterrestrial life of

1806

01:15:47,689 --> 01:15:45,239

intelligent extraterrestrial life

1807

01:15:48,530 --> 01:15:47,699

I'll get on to what intelligence means

1808

01:15:49,910 --> 01:15:48,540

um

1809

01:15:52,189 --> 01:15:49,920

but here I'm just in in the

1810

01:15:54,169 --> 01:15:52,199

anthropomorphic sense right outside of

1811

01:15:56,950 --> 01:15:54,179

intelligence he thinks that they would

1812

01:15:59,090 --> 01:15:56,960

be humanoid because there are certain

1813

01:16:01,130 --> 01:15:59,100

environments which select for

1814

01:16:04,189 --> 01:16:01,140

intelligence and certain things which

1815

01:16:07,010 --> 01:16:04,199

you need in order to you know manipulate

1816

01:16:09,770 --> 01:16:07,020

your environment or be able to

1817

01:16:12,410 --> 01:16:09,780

um communicate with others Etc and that

1818

01:16:14,330 --> 01:16:12,420

places limits on your morphology and

1819

01:16:16,910 --> 01:16:14,340

things like that I don't know if you

1820

01:16:19,370 --> 01:16:16,920

guys have ever seen this speculation by

1821

01:16:22,729 --> 01:16:19,380

Dale Russell

1822

01:16:24,709 --> 01:16:22,739

this is a um oh yeah this is from 1980

1823

01:16:26,930 --> 01:16:24,719

and he actually copped a little bit of

1824

01:16:28,669 --> 01:16:26,940

ridicule for this but this is basically

1825

01:16:30,950 --> 01:16:28,679

just his idea of what would have

1826

01:16:33,830 --> 01:16:30,960

happened if the

1827

01:16:35,930 --> 01:16:33,840

um the KT event which was the the end of

1828

01:16:38,930 --> 01:16:35,940

the Cretaceous Period when the meteorite

1829

01:16:42,770 --> 01:16:38,940

you know struck the Yucatan Peninsula

1830

01:16:43,669 --> 01:16:42,780

leading to the extinction of dinosaurs

1831

01:16:49,130 --> 01:16:43,679

um

1832

01:16:50,149 --> 01:16:49,140

bowline impact theory was popular yet

1833

01:16:52,430 --> 01:16:50,159

but

1834

01:16:53,870 --> 01:16:52,440

the dinosaurs became extinct except for

1835

01:16:55,910 --> 01:16:53,880

the birds

1836

01:16:59,270 --> 01:16:55,920

um but imagine that had not happened is

1837

01:17:01,310 --> 01:16:59,280

it possible that a humanoid

1838

01:17:03,410 --> 01:17:01,320

dinosaur could have evolved from

1839

01:17:04,669 --> 01:17:03,420

something like this

1840

01:17:07,610 --> 01:17:04,679

um so there were some dinosaurs with

1841

01:17:08,930 --> 01:17:07,620

relatively large brains for their body

1842

01:17:09,530 --> 01:17:08,940

size

1843

01:17:12,050 --> 01:17:09,540

um

1844

01:17:15,709 --> 01:17:12,060

you know among the theropods the the

1845

01:17:17,689 --> 01:17:15,719

meat eating dinosaurs and um it's if you

1846

01:17:18,890 --> 01:17:17,699

think about our own Evolution from tree

1847

01:17:20,450 --> 01:17:18,900

dwelling

1848

01:17:23,270 --> 01:17:20,460

organisms

1849

01:17:26,090 --> 01:17:23,280

um this is not that far-fetched

1850

01:17:28,790 --> 01:17:26,100

but the question is really like does it

1851

01:17:31,490 --> 01:17:28,800

have to be that humanoid right but maybe

1852

01:17:34,669 --> 01:17:31,500

that's going too far but um I think

1853

01:17:37,070 --> 01:17:34,679

Simon Conway Morris would probably agree

1854

01:17:37,850 --> 01:17:37,080

with this speculation

1855

01:17:39,649 --> 01:17:37,860

um

1856

01:17:42,649 --> 01:17:39,659

interestingly this actually reminds me

1857

01:17:44,689 --> 01:17:42,659

of something that the Mormons believe

1858

01:17:46,810 --> 01:17:44,699

um and Conway Morris is actually a

1859

01:17:49,610 --> 01:17:46,820

religious believer he draws some

1860

01:17:52,189 --> 01:17:49,620

theological significance from convergent

1861

01:17:54,350 --> 01:17:52,199

evolution but I don't think

1862

01:17:57,229 --> 01:17:54,360

but um the Mormons believe that there

1863

01:17:58,790 --> 01:17:57,239

are people on other planets and um this

1864

01:18:04,070 --> 01:17:58,800

something like this would fit nicely

1865

01:18:08,270 --> 01:18:06,530

yep we have audience member here fig

1866

01:18:10,490 --> 01:18:08,280

commenting that some conspiracy

1867

01:18:11,930 --> 01:18:10,500

theorists actually believe this happened

1868

01:18:15,050 --> 01:18:11,940

and that this accounts for those

1869

01:18:17,930 --> 01:18:15,060

encounters with lizard-like ETS yeah

1870

01:18:20,330 --> 01:18:17,940

right the Republicans

1871

01:18:21,830 --> 01:18:20,340

there was actually a movie in the 1970s

1872

01:18:23,149 --> 01:18:21,840

it was actually a three-part movie

1873

01:18:25,850 --> 01:18:23,159

called V

1874

01:18:27,830 --> 01:18:25,860

about these um reptilians who came to

1875

01:18:28,610 --> 01:18:27,840

Earth to take over

1876

01:18:30,410 --> 01:18:28,620

um

1877

01:18:32,750 --> 01:18:30,420

but I think

1878

01:18:34,729 --> 01:18:32,760

yeah like if you think about abduction

1879

01:18:36,950 --> 01:18:34,739

experiences

1880

01:18:39,890 --> 01:18:36,960

um they're mostly or indeed contact

1881

01:18:43,490 --> 01:18:39,900

experiences um it's either human beings

1882

01:18:45,350 --> 01:18:43,500

or the Grays or something

1883

01:18:47,930 --> 01:18:45,360

basically humanoid

1884

01:18:49,790 --> 01:18:47,940

and um you know depending on what you

1885

01:18:52,010 --> 01:18:49,800

think of convergent evolution and its

1886

01:18:54,350 --> 01:18:52,020

Universe universality

1887

01:18:57,490 --> 01:18:54,360

um that could be evidence

1888

01:19:00,890 --> 01:18:57,500

the the the frequency of humanoid

1889

01:19:04,130 --> 01:19:00,900

extraterrestrials and abduction cases

1890

01:19:11,330 --> 01:19:04,140

can be seen as evidence for or against

1891

01:19:15,709 --> 01:19:13,850

um Okay so

1892

01:19:18,470 --> 01:19:15,719

animals have got they tend to have

1893

01:19:21,890 --> 01:19:18,480

complex nervous systems nervous systems

1894

01:19:22,850 --> 01:19:21,900

are a system a type of tissue which

1895

01:19:25,090 --> 01:19:22,860

gives

1896

01:19:27,350 --> 01:19:25,100

um animals a high degree of

1897

01:19:33,050 --> 01:19:27,360

responsiveness to the environment so

1898

01:19:37,250 --> 01:19:35,330

um I talked about convergent evolution

1899

01:19:38,149 --> 01:19:37,260

there I hear by the way here is an

1900

01:19:43,189 --> 01:19:38,159

example

1901

01:19:45,890 --> 01:19:43,199

North America

1902

01:19:47,030 --> 01:19:45,900

uh or South America and these come from

1903

01:19:49,610 --> 01:19:47,040

Australia

1904

01:19:52,550 --> 01:19:49,620

and these are independently evolved but

1905

01:19:55,970 --> 01:19:52,560

they fit very similar ecological niches

1906

01:19:58,550 --> 01:19:55,980

so this flying squirrel is very similar

1907

01:20:00,709 --> 01:19:58,560

to this uh flying phalanga

1908

01:20:04,189 --> 01:20:00,719

this uh groundhog is similar to the

1909

01:20:06,530 --> 01:20:04,199

wombat Etc but they these all evolved

1910

01:20:08,149 --> 01:20:06,540

separately from a common ancestor which

1911

01:20:10,790 --> 01:20:08,159

arrived in Australia

1912

01:20:12,590 --> 01:20:10,800

and then they Diversified in Australia

1913

01:20:16,130 --> 01:20:12,600

independently of these ones even though

1914

01:20:18,229 --> 01:20:16,140

they look superficially similar so yeah

1915

01:20:21,770 --> 01:20:18,239

convergent evolution is certainly very

1916

01:20:25,490 --> 01:20:21,780

important and very um striking but I

1917

01:20:27,649 --> 01:20:25,500

would be cautious about drawing too many

1918

01:20:29,450 --> 01:20:27,659

um conclusions when we're talking about

1919

01:20:32,209 --> 01:20:29,460

extraterrestrial life

1920

01:20:34,790 --> 01:20:32,219

but what do you guys think well yeah I

1921

01:20:38,689 --> 01:20:34,800

was wondering with uh the uh this is

1922

01:20:41,810 --> 01:20:38,699

related the dinosaurs were conceivably I

1923

01:20:43,870 --> 01:20:41,820

mean wiped out by the uh asteroid how

1924

01:20:47,390 --> 01:20:43,880

long ago was that was that 50 million

1925

01:20:49,970 --> 01:20:47,400

about 66 million years ago 66 million

1926
01:20:52,790 --> 01:20:49,980
years ago and dinosaurs were around for

1927
01:20:56,330 --> 01:20:52,800
for quite a bit longer than 66 million

1928
01:20:58,550 --> 01:20:56,340
years right like uh they were about they

1929
01:21:01,189 --> 01:20:58,560
were around for the last five million or

1930
01:21:02,510 --> 01:21:01,199
so years of the Cretaceous Period okay

1931
01:21:03,890 --> 01:21:02,520
so they were only right for about five

1932
01:21:08,689 --> 01:21:03,900
million years before they got wiped out

1933
01:21:10,430 --> 01:21:08,699
yeah okay okay cool how

1934
01:21:14,330 --> 01:21:10,440
so when

1935
01:21:17,870 --> 01:21:14,340
when the dinosaurs arose from the prior

1936
01:21:19,310 --> 01:21:17,880
uh you know evolutionary history of uh

1937
01:21:21,050 --> 01:21:19,320
whatever was three point whatever

1938
01:21:22,729 --> 01:21:21,060

billion years

1939

01:21:25,610 --> 01:21:22,739

and then they got wiped out and then the

1940

01:21:28,130 --> 01:21:25,620

mammals came up it seemed like the life

1941

01:21:31,070 --> 01:21:28,140

like uh in terms of intelligence like

1942

01:21:33,830 --> 01:21:31,080

humans we sort of filled a niche that

1943

01:21:37,669 --> 01:21:33,840

obviously was not really being maximally

1944

01:21:40,130 --> 01:21:37,679

exploited uh previously now what is

1945

01:21:42,590 --> 01:21:40,140

there what what sort of uh ideas do you

1946

01:21:44,870 --> 01:21:42,600

have about why that is why was there not

1947

01:21:48,050 --> 01:21:44,880

an intelligent thing seemingly filling

1948

01:21:51,350 --> 01:21:48,060

in that Niche uh prior to that it was it

1949

01:21:53,270 --> 01:21:51,360

because of uh efficiency of energy like

1950

01:21:55,790 --> 01:21:53,280

our brains with our warm bloodedness

1951

01:21:57,410 --> 01:21:55,800

