



**STUART
HAMEROFF**

**SELF-SIMILAR
CONSCIOUSNESS**

1
00:00:03,750 --> 00:00:02,230
today's guest is jord hameroff who along

2
00:00:04,789 --> 00:00:03,760
with roger penrose has a theory of

3
00:00:06,789 --> 00:00:04,799
consciousness

4
00:00:08,710 --> 00:00:06,799
what's particularly interesting is that

5
00:00:11,190 --> 00:00:08,720
roger penrose is a rigorous physicist

6
00:00:12,230 --> 00:00:11,200
bordering on mathematician which means

7
00:00:14,310 --> 00:00:12,240
even more rigor

8
00:00:15,509 --> 00:00:14,320
and generally speaking those people tend

9
00:00:16,150 --> 00:00:15,519
to stay away from theories of

10
00:00:17,670 --> 00:00:16,160
consciousness

11
00:00:19,349 --> 00:00:17,680
that aren't simply emergent from

12
00:00:21,590 --> 00:00:19,359
material complexity

13
00:00:22,550 --> 00:00:21,600

however hamneroff and penrose have a

14

00:00:25,029 --> 00:00:22,560

theory that combines

15

00:00:25,830 --> 00:00:25,039

general relativity with quantum theory

16

00:00:28,070 --> 00:00:25,840

and it's in fact

17

00:00:29,509 --> 00:00:28,080

in this unification that produces

18

00:00:30,870 --> 00:00:29,519

consciousness within what are called

19

00:00:32,870 --> 00:00:30,880

microtubules though it doesn't

20

00:00:34,549 --> 00:00:32,880

necessarily need to be within there

21

00:00:35,990 --> 00:00:34,559

this is a technical talk and we didn't

22

00:00:38,310 --> 00:00:36,000

even get to half the questions

23

00:00:39,670 --> 00:00:38,320

there's quite a bit of jargon and that's

24

00:00:41,030 --> 00:00:39,680

because i believe that one needs to

25

00:00:43,430 --> 00:00:41,040

speak with a certain level of

26
00:00:44,630 --> 00:00:43,440
domain-specific language if one is going

27
00:00:47,190 --> 00:00:44,640
to make progress

28
00:00:48,869 --> 00:00:47,200
otherwise we stay at the jejune level if

29
00:00:50,709 --> 00:00:48,879
you're merely listening to this rather

30
00:00:52,869 --> 00:00:50,719
than watching such as on spotify or

31
00:00:54,549 --> 00:00:52,879
itunes or you're away from the monitor

32
00:00:56,229 --> 00:00:54,559
there are concomitant visuals in the

33
00:00:58,150 --> 00:00:56,239
youtube video

34
00:00:59,750 --> 00:00:58,160
for those unacquainted the point of this

35
00:01:01,830 --> 00:00:59,760
channel is to interview those who have

36
00:01:04,549 --> 00:01:01,840
contributions to a theory of everything

37
00:01:05,429 --> 00:01:04,559
and then for you and us to collectively

38
00:01:07,830 --> 00:01:05,439

via discord

39

00:01:10,230 --> 00:01:07,840

via the subreddit come to a greater

40

00:01:13,270 --> 00:01:10,240

understanding of the laws that govern us

41

00:01:15,270 --> 00:01:13,280

and god and free will and so on

42

00:01:16,469 --> 00:01:15,280

there is a clips channel called toe

43

00:01:18,149 --> 00:01:16,479

clippings with shorter

44

00:01:20,789 --> 00:01:18,159

shareable segments from these larger

45

00:01:21,590 --> 00:01:20,799

interviews i welcome people to submit

46

00:01:23,109 --> 00:01:21,600

theories to me

47

00:01:25,109 --> 00:01:23,119

and to each other but it's quickly

48

00:01:27,749 --> 00:01:25,119

becoming overwhelming

49

00:01:29,109 --> 00:01:27,759

so at some point i will host informal

50

00:01:30,310 --> 00:01:29,119

chats with audience members on their

51

00:01:32,630 --> 00:01:30,320

theories of everything

52

00:01:33,429 --> 00:01:32,640

on the toe clippings channel since this

53

00:01:35,830 --> 00:01:33,439

main channel

54

00:01:37,910 --> 00:01:35,840

is heavily dense with information and

55

00:01:39,590 --> 00:01:37,920

plenty of preparation plus editing