like what's going on there probably a

1952

01:21:58,970 --> 01:21:57,420

combination of things one of them is

1953

01:22:01,790 --> 01:21:58,980

that nervous systems are very

1954

01:22:05,090 --> 01:22:01,800

energetically expensive so we are

1955

01:22:07,189 --> 01:22:05,100

consume about well in terms of calories

1956

01:22:10,610 --> 01:22:07,199

the nervous system of a human being is

1957

01:22:13,250 --> 01:22:10,620

about 25 of the calories that we consume

1958

01:22:16,250 --> 01:22:13,260

but even though the mass is only about

1959

01:22:18,649 --> 01:22:16,260

five percent so it's got an outsized

1960

01:22:20,390 --> 01:22:18,659

um consumption of energy

1961

01:22:22,790 --> 01:22:20,400

um so that could be one thing that

1962

01:22:24,890 --> 01:22:22,800

Evolution doesn't tend to favor very

1963

01:22:26,930 --> 01:22:24,900

large

1964

01:22:28,790 --> 01:22:26,940

um or complex nervous systems because

1965

01:22:31,430 --> 01:22:28,800

the animal's already doing the job

1966

01:22:32,930 --> 01:22:31,440

pretty well so there's no need to

1967

01:22:35,390 --> 01:22:32,940

you know

1968

01:22:37,430 --> 01:22:35,400

um complexify that tissue that organ

1969

01:22:40,070 --> 01:22:37,440

system much more

1970

01:22:41,930 --> 01:22:40,080

so there could be a cost benefit ratio

1971

01:22:43,669 --> 01:22:41,940

going on which is not favorable to the

1972

01:22:46,729 --> 01:22:43,679

evolution of complex

1973

01:22:48,890 --> 01:22:46,739

or super complex nervous systems the

1974

01:22:51,050 --> 01:22:48,900

other thing is that probably you need um

1975

01:22:55,149 --> 01:22:51,060

pre-existing conditions in order to have

1976

01:22:58,810 --> 01:22:55,159

human level intelligence arise such as

1977

01:23:01,550 --> 01:22:58,820

dexterous or semi-dextrous uh fingers

1978

01:23:03,350 --> 01:23:01,560

opposable thumbs right yeah opposable

1979

01:23:07,070 --> 01:23:03,360

thumbs and also

1980

01:23:09,890 --> 01:23:07,080

um sociality so that organisms living in

1981

01:23:11,270 --> 01:23:09,900

groups sharing information teaching each

1982

01:23:13,310 --> 01:23:11,280

other stuff

1983

01:23:14,510 --> 01:23:13,320

um passing on what could be called

1984

01:23:17,330 --> 01:23:14,520

culture

1985

01:23:19,250 --> 01:23:17,340

that's probably another constraint and

1986

01:23:22,910 --> 01:23:19,260

so as far as we know it's only happened

1987

01:23:23,870 --> 01:23:22,920

once maybe twice with neanderthals

1988

01:23:26,149 --> 01:23:23,880

um even though there was some

1989

01:23:28,910 --> 01:23:26,159

interbreeding between neanderthals and

1990

01:23:31,970 --> 01:23:28,920

Homo sapiens apparently

1991

01:23:33,229 --> 01:23:31,980

um but certainly a very very rare

1992

01:23:36,050 --> 01:23:33,239

event

1993

01:23:38,570 --> 01:23:36,060

um and so again even if we find animal

1994

01:23:41,450 --> 01:23:38,580

life on other planets uh we shouldn't

1995

01:23:43,910 --> 01:23:41,460

expect it to have any human level

1996

01:23:46,430 --> 01:23:43,920

intelligence as an inevitable outcome of

1997

01:23:49,550 --> 01:23:48,169

um so we have a question from the

1998

01:23:52,189 --> 01:23:49,560

audience here how do we explain

1999

01:23:54,530 --> 01:23:52,199

dinosaurs as a matter of evolution given

2000

01:23:57,229 --> 01:23:54,540

their massive sizes

2001

01:23:59,149 --> 01:23:57,239

um yeah in other words

2002

01:24:01,070 --> 01:23:59,159

um would you say Lewis that dinosaurs

2003

01:24:04,070 --> 01:24:01,080

may have become smaller over time to

2004

01:24:06,830 --> 01:24:04,080

better adapt and survive

2005

01:24:09,470 --> 01:24:06,840

well some dinosaurs were actually very

2006

01:24:11,870 --> 01:24:09,480

small some were like chicken sized

2007

01:24:14,810 --> 01:24:11,880

um the size of a chihuahua

2008

01:24:16,310 --> 01:24:14,820

I was thinking of mini just then

2009

01:24:18,649 --> 01:24:16,320

um

2010

01:24:21,890 --> 01:24:18,659

oh but some dinosaurs obviously were

2011

01:24:24,470 --> 01:24:21,900

huge in especially the sauropods

2012

01:24:27,649 --> 01:24:24,480

now um

2013

01:24:31,189 --> 01:24:27,659

they were actually in the cenozoic

2014

01:24:33,830 --> 01:24:31,199

era which followed the KT event you did

2015

01:24:38,090 --> 01:24:33,840

get the evolution of massive um mega

2016

01:24:40,310 --> 01:24:38,100

mega fauna in in the mammals so the

2017

01:24:41,990 --> 01:24:40,320

dinosaurs were not the only super large

2018

01:24:43,669 --> 01:24:42,000

animals

2019

01:24:45,410 --> 01:24:43,679

um but certainly there were very large

2020

01:24:47,570 --> 01:24:45,420

dinosaurs

2021

01:24:49,790 --> 01:24:47,580

uh it could have been an oxygen level in

2022

01:24:51,290 --> 01:24:49,800

the atmosphere was a bit higher back

2023

01:24:53,870 --> 01:24:51,300

then although I think that's been

2024

01:24:56,330 --> 01:24:53,880

disputed but having more oxygen does

2025

01:24:58,370 --> 01:24:56,340

give you more energy availability so

2026

01:24:59,990 --> 01:24:58,380

that could be one thing there could also

2027

01:25:01,729 --> 01:25:00,000

have been an arms race going on where

2028

01:25:04,370 --> 01:25:01,739

size was

2029

01:25:07,550 --> 01:25:04,380

uh something favored by selection so

2030

01:25:09,950 --> 01:25:07,560

like Predator prey co-evolution favored

2031

01:25:11,030 --> 01:25:09,960

having larger size

2032

01:25:12,290 --> 01:25:11,040

um that could have just been a

2033

01:25:14,870 --> 01:25:12,300

contingent

2034

01:25:16,430 --> 01:25:14,880

thing so we could conceivably have that

2035

01:25:19,370 --> 01:25:16,440

happen again

2036

01:25:21,830 --> 01:25:19,380

the largest land animals these days are

2037

01:25:23,330 --> 01:25:21,840

the um African elephants

2038

01:25:25,729 --> 01:25:23,340

they're pretty big they're about the

2039

01:25:28,330 --> 01:25:25,739

size of a Triceratops but we don't

2040

01:25:30,830 --> 01:25:28,340

currently have anything the size of a

2041

01:25:33,050 --> 01:25:30,840

Brachiosaurus except in the oceans with

2042

01:25:35,090 --> 01:25:33,060

the whales so the Broadway was actually

2043

01:25:37,490 --> 01:25:35,100

the largest animal that's ever lived

2044

01:25:39,110 --> 01:25:37,500

that we know about

2045

01:25:42,709 --> 01:25:39,120

um and it's still around even larger

2046

01:25:45,350 --> 01:25:42,719

than dinosaurs yeah yeah it is oh wow

2047

01:25:47,330 --> 01:25:45,360

in terms of mass uh but it's got you

2048

01:25:49,669 --> 01:25:47,340

know the water the aqueous environment

2049

01:25:52,250 --> 01:25:49,679

to keep it buoyant so you can get very

2050

01:25:54,290 --> 01:25:52,260

long animals yes it doesn't collapse on

2051

01:25:56,149 --> 01:25:54,300

itself or anything right which is why

2052

01:25:59,450 --> 01:25:56,159

when they Beach themselves they they

2053

01:26:00,890 --> 01:25:59,460

Crush their own lungs basically

2054

01:26:02,810 --> 01:26:00,900

um

2055

01:26:04,729 --> 01:26:02,820

but yeah I mean it's not certain why

2056

01:26:07,310 --> 01:26:04,739

dinosaurs got so big I think it was a

2057

01:26:10,370 --> 01:26:07,320

combination of abiotic factors like um

2058

01:26:12,350 --> 01:26:10,380

atmospheric oxygen or some sort of um

2059

01:26:17,209 --> 01:26:12,360

plant

2060

01:26:19,729 --> 01:26:17,219

as they are now although the angiosperms

2061

01:26:21,110 --> 01:26:19,739

did evolve in the Jurassic so those are

2062

01:26:23,209 --> 01:26:21,120

the flowering plants but I don't know if

2063

01:26:25,430 --> 01:26:23,219

that had much of an effect but there

2064

01:26:28,490 --> 01:26:25,440

could have been some food source which

2065

01:26:30,530 --> 01:26:28,500

allowed diners to get very big

2066

01:26:34,370 --> 01:26:30,540

it was it was Pro

2067

01:26:35,270 --> 01:26:34,380

yeah real yes it was definitely Brill

2068

01:26:38,090 --> 01:26:35,280

um

2069

01:26:40,310 --> 01:26:38,100

and also the co-evolutionary arms race

2070

01:26:42,830 --> 01:26:40,320

between predator and prey

2071

01:26:44,030 --> 01:26:42,840

lineages probably favored large size in

2072

01:26:46,370 --> 01:26:44,040

many cases

2073

01:26:47,209 --> 01:26:46,380

mm-hmm

2074

01:26:49,010 --> 01:26:47,219

um

2075

01:26:50,510 --> 01:26:49,020

see if there's any other pictures here

2076

01:26:52,010 --> 01:26:50,520

that I want to show

2077

01:27:02,030 --> 01:26:52,020

um

2078

01:27:03,530 --> 01:27:02,040

intelligence so this is another form of

2079

01:27:06,110 --> 01:27:03,540

complexity because here we're talking

2080

01:27:07,490 --> 01:27:06,120

about cognitive complexity and by

2081

01:27:09,470 --> 01:27:07,500

intelligence

2082

01:27:11,270 --> 01:27:09,480

you know people have come up with

2083

01:27:13,070 --> 01:27:11,280

different definitions and some people

2084

01:27:15,410 --> 01:27:13,080

have denied that you can even have a

2085

01:27:17,030 --> 01:27:15,420

definition of intelligence but in the

2086

01:27:20,030 --> 01:27:17,040

sense that um

2087

01:27:22,010 --> 01:27:20,040

this other author is talking about and

2088

01:27:25,070 --> 01:27:22,020

this is also a very good book

2089

01:27:27,350 --> 01:27:25,080

this is by Kevin and Leyland Darwin's

2090

01:27:28,790 --> 01:27:27,360

unfinished Symphony how culture made the

2091

01:27:31,129 --> 01:27:28,800

the human mind

2092

01:27:33,830 --> 01:27:31,139

in this book he talks about how culture

2093

01:27:35,209 --> 01:27:33,840

is not something that simply arose from

2094

01:27:38,270 --> 01:27:35,219

a large Brain

2095

01:27:39,830 --> 01:27:38,280

but rather something which was involved

2096

01:27:42,530 --> 01:27:39,840

in a

2097

01:27:45,290 --> 01:27:42,540

uh co-evolutionary cycle a positive

2098

01:27:47,450 --> 01:27:45,300

feedback loop with Biology

2099

01:27:49,490 --> 01:27:47,460

so the larger your brain was the more

2100

01:27:50,990 --> 01:27:49,500

culture you could have in in the sense

2101
01:27:52,790 --> 01:27:51,000
that you could share information more

2102
01:27:54,290 --> 01:27:52,800
readily you could try out different

2103
01:27:57,950 --> 01:27:54,300
things

2104
01:28:01,010 --> 01:27:57,960
um and culture itself favored larger

2105
01:28:04,490 --> 01:28:01,020
brains okay and so it was like an auto

2106
01:28:06,649 --> 01:28:04,500
catalytic positive feedback loop so by

2107
01:28:09,050 --> 01:28:06,659
intelligence I mean here the strictly

2108
01:28:11,570 --> 01:28:09,060
anthropomorphic sense of possessing

2109
01:28:13,790 --> 01:28:11,580
certain attributes

2110
01:28:17,030 --> 01:28:13,800
in our cognition such as abstract

2111
01:28:20,149 --> 01:28:17,040
thought complex language with syntax and

2112
01:28:23,290 --> 01:28:20,159
grammar which allows you to construct

2113
01:28:26,390 --> 01:28:23,300

endlessly recursive strings of meaning

2114

01:28:29,450 --> 01:28:26,400

higher order intentionality the ability

2115

01:28:31,250 --> 01:28:29,460

to manipulate tools to pass on cultural

2116

01:28:33,649 --> 01:28:31,260

knowledge between peers and down to

2117

01:28:36,410 --> 01:28:33,659

children as well as to assimilate those

2118

01:28:38,510 --> 01:28:36,420

lessons yourself from your con specifics

2119

01:28:41,930 --> 01:28:38,520

and to learn

2120

01:28:43,310 --> 01:28:41,940

and um in this book he really it's an

2121

01:28:46,189 --> 01:28:43,320

incredible book

2122

01:28:47,510 --> 01:28:46,199

um he goes into animal studies that have

2123

01:28:50,330 --> 01:28:47,520

been done

2124

01:28:53,270 --> 01:28:50,340

um game game theory type simulations

2125

01:28:56,450 --> 01:28:53,280

similar to the ones in the 1970s but

2126
01:28:59,510 --> 01:28:56,460
updated to include learning by the

2127
01:29:02,090 --> 01:28:59,520
agents in this in these games yeah like

2128
01:29:04,430 --> 01:29:02,100
agent-based modeling right exactly sure

2129
01:29:06,169 --> 01:29:04,440
and it seems that learning and imitation

2130
01:29:08,930 --> 01:29:06,179
are incredibly important to the

2131
01:29:10,370 --> 01:29:08,940
evolution of intelligence and yeah well

2132
01:29:12,550 --> 01:29:10,380
that makes sense like memetic

2133
01:29:15,350 --> 01:29:12,560
intellectual development

2134
01:29:18,290 --> 01:29:15,360
and one one cool thing about learning is

2135
01:29:20,570 --> 01:29:18,300
that you don't have to engage in the

2136
01:29:22,370 --> 01:29:20,580
dangerous activities which allow the

2137
01:29:24,649 --> 01:29:22,380
person that learned that

2138
01:29:26,870 --> 01:29:24,659

to you know get gain that knowledge you

2139

01:29:30,110 --> 01:29:26,880

can just copy what they did right and

2140

01:29:31,010 --> 01:29:30,120

pressured the the risks

2141

01:29:34,729 --> 01:29:31,020

um

2142

01:29:37,669 --> 01:29:34,739

I am so I I follow this neuroscientist

2143

01:29:40,070 --> 01:29:37,679

and writer Eric Hall and he just won an

2144

01:29:42,649 --> 01:29:40,080

essay contest

2145

01:29:45,530 --> 01:29:42,659

um basically writing about why human

2146

01:29:47,810 --> 01:29:45,540

culture why humans existed so long

2147

01:29:49,970 --> 01:29:47,820

before we saw the emergence of like

2148

01:29:52,310 --> 01:29:49,980

human culture as we would understand it

2149

01:29:54,470 --> 01:29:52,320

in terms of like storytelling art music

2150

01:29:56,930 --> 01:29:54,480

things like that and he had this really

2151
01:29:58,910 --> 01:29:56,940
interesting theory about how or he was

2152
01:30:01,850 --> 01:29:58,920
he was reviewing a book that was talking

2153
01:30:04,430 --> 01:30:01,860
about this theory about how it's only

2154
01:30:07,669 --> 01:30:04,440
when humans were living in environments

2155
01:30:10,310 --> 01:30:07,679
where there are Social Circles grew

2156
01:30:12,410 --> 01:30:10,320
substantially before they started to

2157
01:30:14,090 --> 01:30:12,420
actually develop like meaningful culture

2158
01:30:16,970 --> 01:30:14,100
Beyond just immediate survival

2159
01:30:19,910 --> 01:30:16,980
considerations and he basically

2160
01:30:22,970 --> 01:30:19,920
attributes this to the idea that

2161
01:30:25,910 --> 01:30:22,980
um when you have this broader extended

2162
01:30:27,830 --> 01:30:25,920
network of social connection

2163
01:30:29,450 --> 01:30:27,840

um there's not as much squabbling in

2164

01:30:31,310 --> 01:30:29,460

infighting the way there is and like

2165

01:30:33,530 --> 01:30:31,320

your immediate Social Circle so think

2166

01:30:35,090 --> 01:30:33,540

about how you get things done in a

2167

01:30:36,709 --> 01:30:35,100

professional environment you're not like

2168

01:30:38,510 --> 01:30:36,719

fighting and arguing and beating each

2169

01:30:42,649 --> 01:30:38,520

other up because you have less personal

2170

01:30:44,510 --> 01:30:42,659

involvement and he he talks basically

2171

01:30:47,090 --> 01:30:44,520

about this idea that once you had this

2172

01:30:52,490 --> 01:30:47,100

critical mass of social organization

2173

01:30:53,209 --> 01:30:52,500

found in like Villages or like Community

2174

01:30:55,490 --> 01:30:53,219

um

2175

01:30:58,310 --> 01:30:55,500

and once people's social engagements

2176
01:31:00,290 --> 01:30:58,320
grew Beyond like the immediate family

2177
01:31:02,689 --> 01:31:00,300
um that's really what started that

2178
01:31:05,570 --> 01:31:02,699
flywheel of collaborative cultural

2179
01:31:07,550 --> 01:31:05,580
establishment and creativity

2180
01:31:10,910 --> 01:31:07,560
yeah that does resonate a lot with what

2181
01:31:13,850 --> 01:31:10,920
Leyland also says I guess leylands would

2182
01:31:15,470 --> 01:31:13,860
emphasize the um teaching aspect which

2183
01:31:18,709 --> 01:31:15,480
is pressing on information to your

2184
01:31:21,470 --> 01:31:18,719
Offspring and um

2185
01:31:23,990 --> 01:31:21,480
that involves the most efficient way of

2186
01:31:26,590 --> 01:31:24,000
doing that is using language so in his

2187
01:31:29,510 --> 01:31:26,600
view language evolved specifically to

2188
01:31:31,729 --> 01:31:29,520

facilitate the passing of the passing on

2189

01:31:33,350 --> 01:31:31,739

of cultural information from parents to

2190

01:31:36,770 --> 01:31:33,360

offspring and various things like pool

2191

01:31:38,810 --> 01:31:36,780

use or manufacturing certain items or um

2192

01:31:40,550 --> 01:31:38,820

you know knowing where food is in the

2193

01:31:41,990 --> 01:31:40,560

environment

2194

01:31:44,090 --> 01:31:42,000

um but that could have generalized as

2195

01:31:46,850 --> 01:31:44,100

well into a like a general purpose

2196

01:31:49,550 --> 01:31:46,860

module in the brain which could um not

2197

01:31:51,890 --> 01:31:49,560

only be good good at learning how to

2198

01:31:54,169 --> 01:31:51,900

build tools but also learning how to

2199

01:31:57,470 --> 01:31:54,179

conspire or learning how to form

2200

01:32:02,450 --> 01:31:59,450

um there is also some backstabbing and

2201
01:32:03,709 --> 01:32:02,460
sort of Machiavellian uh aspects to this

2202
01:32:05,990 --> 01:32:03,719
as well but there's also a lot of

2203
01:32:08,270 --> 01:32:06,000
Cooperative aspects

2204
01:32:10,729 --> 01:32:08,280
yeah for sure so so we have audience

2205
01:32:12,350 --> 01:32:10,739
comment here saying that I would say

2206
01:32:14,330 --> 01:32:12,360
meaningful culture happened when Iron

2207
01:32:16,189 --> 01:32:14,340
Maiden was formed in the 70s in Britain

2208
01:32:18,410 --> 01:32:16,199
before that it was still the Dark Ages

2209
01:32:21,050 --> 01:32:18,420
yes truly

2210
01:32:24,830 --> 01:32:21,060
um the release of Power Slave is what

2211
01:32:29,750 --> 01:32:24,840
Marx our emergence into modernity

2212
01:32:31,070 --> 01:32:29,760
um yeah I mean I think you know a

2213
01:32:33,950 --> 01:32:31,080

I

2214

01:32:36,770 --> 01:32:33,960

am so fascinated by the historiography

2215

01:32:39,649 --> 01:32:36,780

and values and behaviors that we

2216

01:32:41,270 --> 01:32:39,659

project onto our ancestors and

2217

01:32:43,550 --> 01:32:41,280

predecessors I think there's this

2218

01:32:46,790 --> 01:32:43,560

natural inclination

2219

01:32:49,129 --> 01:32:46,800

um candidly I think Born of

2220

01:32:52,910 --> 01:32:49,139

um excessive romanticization of American

2221

01:32:55,070 --> 01:32:52,920

record individualism that existing in

2222

01:32:58,129 --> 01:32:55,080

prehistoric times was extremely

2223

01:33:01,550 --> 01:32:58,139

adversarial and violent and terrible but

2224

01:33:03,950 --> 01:33:02,090

um

2225

01:33:05,330 --> 01:33:03,960

it seems to me that there's consistent

2226

01:33:07,729 --> 01:33:05,340

evidence that it was highly

2227

01:33:09,350 --> 01:33:07,739

collaborative that people behaved very

2228

01:33:10,970 --> 01:33:09,360

similarly to how they behave now with

2229

01:33:12,770 --> 01:33:10,980

like their immediate cohort in terms of

2230

01:33:15,229 --> 01:33:12,780

caretaking

2231

01:33:17,270 --> 01:33:15,239

um I can distinctly remember reading

2232

01:33:17,930 --> 01:33:17,280

about

2233

01:33:22,010 --> 01:33:17,940

um

2234

01:33:24,110 --> 01:33:22,020

uh anthrop like a an archaeological dig

2235

01:33:26,330 --> 01:33:24,120

that Unearthed a prehistoric person

2236

01:33:28,189 --> 01:33:26,340

who'd had a broken leg and healed and

2237

01:33:30,709 --> 01:33:28,199

that was basically taken as an oblique

2238

01:33:32,629 --> 01:33:30,719

indicator that humans were caring for

2239

01:33:35,030 --> 01:33:32,639

their sick and for their ailing instead

2240

01:33:35,750 --> 01:33:35,040

of just leaving them to die

2241

01:33:38,090 --> 01:33:35,760

um

2242

01:33:40,430 --> 01:33:38,100

you know and I think

2243

01:33:42,110 --> 01:33:40,440