56

00:01:41,190 --> 00:01:39,600

it would be great to keep it that way if

57

00:01:42,550 --> 00:01:41,200

you'd like to see more conversations

58

00:01:45,990 --> 00:01:42,560

such as this then please consider

59

00:01:48,069 --> 00:01:46,000

donating at patreon.com or if you're

60

00:01:51,030 --> 00:01:48,079

simply interested in the general mission

61

00:01:52,950 --> 00:01:51,040

once 50 patrons is reached we'll host a

62

00:01:55,429 --> 00:01:52,960

friendly constructive conversation

63

00:01:56,230 --> 00:01:55,439

rather than a critical one with bernardo

64

00:01:59,429 --> 00:01:56,240

castro

65

00:02:02,630 --> 00:01:59,439

donald hoffman and jonathan verveicky

66

00:02:05,350 --> 00:02:02,640

enjoy so stewart how was your day ah

67

00:02:06,550 --> 00:02:05,360

hi kurt it's great uh i'm in california

68

00:02:08,150 --> 00:02:06,560

with my wife

69

00:02:11,270 --> 00:02:08,160

and uh we're kind of taking it easy

70

00:02:14,630 --> 00:02:11,280

today so i'm happy to talk with you and

71

00:02:15,190 --> 00:02:14,640

catch up did you perform any daily

72

00:02:18,949 --> 00:02:15,200

ritual

73

00:02:22,470 --> 00:02:18,959

any meditation any special diet today no

74

00:02:26,229 --> 00:02:22,480

usual well something i noticed about you

75

00:02:29,589 --> 00:02:26,239

was you're extremely quick-minded astute

76

00:02:30,229 --> 00:02:29,599

and and lucid and then i looked up your

77

00:02:32,390 --> 00:02:30,239

age

78

00:02:33,589 --> 00:02:32,400

and you're past 70. i hope i'm not

79

00:02:35,030 --> 00:02:33,599

spoiling anything

80

00:02:37,030 --> 00:02:35,040

but i'm curious how is it that you're

81

00:02:39,190 --> 00:02:37,040

able to stay so quick-witted

82

00:02:41,030 --> 00:02:39,200

and articulate well i'm still working as

83

00:02:41,830 --> 00:02:41,040

an anesthesiologist i'm on vacation at

84

00:02:45,589 --> 00:02:41,840

the moment but

85

00:02:48,869 --> 00:02:45,599

uh um i stay active i have

86

00:02:52,070 --> 00:02:48,879

keen intellectual interests as you know

87

00:02:52,550 --> 00:02:52,080

and love life and savor every moment and

88

00:02:55,990 --> 00:02:52,560

uh

89

00:02:57,750 --> 00:02:56,000

just keep going were you always like

90

00:03:01,670 --> 00:02:57,760

that

91

00:03:04,229 --> 00:03:01,680

probably yeah do you pray do you believe

92

00:03:07,509 --> 00:03:04,239

in god uh

93

00:03:09,830 --> 00:03:07,519

i do i in my own way i uh

94

00:03:11,830 --> 00:03:09,840

my beliefs are kind of personal and in

95

00:03:14,309 --> 00:03:11,840

tune with my own personal beliefs but i

96

00:03:17,670 --> 00:03:14,319

was raised in a religious family and

97

00:03:19,910 --> 00:03:17,680

got uh you know got that from them

98

00:03:20,710 --> 00:03:19,920

and uh i'm very grateful my parents and

99

00:03:22,949 --> 00:03:20,720

my family for

100

00:03:24,789 --> 00:03:22,959

my upbringing including including my

101
00:03:26,070 --> 00:03:24,799
religious i kind of rebelled against

102
00:03:29,190 --> 00:03:26,080
organized religion but

103
00:03:31,350 --> 00:03:29,200
believe in uh and something uh

104
00:03:32,309 --> 00:03:31,360
that organizes the universe some kind of

105
00:03:33,949 --> 00:03:32,319
uh uh

106
00:03:36,309 --> 00:03:33,959
probably conscious function that

107
00:03:37,670 --> 00:03:36,319
organizes the universe

108
00:03:39,190 --> 00:03:37,680
i find that most people who study

109
00:03:40,550 --> 00:03:39,200
consciousness have a dislike for

110
00:03:42,550 --> 00:03:40,560
institutionalized religion

111
00:03:43,750 --> 00:03:42,560