I I just think that speaks um I mean

2244

01:33:44,270 --> 01:33:42,120

maybe I'm I'm feeling brahmatic on

2245

01:33:46,189 --> 01:33:44,280

Thanksgiving giving Eve but that speaks

2246

01:33:47,930 --> 01:33:46,199

to sort of a pervasive sense of

2247

01:33:49,550 --> 01:33:47,940

cooperation and collaboration that I

2248

01:33:50,990 --> 01:33:49,560

think humans have exhibited for a very

2249

01:33:52,970 --> 01:33:51,000

very long time

2250

01:33:55,750 --> 01:33:52,980

yes and actually that reminds me of

2251

01:33:59,149 --> 01:33:55,760

another book by um David Sloan Wilson

2252

01:34:01,430 --> 01:33:59,159

who is uh he he's actually investigated

2253

01:34:03,530 --> 01:34:01,440

the evolution of religion

2254

01:34:06,649 --> 01:34:03,540

um but he he's written a recent book

2255

01:34:09,830 --> 01:34:06,659

about how we can use darwinian lessons

2256

01:34:12,890 --> 01:34:09,840

in shaping Society to be more

2257

01:34:15,050 --> 01:34:12,900

Humane and cooperative and he does talk

2258

01:34:17,030 --> 01:34:15,060

about group selection as a important

2259

01:34:18,910 --> 01:34:17,040

driver in human evolution

2260

01:34:21,350 --> 01:34:18,920

because if you think about it

2261

01:34:22,610 --> 01:34:21,360

throughout most of our history as humans

2262

01:34:26,149 --> 01:34:22,620

we've been living in small

2263

01:34:28,910 --> 01:34:26,159

hunter-gatherer groups of um no more

2264

01:34:31,610 --> 01:34:28,920

than a few dozen individuals and your

2265

01:34:34,129 --> 01:34:31,620

fate is really tied to the group so yes

2266

01:34:36,950 --> 01:34:34,139

you know help your group

2267

01:34:39,830 --> 01:34:36,960

um even go out of your way to help it

2268

01:34:42,050 --> 01:34:39,840

risk your own life for example

2269

01:34:43,910 --> 01:34:42,060

um then

2270

01:34:46,729 --> 01:34:43,920

you know the group the group as a whole

2271

01:34:48,590 --> 01:34:46,739

can benefit and um so he thinks that

2272

01:34:50,990 --> 01:34:48,600

group selection was important

2273

01:34:53,030 --> 01:34:51,000

um probably is important for any

2274

01:34:54,350 --> 01:34:53,040

species with a significant amount of

2275

01:34:56,270 --> 01:34:54,360

culture

2276

01:34:57,410 --> 01:34:56,280

especially because the information is

2277

01:35:00,110 --> 01:34:57,420

going to be

2278

01:35:01,129 --> 01:35:00,120

uh is going to accumulate

2279

01:35:04,430 --> 01:35:01,139

um

2280

01:35:06,890 --> 01:35:04,440

and be shared so one of the important

2281

01:35:10,370 --> 01:35:06,900

things about culture is that it's acting

2282

01:35:12,770 --> 01:35:10,380

as a reservoir of experience so you can

2283

01:35:15,229 --> 01:35:12,780

tap into that those lessons and that

2284

01:35:17,570 --> 01:35:15,239

information to do things yourself and

2285

01:35:20,270 --> 01:35:17,580

then potentially you can build upon that

2286

01:35:22,729 --> 01:35:20,280

and you know it's information technology

2287

01:35:25,729 --> 01:35:22,739

these days we can see that very clearly

2288

01:35:28,850 --> 01:35:25,739

but um it was always important

2289

01:35:32,030 --> 01:35:28,860

and well and the origin origin if I'm

2290

01:35:34,910 --> 01:35:32,040

not mistaken of even the word meme it it

2291

01:35:37,729 --> 01:35:34,920

or it originates in gene right like it

2292

01:35:40,790 --> 01:35:37,739

it's these things that self-replicate

2293

01:35:43,970 --> 01:35:40,800

some remain that have a lasting power

2294

01:35:46,910 --> 01:35:43,980

others go away upon the Wayside through

2295

01:35:49,370 --> 01:35:46,920

this self-selection process so there's

2296

01:35:51,050 --> 01:35:49,380

this interesting process where it's

2297

01:35:53,629 --> 01:35:51,060

almost like I'm getting the sense that

2298

01:35:56,030 --> 01:35:53,639

uh language and communication and things

2299

01:36:00,250 --> 01:35:56,040

like that are acting

2300

01:36:04,430 --> 01:36:00,260

in a secondary capacity very similarly

2301

01:36:06,410 --> 01:36:04,440
to DNA itself in the sense that

2302

01:36:09,590 --> 01:36:06,420
we are

2303

01:36:14,030 --> 01:36:09,600
able to through our conscious intellects

2304

01:36:16,610 --> 01:36:14,040
almost be choosing the material that

2305

01:36:19,070 --> 01:36:16,620
gets propagated whereas the the DNA it

2306

01:36:22,850 --> 01:36:19,080
produces automatic reflexive uh

2307

01:36:26,930 --> 01:36:22,860
responses in the animals so it

2308

01:36:30,169 --> 01:36:26,940
is it basically like uh it's an extra

2309

01:36:32,990 --> 01:36:30,179
layer on top of the DNA that is uh

2310

01:36:35,090 --> 01:36:33,000
adding to that ability to sort of uh

2311

01:36:38,090 --> 01:36:35,100
have just the best things stick with us

2312

01:36:39,530 --> 01:36:38,100
is that sort of what uh the idea is

2313

01:36:41,810 --> 01:36:39,540

yeah

2314

01:36:43,250 --> 01:36:41,820

um so memes were first mentioned by I

2315

01:36:45,709 --> 01:36:43,260

think came from a French word actually

2316

01:36:47,870 --> 01:36:45,719

but um Richard Dawkins is the one who at

2317

01:36:51,350 --> 01:36:47,880

least popularized the word in his book

2318

01:36:52,850 --> 01:36:51,360

The Selfish Gene which came out in 1976

2319

01:36:53,510 --> 01:36:52,860

I think

2320

01:36:56,270 --> 01:36:53,520

um

2321

01:36:58,850 --> 01:36:56,280

and uh the me Minds here is yeah saying

2322

01:37:00,770 --> 01:36:58,860

that there's this self-replicating

2323

01:37:03,950 --> 01:37:00,780

um

2324

01:37:07,250 --> 01:37:03,960

unit of information which is analogous

2325

01:37:09,470 --> 01:37:07,260

to DNA but it exists as information

2326
01:37:10,669 --> 01:37:09,480
um so in concrete terms I guess that

2327
01:37:14,030 --> 01:37:10,679
would be

2328
01:37:16,610 --> 01:37:14,040
patterns in the brain encoding certain

2329
01:37:19,010 --> 01:37:16,620
meanings or whatever sentences or

2330
01:37:20,990 --> 01:37:19,020
stories and some of those

2331
01:37:22,910 --> 01:37:21,000
um bits of information are better at

2332
01:37:25,010 --> 01:37:22,920
propagating themselves because of their

2333
01:37:27,770 --> 01:37:25,020
effects on the host

2334
01:37:29,629 --> 01:37:27,780
and um

2335
01:37:30,430 --> 01:37:29,639
the the interesting thing

2336
01:37:32,930 --> 01:37:30,440
um

2337
01:37:34,850 --> 01:37:32,940
the mimetics

2338
01:37:37,310 --> 01:37:34,860

um is not really taken that seriously I

2339

01:37:39,470 --> 01:37:37,320

should say by most anthropologists and

2340

01:37:42,890 --> 01:37:39,480

evolutionary biologists

2341

01:37:45,229 --> 01:37:42,900

possibly Dawkins went too far but um

2342

01:37:48,709 --> 01:37:45,239

there is a sense in which certain ideas

2343

01:37:50,750 --> 01:37:48,719

are more virile than others okay

2344

01:37:53,750 --> 01:37:50,760

by virtue of the effects that they have

2345

01:37:56,390 --> 01:37:53,760

on their hosts so the brains in which

2346

01:37:59,209 --> 01:37:56,400

they reside and there's also a sense in

2347

01:38:00,649 --> 01:37:59,219

which some ideas are pathogenic instead

2348

01:38:02,810 --> 01:38:00,659

of helpful

2349

01:38:04,010 --> 01:38:02,820

so think about like

2350

01:38:07,610 --> 01:38:04,020

um how

2351

01:38:09,950 --> 01:38:07,620

I don't know suicide bombers or

2352

01:38:11,629 --> 01:38:09,960

um religious fundamentalists to

2353

01:38:14,110 --> 01:38:11,639

believe that you know you should

2354

01:38:17,510 --> 01:38:14,120

exterminate members of other religions

2355

01:38:19,970 --> 01:38:17,520

these are toxic and pathogenic memes

2356

01:38:22,430 --> 01:38:19,980

which can spread and they can actually

2357

01:38:23,390 --> 01:38:22,440

co-opt

2358

01:38:25,850 --> 01:38:23,400

um certain

2359

01:38:27,950 --> 01:38:25,860

structures in the brain let's say which

2360

01:38:29,870 --> 01:38:27,960

evolves with other things but then they

2361

01:38:30,530 --> 01:38:29,880

can go bad

2362

01:38:33,169 --> 01:38:30,540

um

2363

01:38:35,149 --> 01:38:33,179

that's very simplistically put but I

2364

01:38:36,590 --> 01:38:35,159

think you sort of know what I mean yeah

2365

01:38:39,110 --> 01:38:36,600

well and that's that's very interesting

2366

01:38:41,689 --> 01:38:39,120

because that that's a lot like uh like

2367

01:38:43,970 --> 01:38:41,699

the behaviors are similar I'm thinking

2368

01:38:46,810 --> 01:38:43,980

to the underlying things with genes

2369

01:38:49,189 --> 01:38:46,820

where uh you know like

2370

01:38:51,790 --> 01:38:49,199

something that can be under some

2371

01:38:54,890 --> 01:38:51,800

circumstances helpful can understand

2372

01:38:56,990 --> 01:38:54,900

be harmful so like in the small group

2373

01:38:59,090 --> 01:38:57,000

situation that you're describing

2374

01:39:01,390 --> 01:38:59,100

um I I mean I can immediately imagine

2375

01:39:04,610 --> 01:39:01,400

many different instances where a

2376

01:39:08,149 --> 01:39:04,620

hunter-gatherer taking on a in quote

2377

01:39:11,810 --> 01:39:08,159

suicide bomber psychology uh could end

2378

01:39:14,149 --> 01:39:11,820

up saving his little group uh you know

2379

01:39:16,250 --> 01:39:14,159

so that's very interesting that that

2380

01:39:18,470 --> 01:39:16,260

they can kind of maybe misfire in some

2381

01:39:21,530 --> 01:39:18,480

ways at times just like normal like a

2382

01:39:24,169 --> 01:39:21,540

genes underlying that right exactly you

2383

01:39:25,490 --> 01:39:24,179

can have you can also have selection at

2384

01:39:27,169 --> 01:39:25,500

different levels of biological

2385

01:39:29,990 --> 01:39:27,179

organization

2386

01:39:32,270 --> 01:39:30,000

um happening at Cross purposes so what's

2387

01:39:34,310 --> 01:39:32,280

group good for the group may not be good

2388

01:39:37,370 --> 01:39:34,320

for certain individuals within the group

2389

01:39:39,890 --> 01:39:37,380

and vice versa but sometimes they can be

2390

01:39:42,229 --> 01:39:39,900

aligned sometimes your fate really is

2391

01:39:44,209 --> 01:39:42,239

tied to the good of the group in which

2392

01:39:45,709 --> 01:39:44,219

case um group selection could come into

2393

01:39:47,570 --> 01:39:45,719

play

2394

01:39:50,570 --> 01:39:47,580

right so um

2395

01:39:53,390 --> 01:39:50,580

um now I mentioned tool use okay which

2396

01:39:55,910 --> 01:39:53,400

is often been touted as the factor

2397

01:39:58,550 --> 01:39:55,920

favoring the co-evolutionary process

2398

01:39:59,990 --> 01:39:58,560

leading to intelligence but um according

2399

01:40:01,790 --> 01:40:00,000

to Leyland

2400

01:40:04,850 --> 01:40:01,800

um it's actually the teaching of tool

2401

01:40:08,450 --> 01:40:04,860

use and other skills um which was the

2402

01:40:10,310 --> 01:40:08,460

critical selective environment and um a

2403

01:40:12,590 --> 01:40:10,320

language I came out of that because it's

2404

01:40:15,590 --> 01:40:12,600

such an efficient way of conveying

2405

01:40:16,850 --> 01:40:15,600

information and meaning to uh right a

2406

01:40:18,649 --> 01:40:16,860

student

2407

01:40:22,970 --> 01:40:18,659

um

2408

01:40:25,850 --> 01:40:22,980

does intelligence make technological

2409

01:40:27,890 --> 01:40:25,860

Society inevitable so this also ties

2410

01:40:30,470 --> 01:40:27,900

into the Fermi Paradox and thinking

2411

01:40:32,030 --> 01:40:30,480

about extraterrestrials because just

2412

01:40:34,129 --> 01:40:32,040

because there are potentially

2413

01:40:36,709 --> 01:40:34,139

intelligent beings out there doesn't

2414

01:40:38,530 --> 01:40:36,719

mean that they will ever develop what we

2415

01:40:41,390 --> 01:40:38,540

would consider technological Society

2416

01:40:43,970 --> 01:40:41,400

okay there could be certain constraints

2417

01:40:44,629 --> 01:40:43,980

on that first of all

2418

01:40:47,270 --> 01:40:44,639

um

2419

01:40:49,910 --> 01:40:47,280

just bad luck the contingent events in

2420

01:40:51,110 --> 01:40:49,920

the environment like a meteorite or a

2421

01:40:53,510 --> 01:40:51,120

volcano

2422

01:40:54,649 --> 01:40:53,520

could Wipe Out the entire population of

2423

01:40:57,470 --> 01:40:54,659

organisms

2424

01:41:00,290 --> 01:40:57,480

so you know human beings once faced a

2425

01:41:02,810 --> 01:41:00,300

very tight genetic bottleneck where

2426
01:41:04,010 --> 01:41:02,820
there were only about 20 000 humans on

2427
01:41:05,510 --> 01:41:04,020
Earth

2428
01:41:07,729 --> 01:41:05,520
um and that they could easily have gone

2429
01:41:08,450 --> 01:41:07,739
extinct right there

2430
01:41:10,729 --> 01:41:08,460
um

2431
01:41:12,890 --> 01:41:10,739
so that's one thing

2432
01:41:15,169 --> 01:41:12,900
um if we think about you know permanent

2433
01:41:17,629 --> 01:41:15,179
human settlements like city-states and

2434
01:41:21,169 --> 01:41:17,639
industrial societies

2435
01:41:24,169 --> 01:41:21,179
there's a requisite there for uh prior

2436
01:41:26,390 --> 01:41:24,179
domestication of animals and agriculture

2437
01:41:28,729 --> 01:41:26,400
so certain animals aren't just not

2438
01:41:30,709 --> 01:41:28,739

suitable for agriculture which is maybe

2439

01:41:33,189 --> 01:41:30,719

why the Australian Aborigines never

2440

01:41:36,530 --> 01:41:33,199

developed um you know settled into

2441

01:41:38,750 --> 01:41:36,540

permanent settlements they've you know

2442

01:41:42,169 --> 01:41:38,760

for tens of thousands of years

2443

01:41:44,090 --> 01:41:42,179

um up till when um Europeans discovered

2444

01:41:45,109 --> 01:41:44,100

Australia

2445

01:41:47,330 --> 01:41:45,119

um they were just living as

2446

01:41:48,770 --> 01:41:47,340

hunter-gatherers and it could just be

2447

01:41:50,109 --> 01:41:48,780

because the animals there were not

2448

01:41:53,870 --> 01:41:50,119

suitable for

2449

01:41:56,930 --> 01:41:53,880

domestication so

2450

01:41:58,129 --> 01:41:56,940

uh and just culture so certain cultures

2451

01:42:01,250 --> 01:41:58,139

just um

2452

01:42:04,370 --> 01:42:01,260

can develop where staying put is just

2453

01:42:07,370 --> 01:42:04,380

not viewed as a good thing it could be

2454

01:42:09,530 --> 01:42:07,380

religious reasons or other reasons

2455

01:42:12,830 --> 01:42:09,540

um if you think about the the amount of

2456

01:42:16,970 --> 01:42:12,840

coercion that's taken place in human um

2457

01:42:20,270 --> 01:42:16,980

societal Evolution so large um

2458

01:42:21,410 --> 01:42:20,280

settler populations could um accumulate

2459

01:42:24,530 --> 01:42:21,420

um

2460

01:42:26,270 --> 01:42:24,540

uh whatever food or they could build up

2461

01:42:28,250 --> 01:42:26,280

armies because they've got more division

2462

01:42:29,570 --> 01:42:28,260

of labor then they can force other

2463

01:42:32,930 --> 01:42:29,580

groups to

2464

01:42:35,330 --> 01:42:32,940

you know right to do that bidding or

2465

01:42:38,870 --> 01:42:35,340

they would exterminate them yeah it's

2466

01:42:42,550 --> 01:42:38,880

it's like almost like economies of scale

2467

01:42:45,790 --> 01:42:42,560

um yeah around human survival so we have

2468

01:42:49,129 --> 01:42:45,800

a question from friend of the show

2469

01:42:52,250 --> 01:42:49,139

simonfly how big a factor is environment

2470

01:42:54,590 --> 01:42:52,260

to the development of complex life

2471

01:42:56,930 --> 01:42:54,600

the environment is extremely

2472

01:42:58,850 --> 01:42:56,940

I mean it's really Central uh whether

2473

01:43:00,530 --> 01:42:58,860

you're thinking of biotic or abiotic

2474

01:43:01,609 --> 01:43:00,540

factors

2475

01:43:03,410 --> 01:43:01,619

um

2476

01:43:05,149 --> 01:43:03,420

so let's see if we're thinking about

2477

01:43:08,750 --> 01:43:05,159

abiotic factors that would be things

2478

01:43:10,310 --> 01:43:08,760

like temperature acidity availability of

2479

01:43:12,649 --> 01:43:10,320

water

2480

01:43:15,169 --> 01:43:12,659

um and organisms have got countless

2481

01:43:18,229 --> 01:43:15,179

adaptations you know tailored to dealing

2482

01:43:19,609 --> 01:43:18,239

with different abiotic conditions if you

2483

01:43:21,410 --> 01:43:19,619

think about like when you go out into

2484

01:43:22,850 --> 01:43:21,420

the desert there are some plants which

2485

01:43:25,669 --> 01:43:22,860

have evolved to

2486

01:43:27,470 --> 01:43:25,679

retain moisture whereas if you go into a

2487

01:43:30,290 --> 01:43:27,480

jungle they're going to have different

2488

01:43:31,850 --> 01:43:30,300

adaptations because the um right you

2489

01:43:34,010 --> 01:43:31,860

know the availability of water is so

2490

01:43:36,350 --> 01:43:34,020

much greater there but then there's also

2491

01:43:38,270 --> 01:43:36,360

the um

2492

01:43:41,450 --> 01:43:38,280

the uh

2493

01:43:43,010 --> 01:43:41,460

the biotic environment which is how do

2494

01:43:45,850 --> 01:43:43,020

you interact with other living things

2495

01:43:49,010 --> 01:43:45,860

and there we're dealing with parasites

2496

01:43:51,530 --> 01:43:49,020

Predators prey

2497

01:43:54,169 --> 01:43:51,540

right at the endosymbiontes which live

2498

01:43:57,530 --> 01:43:54,179

inside of us we've evolved

2499

01:43:59,090 --> 01:43:57,540

and they've evolved oh man I don't I

2500

01:44:01,609 --> 01:43:59,100

don't have any parasites or anything

2501

01:44:05,149 --> 01:44:01,619

living at me no I'm I'm talking about

2502

01:44:08,330 --> 01:44:05,159

benefits right right yeah like gut flora

2503

01:44:10,550 --> 01:44:08,340

and stuff yeah sure so I mean

2504

01:44:13,250 --> 01:44:10,560

I mean it's really difficult to

2505

01:44:15,410 --> 01:44:13,260

sometimes separate the two because um

2506

01:44:19,609 --> 01:44:15,420

the uh the other partner is itself

2507

01:44:21,410 --> 01:44:19,619

evolving to the abiotic factors as well

2508

01:44:22,850 --> 01:44:21,420

um but yeah I mean they're both

2509

01:44:25,209 --> 01:44:22,860

extremely important

2510

01:44:28,129 --> 01:44:25,219

um and then often you get like a very

2511

01:44:30,470 --> 01:44:28,139

important event like a seminal event

2512

01:44:32,450 --> 01:44:30,480

which changes everything

2513

01:44:34,669 --> 01:44:32,460

um for example the great oxidation event

2514

01:44:36,649 --> 01:44:34,679

which happened very

2515

01:44:39,950 --> 01:44:36,659

you know long long time ago billions of

2516

01:44:42,169 --> 01:44:39,960

years ago when a lot of oxygen became

2517

01:44:45,109 --> 01:44:42,179

available in the atmosphere

2518

01:44:47,390 --> 01:44:45,119

that allowed for well that opened the

2519

01:44:49,790 --> 01:44:47,400

way for aerobic respiration to evolve

2520

01:44:53,330 --> 01:44:49,800

that's when you use O₂ as the electron

2521

01:44:55,250 --> 01:44:53,340

transport the electron acceptor and then

2522

01:44:57,410 --> 01:44:55,260

that set off other things so you have

2523

01:44:59,870 --> 01:44:57,420

these kind of revolutionary events which

2524

01:45:04,430 --> 01:44:59,880

change the nature of the game

2525

01:45:09,470 --> 01:45:06,890

and do we know why that event occurred

2526

01:45:11,270 --> 01:45:09,480

the uh oxygenation event or whatever

2527

01:45:14,890 --> 01:45:11,280

it's called yeah the oxidation event

2528

01:45:21,729 --> 01:45:18,229

yeah it wasn't plants per se it was

2529

01:45:23,810 --> 01:45:21,739

cyanobacteria but they um by the way

2530

01:45:26,689 --> 01:45:23,820

cyanobacteria are

2531

01:45:28,910 --> 01:45:26,699

I mentioned the mitochondria are derived

2532

01:45:31,729 --> 01:45:28,920

from Free Living bacteria which entered

2533

01:45:34,609 --> 01:45:31,739

into an endosymbiosis with a archaeal

2534

01:45:36,890 --> 01:45:34,619

cell it turns out that chloroplasts

2535

01:45:38,930 --> 01:45:36,900

which live in Plants those are the sites

2536

01:45:41,709 --> 01:45:38,940

of photosynthesis

2537

01:45:44,689 --> 01:45:41,719

um in Plants they themselves came from

2538

01:45:47,870 --> 01:45:44,699

cyanobacteria so that was another uh

2539

01:45:53,810 --> 01:45:51,010

um but the release of oxygen from

2540

01:45:56,450 --> 01:45:53,820

photosynthesis okay so that took a long

2541

01:45:58,189 --> 01:45:56,460

time uh to build up in the atmosphere

2542

01:46:00,530 --> 01:45:58,199

but once it did

2543

01:46:04,070 --> 01:46:00,540

some organisms had to adapt to that

2544

01:46:07,490 --> 01:46:04,080

because oxygen is often you know it was

2545

01:46:09,830 --> 01:46:07,500

poisonous to life back then and so you

2546

01:46:12,050 --> 01:46:09,840

had to either hide from the oxygen or

2547

01:46:14,450 --> 01:46:12,060

you had to adapt to it and many

2548

01:46:18,649 --> 01:46:14,460

organisms did adapt and they found ways

2549

01:46:22,250 --> 01:46:20,990

I've actually got a graph here actually

2550

01:46:24,590 --> 01:46:22,260

of the um

2551
01:46:27,229 --> 01:46:24,600
the oxidation

2552
01:46:30,410 --> 01:46:27,239
where is it

2553
01:46:32,890 --> 01:46:30,420
is it oxygenation yeah

2554
01:46:34,970 --> 01:46:32,900
cool damn it look

2555
01:46:37,609 --> 01:46:34,980
foiled again

2556
01:46:41,570 --> 01:46:37,619
but this is showing like the level of

2557
01:46:44,090 --> 01:46:41,580
using uh geochemical signatures this is

2558
01:46:46,490 --> 01:46:44,100
the time in billions of years

2559
01:46:48,709 --> 01:46:46,500
um so this is three billion years ago

2560
01:46:51,890 --> 01:46:48,719
the red is the upper limit and the the

2561
01:46:53,629 --> 01:46:51,900
green is the lower estimate so this is

2562
01:46:55,250 --> 01:46:53,639
the increase in oxygen in the atmosphere

2563
01:46:59,090 --> 01:46:55,260

okay

2564

01:47:02,930 --> 01:47:00,590

have you guys heard of the Cambrian

2565

01:47:07,250 --> 01:47:02,940

explosion

2566

01:47:08,510 --> 01:47:07,260

place

2567

01:47:11,689 --> 01:47:08,520

um

2568

01:47:15,470 --> 01:47:11,699

kind of around here I guess

2569

01:47:17,629 --> 01:47:15,480

um so that was the evolution of most of

2570

01:47:20,810 --> 01:47:17,639

the phyla or body plans in the animal

2571

01:47:22,490 --> 01:47:20,820

kingdom this took place about 538

2572

01:47:23,870 --> 01:47:22,500

million years ago

2573

01:47:25,189 --> 01:47:23,880

and

2574

01:47:27,770 --> 01:47:25,199

um that's when you got this great

2575

01:47:29,390 --> 01:47:27,780

diversification in animal life nobody

2576

01:47:31,370 --> 01:47:29,400

knows why that happened

2577

01:47:34,250 --> 01:47:31,380

it's called an explosion because it

2578

01:47:35,870 --> 01:47:34,260

happened relatively in a relatively

2579

01:47:37,790 --> 01:47:35,880

short period of a few million years

2580

01:47:42,590 --> 01:47:37,800

maybe

2581

01:47:45,950 --> 01:47:42,600

13 million years although some estimates

2582

01:47:47,689 --> 01:47:45,960

push it out to 25 million so um against

2583

01:47:50,510 --> 01:47:47,699

the backdrop of Earth's history that's

2584

01:47:53,689 --> 01:47:50,520

very that's a very short time but most

2585

01:47:57,430 --> 01:47:53,699

of the phyla uh arose during that period

2586

01:47:59,390 --> 01:47:57,440

and um there could have been different

2587

01:48:02,570 --> 01:47:59,400

environmental factors like an increase

2588

01:48:04,370 --> 01:48:02,580

in oxygen or ironically anoxia which is

2589

01:48:06,530 --> 01:48:04,380

the opposite because then that would

2590

01:48:08,990 --> 01:48:06,540

force some animals to seek out different

2591

01:48:12,770 --> 01:48:09,000

environments

2592

01:48:14,330 --> 01:48:12,780

um especially mobile organisms

2593

01:48:16,669 --> 01:48:14,340

um it could have been co-evolutionary

2594

01:48:18,830 --> 01:48:16,679

arms races between

2595

01:48:21,050 --> 01:48:18,840

predator and prey so this is when eyes

2596

01:48:24,050 --> 01:48:21,060

evolved and that's a very useful thing

2597

01:48:25,370 --> 01:48:24,060

to have to escape Predators or to find

2598

01:48:27,050 --> 01:48:25,380

prey

2599

01:48:29,510 --> 01:48:27,060

um and then you also get the evolution

2600

01:48:31,129 --> 01:48:29,520

of like hard parts and weapons and stuff

2601

01:48:33,709 --> 01:48:31,139

like that

2602

01:48:36,109 --> 01:48:33,719

um but nobody knows it was probably a

2603

01:48:38,689 --> 01:48:36,119

Confluence of factors

2604

01:48:40,430 --> 01:48:38,699

and again that also shows the

2605

01:48:42,890 --> 01:48:40,440

contingency of life

2606

01:48:45,350 --> 01:48:42,900

um because probably you would need

2607

01:48:47,990 --> 01:48:45,360

different factors coming together at the

2608

01:48:49,729 --> 01:48:48,000

right time and in the right amounts to

2609

01:48:50,990 --> 01:48:49,739

produce something so it's not just like

2610

01:48:54,169 --> 01:48:51,000

an inevitable

2611

01:48:56,209 --> 01:48:54,179

unfolding of complexity

2612

01:48:58,790 --> 01:48:56,219

um if you were to run the tape again

2613

01:49:01,250 --> 01:48:58,800

it might have a very different outcome

2614

01:49:03,410 --> 01:49:01,260

yeah we have we have audience member

2615

01:49:05,330 --> 01:49:03,420

here the Earth which is a perfect

2616

01:49:07,550 --> 01:49:05,340

username for the subject of our

2617

01:49:09,950 --> 01:49:07,560

discussion tonight mentioning that there

2618

01:49:12,890 --> 01:49:09,960

was a similar event the edia Karen

2619

01:49:15,590 --> 01:49:12,900

explosion which was not as successful

2620

01:49:18,109 --> 01:49:15,600

the ediacaran fauna preceded the

2621

01:49:21,770 --> 01:49:18,119

Cambrian fauna and uh there wasn't as

2622

01:49:24,229 --> 01:49:21,780

much diversification back then uh but

2623

01:49:26,390 --> 01:49:24,239

there was there seems to be there seems

2624

01:49:28,850 --> 01:49:26,400

to have been a sort of a mini explosion

2625

01:49:30,350 --> 01:49:28,860

back then as well not as exuberance as

2626

01:49:33,890 --> 01:49:30,360

the Cambrian though

2627

01:49:36,590 --> 01:49:33,900

so we yeah oh I was gonna say we have

2628

01:49:38,090 --> 01:49:36,600

another question from Simon um asking if

2629

01:49:41,390 --> 01:49:38,100

there was a big environmental change

2630

01:49:43,609 --> 01:49:41,400

after the extinction of the Dinosaurs

2631

01:49:47,450 --> 01:49:43,619

yeah there was the um

2632

01:49:49,790 --> 01:49:47,460

so something like 60 of all the species

2633

01:49:51,830 --> 01:49:49,800

on Earth died

2634

01:49:53,810 --> 01:49:51,840

um there was the extinction not just of

2635

01:49:55,850 --> 01:49:53,820

the dinosaurs but other groups like

2636

01:49:58,250 --> 01:49:55,860

certain marine reptiles like the

2637

01:50:00,109 --> 01:49:58,260

ichthyosaurs and the plesiosaurs and

2638

01:50:02,330 --> 01:50:00,119

also the uh the pterosaurs which were

2639

01:50:03,050 --> 01:50:02,340

the flying reptiles

2640

01:50:05,510 --> 01:50:03,060

um

2641

01:50:07,189 --> 01:50:05,520

some animals some groups made it through

2642

01:50:08,930 --> 01:50:07,199

like the crocodilians

2643

01:50:10,550 --> 01:50:08,940

which actually are older than the

2644

01:50:11,330 --> 01:50:10,560

dinosaurs

2645

01:50:17,930 --> 01:50:11,340

um

2646

01:50:20,689 --> 01:50:17,940

more diverse or at least they continued

2647

01:50:22,490 --> 01:50:20,699

from the Jurassic and stuff like that so

2648

01:50:23,870 --> 01:50:22,500

you got the extinction of some groups

2649

01:50:26,390 --> 01:50:23,880

and the um

2650

01:50:28,790 --> 01:50:26,400

the uh diversification or at least

2651
01:50:30,070 --> 01:50:28,800
survival of others

2652
01:50:33,709 --> 01:50:30,080
um

2653
01:50:35,870 --> 01:50:33,719
I forget exactly what the

2654
01:50:36,890 --> 01:50:35,880
the abiotic changes were in the

2655
01:50:38,870 --> 01:50:36,900
environment

2656
01:50:41,689 --> 01:50:38,880
I think there were more ice ages which

2657
01:50:42,669 --> 01:50:41,699
took place in the cenozoic so after the

2658
01:50:45,470 --> 01:50:42,679
extinction

2659
01:50:47,390 --> 01:50:45,480
certainly right after the um

2660
01:50:49,189 --> 01:50:47,400
the the meteorite impact you would have

2661
01:50:52,129 --> 01:50:49,199
gotten a um

2662
01:50:53,990 --> 01:50:52,139
shutdown in photosynthesis across much

2663
01:50:56,689 --> 01:50:54,000

of the world because of the debris

2664

01:50:59,270 --> 01:50:56,699

kicked up by the impact and so that shut

2665

01:51:01,729 --> 01:50:59,280

down a lot of plants and then that led

2666

01:51:04,010 --> 01:51:01,739

to the collapse of ecosystems

2667

01:51:07,850 --> 01:51:04,020

but some animals were able to survive

2668

01:51:10,430 --> 01:51:07,860

that and some plants obviously as well

2669

01:51:13,010 --> 01:51:10,440

um I'd have to look at the

2670

01:51:14,990 --> 01:51:13,020

exact um

2671

01:51:17,629 --> 01:51:15,000

the other changes which took place

2672

01:51:19,970 --> 01:51:17,639

though when um

2673

01:51:22,790 --> 01:51:19,980

in the discussions around complexity

2674

01:51:26,709 --> 01:51:22,800

science and complex systems

2675

01:51:29,390 --> 01:51:26,719

um they'll term these kinds of events

2676

01:51:31,490 --> 01:51:29,400

bifurcations and that these are

2677

01:51:35,570 --> 01:51:31,500

bifurcation events in the sense that

2678

01:51:37,550 --> 01:51:35,580

they effectively shift the Paradigm of

2679

01:51:39,410 --> 01:51:37,560

whatever is going on at a particular

2680

01:51:41,330 --> 01:51:39,420

point in time

2681

01:51:44,930 --> 01:51:41,340

and that's what I keep thinking of as

2682

01:51:47,030 --> 01:51:44,940

you describe these you know explosions

2683

01:51:49,850 --> 01:51:47,040

um throughout history

2684

01:51:51,590 --> 01:51:49,860

and punctuations so mass extinction

2685

01:51:54,770 --> 01:51:51,600

events um

2686

01:51:57,350 --> 01:51:54,780

wipe out a lot of the diversity in the

2687

01:51:59,930 --> 01:51:57,360

uh biosphere but then they ironically

2688

01:52:03,410 --> 01:51:59,940

open the way for diversity to have to

2689

01:52:05,570 --> 01:52:03,420

fluoresce again because the ecological

2690

01:52:08,149 --> 01:52:05,580

niches are left empty without

2691

01:52:10,970 --> 01:52:08,159

competition and so the surviving

2692

01:52:14,149 --> 01:52:10,980

lineages can then diversify to fill up

2693

01:52:16,609 --> 01:52:14,159

those niches so often you get when you

2694

01:52:19,430 --> 01:52:16,619

get mass extinctions you also get the

2695

01:52:21,530 --> 01:52:19,440

the rapid uh filling in of those vacant

2696

01:52:23,330 --> 01:52:21,540

niches afterwards

2697

01:52:26,330 --> 01:52:23,340

right yeah almost like a power vacuum

2698

01:52:29,030 --> 01:52:26,340

yeah

2699

01:52:31,430 --> 01:52:29,040

um so we'll be wrapping this stream up

2700

01:52:33,950 --> 01:52:31,440

in a few minutes at the top of the hour

2701

01:52:35,450 --> 01:52:33,960

so anyone tuning in like feel free to

2702

01:52:44,209 --> 01:52:35,460

post your questions and I'll get them

2703

01:52:49,070 --> 01:52:47,149

um so Lewis what are there

2704

01:52:50,950 --> 01:52:49,080

how do I phrase those

2705

01:52:53,090 --> 01:52:50,960

how have

2706

01:52:55,310 --> 01:52:53,100

in your

2707

01:52:58,250 --> 01:52:55,320

um throughout your education and work

2708

01:53:01,910 --> 01:52:58,260

how have the theories around complex

2709

01:53:04,810 --> 01:53:01,920

life changed or adjusted

2710

01:53:07,910 --> 01:53:04,820

I think that they've moved away from

2711

01:53:11,629 --> 01:53:07,920

gene-centric views to a more kind of

2712

01:53:13,669 --> 01:53:11,639

uh systems type biology so seeing the

2713

01:53:16,129 --> 01:53:13,679

interactions of many parts

2714

01:53:19,189 --> 01:53:16,139

and then seeing that as a whole so kind

2715

01:53:21,890 --> 01:53:19,199

of a more holistic view of life

2716

01:53:24,649 --> 01:53:21,900

it it reminds me I've heard a lot more

2717

01:53:26,930 --> 01:53:24,659

discussion around epigenetics and

2718

01:53:29,090 --> 01:53:26,940

epigenetics yeah so and it seems like

2719

01:53:31,970 --> 01:53:29,100

that's come into more of the Forefront

2720

01:53:34,070 --> 01:53:31,980

of the conversation as well exactly and

2721

01:53:35,810 --> 01:53:34,080

that also it ties into what Leyland was

2722

01:53:38,090 --> 01:53:35,820

talking about in his book

2723

01:53:40,070 --> 01:53:38,100

um Dolan's unfinished business uh

2724

01:53:41,810 --> 01:53:40,080

Symphony uh which is that there's

2725

01:53:43,310 --> 01:53:41,820

different kinds of inheritance so

2726

01:53:45,709 --> 01:53:43,320

there's obviously genetic inheritance

2727

01:53:48,290 --> 01:53:45,719

but then there's also epigenetic effects

2728

01:53:50,629 --> 01:53:48,300

and also culture so

2729

01:53:52,189 --> 01:53:50,639

yeah seeing more of the um diversity of

2730

01:53:54,470 --> 01:53:52,199

different kinds of inheritance is

2731

01:53:56,510 --> 01:53:54,480

certainly another one

2732

01:53:59,030 --> 01:53:56,520

um then there's also the hierarchical

2733

01:54:02,990 --> 01:53:59,040

selection view favored by Stephen J

2734

01:54:05,270 --> 01:54:03,000

Gould and wrote This Book

2735

01:54:07,070 --> 01:54:05,280

you know I read this book um I finished

2736

01:54:08,990 --> 01:54:07,080

reading it like two years ago it took me

2737

01:54:12,109 --> 01:54:09,000

a year to read this because

2738

01:54:15,109 --> 01:54:12,119

it's over a thousand pages of text

2739

01:54:17,870 --> 01:54:15,119

oh my yeah this was his last book before

2740

01:54:20,270 --> 01:54:17,880

he died in 2003. he's a real one too

2741

01:54:22,189 --> 01:54:20,280

Stephen J Gould is great oh yeah I love

2742

01:54:23,649 --> 01:54:22,199

him yeah yeah well this book is great

2743

01:54:27,350 --> 01:54:23,659

because it goes into

2744

01:54:29,450 --> 01:54:27,360

an expanded view of Darwinism away from

2745

01:54:32,030 --> 01:54:29,460

just the individual level to multiple

2746

01:54:34,189 --> 01:54:32,040

levels and um he also talks about

2747

01:54:36,050 --> 01:54:34,199

constraints in both the positive and the

2748

01:54:39,590 --> 01:54:36,060

negative sense that there could be

2749

01:54:43,910 --> 01:54:39,600

channels of change along which

2750

01:54:44,510 --> 01:54:43,920

um evolution is sort of biased and that

2751
01:54:46,850 --> 01:54:44,520
um

2752
01:54:47,930 --> 01:54:46,860
and stuff like that so this is really

2753
01:54:49,310 --> 01:54:47,940
really rich

2754
01:54:52,430 --> 01:54:49,320
um book

2755
01:54:55,189 --> 01:54:52,440
um but that's another one um so Niles

2756
01:54:57,109 --> 01:54:55,199
Eldridge was actually the guy who came

2757
01:54:59,570 --> 01:54:57,119
up with the um idea of punctuated

2758
01:55:01,790 --> 01:54:59,580
equilibria even though Stephen J Gould

2759
01:55:04,910 --> 01:55:01,800
popularized and developed it further

2760
01:55:07,010 --> 01:55:04,920
with uh Eldridge but Eldridge is still

2761
01:55:12,530 --> 01:55:07,020
around he um

2762
01:55:13,609 --> 01:55:12,540
makes a big uh focuses a lot on um the

2763
01:55:16,729 --> 01:55:13,619

idea that there could be different

2764

01:55:18,830 --> 01:55:16,739

levels of selection and you know from

2765

01:55:20,629 --> 01:55:18,840

the group from the individual or

2766

01:55:23,570 --> 01:55:20,639

actually from the gene to the individual

2767

01:55:27,649 --> 01:55:23,580

to the group to the species and even

2768

01:55:33,109 --> 01:55:29,510

um and then also that there are certain

2769

01:55:35,209 --> 01:55:33,119

patterns which are non-roots useful so

2770

01:55:38,209 --> 01:55:35,219

you know you can think of a species as

2771

01:55:42,229 --> 01:55:38,219

being an individual in its own right and

2772

01:55:45,229 --> 01:55:42,239

the Persistence of that individual

2773

01:55:48,290 --> 01:55:45,239

um is not dependent on what any one of

2774

01:55:50,950 --> 01:55:48,300

its individual constituents does right

2775

01:55:55,070 --> 01:55:50,960

so like a higher level kind of reality

2776

01:55:57,649 --> 01:55:55,080

or ontology to the components

2777

01:56:00,410 --> 01:55:57,659

mm-hmm that that's a really uh

2778

01:56:02,629 --> 01:56:00,420

interesting point it makes me think of

2779

01:56:06,169 --> 01:56:02,639

uh something I was reading about this

2780

01:56:09,709 --> 01:56:06,179

with slime molds where you can make a

2781

01:56:13,609 --> 01:56:09,719

topographical map and put slime molds

2782

01:56:16,189 --> 01:56:13,619

down and they naturally replicate on the

2783

01:56:19,250 --> 01:56:16,199

topography and spread out along

2784

01:56:22,970 --> 01:56:19,260

essentially the exact same channels that

2785

01:56:25,910 --> 01:56:22,980

humans have on the Earth's topography

2786

01:56:28,609 --> 01:56:25,920

and so if there's a lot of metaphor

2787

01:56:30,530 --> 01:56:28,619

there well if you look yeah exactly yeah

2788

01:56:32,209 --> 01:56:30,540

like we're slime or whatever it is well

2789

01:56:34,250 --> 01:56:32,219

that's the thing it's like if you look

2790

01:56:37,490 --> 01:56:34,260

from uh I keep hitting my mic from an

2791

01:56:39,830 --> 01:56:37,500

abstract perspective and you see these

2792

01:56:41,810 --> 01:56:39,840

uh cities and rows and stuff and then

2793

01:56:43,850 --> 01:56:41,820

you look at the slime mold and it's

2794

01:56:46,070 --> 01:56:43,860

exactly the same it really starts to

2795

01:56:49,310 --> 01:56:46,080

make me wonder uh what are we as

2796

01:56:51,590 --> 01:56:49,320

individuals and if we're looking through

2797

01:56:54,470 --> 01:56:51,600

a microscope at the Earth and we see a

2798

01:56:56,390 --> 01:56:54,480

tiny sliver on the side of a rock with a

2799

01:56:58,850 --> 01:56:56,400

scum layer on it

2800

01:57:00,770 --> 01:56:58,860

is it really uh we think we're

2801
01:57:04,550 --> 01:57:00,780
individuals but are we really what's

2802
01:57:06,290 --> 01:57:04,560
going on there yeah that's I I'm so

2803
01:57:09,410 --> 01:57:06,300
fascinated on the intersection again

2804
01:57:11,990 --> 01:57:09,420
with uh complexity and complex systems

2805
01:57:14,450 --> 01:57:12,000
particularly like agent based systems

2806
01:57:16,609 --> 01:57:14,460
where there's no hierarchical rule

2807
01:57:17,350 --> 01:57:16,619
structure but rather

2808
01:57:20,930 --> 01:57:17,360
um

2809
01:57:21,910 --> 01:57:20,940
behaviors are

2810
01:57:24,770 --> 01:57:21,920
um

2811
01:57:27,310 --> 01:57:24,780
informed on like the node to node

2812
01:57:30,770 --> 01:57:27,320
relationships rather than an overarching

2813
01:57:32,510 --> 01:57:30,780

type of rules to drive particular

2814

01:57:34,910 --> 01:57:32,520

engagements

2815

01:57:38,510 --> 01:57:34,920

um and Campbell to your point like

2816

01:57:40,850 --> 01:57:38,520

whether we're talking this is this is

2817

01:57:44,030 --> 01:57:40,860

what for me is so fascinating is we see

2818

01:57:46,070 --> 01:57:44,040

these repetition of patterns on so many

2819

01:57:47,870 --> 01:57:46,080

different scales

2820

01:57:50,030 --> 01:57:47,880

um through this sort of distributed

2821

01:57:53,390 --> 01:57:50,040

systems whether it's a biological system

2822

01:57:55,970 --> 01:57:53,400

like a body or cell or a collection of

2823

01:57:58,370 --> 01:57:55,980

humans or other animals or

2824

01:58:00,649 --> 01:57:58,380

um how cities and communities evolve and

2825

01:58:03,589 --> 01:58:00,659

grow or how slime mold does like these

2826
01:58:06,970 --> 01:58:03,599
are sort of repetitions that exist at

2827
01:58:09,709 --> 01:58:06,980
all different levels of um

2828
01:58:12,530 --> 01:58:09,719
existence and within I think the

2829
01:58:15,050 --> 01:58:12,540
biological hierarchies that consistently

2830
01:58:17,089 --> 01:58:15,060
demonstrate various similar uh behaviors

2831
01:58:20,209 --> 01:58:17,099
around self-organization it's super

2832
01:58:25,609 --> 01:58:23,450
yeah it really is

2833
01:58:27,709 --> 01:58:25,619
um I really like the idea of emergent

2834
01:58:28,609 --> 01:58:27,719
properties

2835
01:58:30,589 --> 01:58:28,619
um

2836
01:58:32,930 --> 01:58:30,599
that they could be properties of systems

2837
01:58:36,530 --> 01:58:32,940
which are not present at lower levels

2838
01:58:40,490 --> 01:58:38,930

you know obviously all these um claims

2839

01:58:43,430 --> 01:58:40,500

are contested and they're controversial

2840

01:58:45,770 --> 01:58:43,440

but I think we are um going into a new

2841

01:58:47,270 --> 01:58:45,780

paradigm of biology which moves away

2842

01:58:49,189 --> 01:58:47,280

from the

2843

01:58:51,410 --> 01:58:49,199

the what the you know obviously

2844

01:58:54,770 --> 01:58:51,420

darwinian evolution is very important

2845

01:58:56,390 --> 01:58:54,780

but um we have to expand it and um think

2846

01:58:59,030 --> 01:58:56,400

about different levels of interaction

2847

01:59:01,250 --> 01:58:59,040

and organization as well

2848

01:59:03,410 --> 01:59:01,260

uh what's the other thing um there's

2849

01:59:06,950 --> 01:59:03,420

another aspect of biology which is come

2850

01:59:09,109 --> 01:59:06,960

come to the fore in recent years of the

2851

01:59:13,790 --> 01:59:10,609

thinking about

2852

01:59:16,129 --> 01:59:13,800

um endosymbiosis so

2853

01:59:17,750 --> 01:59:16,139

um Lin Mark gulus went too far with

2854

01:59:19,729 --> 01:59:17,760

this she thought that all of the

2855

01:59:22,970 --> 01:59:19,739

structures in um

2856

01:59:25,729 --> 01:59:22,980

the eukaryotic cell derived from Free

2857

01:59:27,890 --> 01:59:25,739

Living bacteria that's probably not the

2858

01:59:31,609 --> 01:59:27,900

case but certainly the mitochondria and

2859

01:59:33,709 --> 01:59:31,619

the chloroplasts did and um

2860

01:59:35,629 --> 01:59:33,719

you know obviously there's that um which

2861

01:59:39,109 --> 01:59:35,639

I've talked about today but there's also

2862

01:59:42,050 --> 01:59:39,119

the um the important role that bacteria

2863

01:59:43,189 --> 01:59:42,060

play in us and also just

2864

01:59:46,370 --> 01:59:43,199

how

2865

01:59:47,450 --> 01:59:46,380

symbiosis is so important for really all

2866

01:59:50,930 --> 01:59:47,460

of life

2867

01:59:56,629 --> 01:59:54,050

so yeah I've read before that it's like

2868

01:59:59,390 --> 01:59:56,639

uh of all the individual cells in your

2869

02:00:01,970 --> 01:59:59,400

body it's like there are more cells that

2870

02:00:05,089 --> 02:00:01,980

are not your DNA than are your DNA

2871

02:00:07,669 --> 02:00:05,099

inside you that's so crazy to me I don't

2872

02:00:09,649 --> 02:00:07,679

like thickest me weird feelings yeah

2873

02:00:11,570 --> 02:00:09,659

it's like a reliving thing about that

2874

02:00:13,550 --> 02:00:11,580

yeah

2875

02:00:16,310 --> 02:00:13,560

it's like it's it's sort of like a ship

2876
02:00:17,930 --> 02:00:16,320
of Theseus situation where at what point

2877
02:00:21,050 --> 02:00:17,940
do you stop being you and start

2878
02:00:23,330 --> 02:00:21,060
disputing this these other dnas exactly

2879
02:00:26,930 --> 02:00:23,340
yeah did you have you guys watched this

2880
02:00:29,510 --> 02:00:26,940
movie called the color out of space no

2881
02:00:34,189 --> 02:00:29,520
it's actually based on a Lovecraft uh

2882
02:00:35,930 --> 02:00:34,199
that's an old sci-fi movie yeah yeah oh

2883
02:00:37,729 --> 02:00:35,940
no well this one's got Nicholas Cage in

2884
02:00:40,070 --> 02:00:37,739
it I think oh so never mind it's not

2885
02:00:41,990 --> 02:00:40,080
that it's not that old but I don't know

2886
02:00:44,870 --> 02:00:42,000
if there was a previous version but this

2887
02:00:47,450 --> 02:00:44,880
is a relatively new one

2888
02:00:49,070 --> 02:00:47,460

um but in that in that movie there was a

2889

02:00:50,629 --> 02:00:49,080

very interesting kind of philosophical

2890

02:00:52,010 --> 02:00:50,639

Point

2891

02:00:55,129 --> 02:00:52,020

um

2892

02:00:55,669 --> 02:00:55,139

which is that the individual

2893

02:00:57,890 --> 02:00:55,679

um

2894

02:01:00,169 --> 02:00:57,900

it wants to maintain its Integrity right

2895

02:01:02,390 --> 02:01:00,179

it's separation from the environment and

2896

02:01:04,790 --> 02:01:02,400

we sort of we regard anything that

2897

02:01:06,950 --> 02:01:04,800

invades us or is like continuous with us

2898

02:01:09,109 --> 02:01:06,960

with a sense of Horror

2899

02:01:11,629 --> 02:01:09,119

um it's like Cronenberg

2900

02:01:14,510 --> 02:01:11,639

like like the body horror of David

2901
02:01:15,290 --> 02:01:14,520
Cronenberg draws yeah yeah video drum

2902
02:01:18,290 --> 02:01:15,300
yeah

2903
02:01:20,570 --> 02:01:18,300
but um in that movie there's a uh

2904
02:01:23,149 --> 02:01:20,580
there's a glimpse or a vision of the

2905
02:01:25,270 --> 02:01:23,159
alien planet where it's basically just

2906
02:01:27,649 --> 02:01:25,280
like a roiling massive

2907
02:01:30,169 --> 02:01:27,659
worm-like creatures and they're kind of

2908
02:01:32,390 --> 02:01:30,179
all inside of each other and they don't

2909
02:01:34,490 --> 02:01:32,400
really have a sense of individuality or

2910
02:01:37,250 --> 02:01:34,500
privacy and I just wonder like whether

2911
02:01:39,530 --> 02:01:37,260
that could be a viable

2912
02:01:41,990 --> 02:01:39,540
type of alien life or whether the

2913
02:01:43,430 --> 02:01:42,000

individual will always try to maintain

2914

02:01:46,790 --> 02:01:43,440

its own

2915

02:01:49,550 --> 02:01:46,800

you know dignity so to speak

2916

02:01:53,570 --> 02:01:51,350

I'm wonderful

2917

02:01:59,629 --> 02:01:57,070

Kimball any final questions for Lewis

2918

02:02:01,609 --> 02:01:59,639

uh I don't think so that's been

2919

02:02:04,189 --> 02:02:01,619

extremely interesting I really

2920

02:02:06,910 --> 02:02:04,199

appreciated uh this conversation thank

2921

02:02:10,790 --> 02:02:06,920

you so much for giving us that uh

2922

02:02:12,290 --> 02:02:10,800

presentation please yeah this was this

2923

02:02:15,050 --> 02:02:12,300

was super cool

2924

02:02:18,169 --> 02:02:15,060

um really nice to get into something in

2925

02:02:20,330 --> 02:02:18,179

depth on which you uh possess subject

2926

02:02:22,669 --> 02:02:20,340

matter expertise and also to just you

2927

02:02:25,010 --> 02:02:22,679

know give us more exposure to different

2928

02:02:27,649 --> 02:02:25,020

topics and ideas

2929

02:02:29,870 --> 02:02:27,659

um also really cool to see uh audience

2930

02:02:31,850 --> 02:02:29,880

chiming in with questions

2931

02:02:34,669 --> 02:02:31,860

um and having this opportunity for like

2932

02:02:38,270 --> 02:02:34,679

interaction it's great

2933

02:02:39,649 --> 02:02:38,280

it was awesome thanks so yeah so we'll

2934

02:02:41,030 --> 02:02:39,659

get things wrapped up for the evening

2935

02:02:44,089 --> 02:02:41,040

here

2936

02:02:47,450 --> 02:02:44,099

um we'll be back next week Wednesday 9

2937

02:02:50,209 --> 02:02:47,460

p.m Eastern 6 p.m Pacific uh as it

2938

02:02:51,169 --> 02:02:50,219

stands right now it's a

2939

02:02:53,629 --> 02:02:51,179

um

2940

02:02:54,890 --> 02:02:53,639

TBD not totally sure what we're going to

2941

02:02:57,410 --> 02:02:54,900

talk about we don't have a guest

2942

02:03:01,250 --> 02:02:57,420

scheduled but thereafter we'll be

2943

02:03:03,770 --> 02:03:01,260

hosting Erica Lukes on December 7th oh

2944

02:03:06,830 --> 02:03:03,780

yeah Brian sentis is he coming next week

2945

02:03:08,510 --> 02:03:06,840

next week yeah oh fantastic oh my God

2946

02:03:10,430 --> 02:03:08,520

I'm delighted never mind Brian sent his

2947

02:03:12,589 --> 02:03:10,440

next week I can't wait

2948

02:03:14,450 --> 02:03:12,599

um so yes we'll be talking to him if you

2949

02:03:16,370 --> 02:03:14,460

are unfamiliar with Brian sentus I

2950

02:03:18,169 --> 02:03:16,380

highly recommend checking out uh his

2951

02:03:20,270 --> 02:03:18,179

interviews with Lewis on Lewis's Channel

2952

02:03:23,169 --> 02:03:20,280

seriously great stuff

2953

02:03:29,270 --> 02:03:27,109

blog what's it called Skunk Works Skunk

2954

02:03:31,550 --> 02:03:29,280

Works yeah the Skunk Works bug it's a

2955

02:03:32,810 --> 02:03:31,560

deeply interdisciplinary intellectual

2956

02:03:35,450 --> 02:03:32,820

who

2957

02:03:37,669 --> 02:03:35,460

um I think has some of some truly

2958

02:03:39,530 --> 02:03:37,679

brilliant things to say about ufology as

2959

02:03:40,850 --> 02:03:39,540

both like a cultural and social

2960

02:03:43,010 --> 02:03:40,860

phenomena

2961

02:03:44,390 --> 02:03:43,020

um and a he's coming on honestly because

2962

02:03:46,129 --> 02:03:44,400

I've listened to those interviews so

2963

02:03:47,750 --> 02:03:46,139

many times that Lewis has done with them

2964

02:03:49,550 --> 02:03:47,760

that I'm excited at the prospect of

2965

02:03:50,270 --> 02:03:49,560

talking to him

2966

02:03:51,890 --> 02:03:50,280

um

2967

02:03:53,990 --> 02:03:51,900

so yeah again

2968

02:03:57,770 --> 02:03:54,000

um everyone have a great Thanksgiving we

2969

02:03:59,510 --> 02:03:57,780

will regroup next Wednesday uh same time

2970

02:04:02,510 --> 02:03:59,520

same place

2971

02:04:04,189 --> 02:04:02,520

um and uh otherwise hang in there we

2972

02:04:05,689 --> 02:04:04,199

can't wait to see you again

2973

02:04:12,280 --> 02:04:05,699

cheers

2974

02:04:53,470 --> 02:04:47,560

[Music]

2975

02:05:47,089 --> 02:04:56,390

thank you