yeah but they like spirituality in some

112
00:03:45,509 --> 00:03:43,760
way shape or form

113
00:03:47,030 --> 00:03:45,519

yes right so why don't you give the

114

00:03:50,229 --> 00:03:47,040

audience a cliff notes

115

00:03:51,830 --> 00:03:50,239

version of your theory okay um

116

00:03:53,350 --> 00:03:51,840

well i got interested in the problem of

117

00:03:56,869 --> 00:03:53,360

consciousness when i was in

118

00:03:58,710 --> 00:03:56,879

uh undergrad uh and i took a philosophy

119

00:04:01,990 --> 00:03:58,720

of mine class i was a chemistry physics

120

00:04:03,910 --> 00:04:02,000

math major pre-med uh it was also the

121

00:04:05,030 --> 00:04:03,920

late 60s and we did things then that

122

00:04:07,750 --> 00:04:05,040

people did then

123

00:04:09,429 --> 00:04:07,760

and uh there was a lot of political

124

00:04:10,949 --> 00:04:09,439

turmoil social unrest as you might

125

00:04:12,550 --> 00:04:10,959

imagine

126

00:04:14,550 --> 00:04:12,560

and uh i got really interested in this

127

00:04:17,430 --> 00:04:14,560

velocity mind class

128

00:04:19,830 --> 00:04:17,440

but went to medical school and in

129

00:04:23,350 --> 00:04:19,840

medical school none of the particular

130

00:04:25,030 --> 00:04:23,360

specialties i like the brain mind

131

00:04:25,990 --> 00:04:25,040

problem but neurology psychiatry

132

00:04:27,749 --> 00:04:26,000

neurosurgery

133

00:04:30,310 --> 00:04:27,759

didn't appeal to me in terms of

134

00:04:32,550 --> 00:04:30,320

lifestyle and stuff to do

135

00:04:34,469 --> 00:04:32,560

i stumbled into anesthesiology but while

136

00:04:35,990 --> 00:04:34,479

i was still in medical school i did a

137

00:04:37,430 --> 00:04:36,000

research elective thinking i might like

138

00:04:39,670 --> 00:04:37,440

academics

139

00:04:42,550 --> 00:04:39,680

and i was in a cancer lab studying cell

140

00:04:44,550 --> 00:04:42,560

division how cells divide mitosis

141

00:04:46,550 --> 00:04:44,560

and you know the chromosomes the genes

142

00:04:49,110 --> 00:04:46,560

are genes are pulled apart by these

143

00:04:50,550 --> 00:04:49,120

structures called mitotic spindles made

144

00:04:52,230 --> 00:04:50,560

of microtubules

145

00:04:54,469 --> 00:04:52,240

and that perfectly separates the

146

00:04:56,469 --> 00:04:54,479

chromosomes the genetic material

147

00:04:58,390 --> 00:04:56,479

and everybody else in the lab i'm pretty

148

00:04:59,030 --> 00:04:58,400

sure got into the genes and went on into

149

00:05:01,350 --> 00:04:59,040

genetic

150

00:05:02,150 --> 00:05:01,360

engineering and all that but for some

151
00:05:03,909 --> 00:05:02,160
reason i got

152
00:05:05,430 --> 00:05:03,919
fixated on these structures that pulled

153
00:05:07,430 --> 00:05:05,440
apart the chromosomes

154
00:05:08,870 --> 00:05:07,440
and if they didn't do this delicate

155
00:05:10,870 --> 00:05:08,880
dance perfectly

156
00:05:12,790 --> 00:05:10,880
the genetic material would not be

157
00:05:15,029 --> 00:05:12,800
perfectly divided and you'd get

158
00:05:16,070 --> 00:05:15,039
abnormal mitosis you get mal development

159
00:05:18,710 --> 00:05:16,080
you get

160
00:05:19,830 --> 00:05:18,720
cancer and so forth so i got interested

161
00:05:21,510 --> 00:05:19,840
in the structures that did the

162
00:05:23,670 --> 00:05:21,520
mechanical movement

163
00:05:25,670 --> 00:05:23,680

and at that time in the early 70s it was

164

00:05:28,790 --> 00:05:25,680

appreciated that they are also

165

00:05:30,629 --> 00:05:28,800

in neurons the neurons were full of them

166

00:05:32,550 --> 00:05:30,639

and their structure was revealed and

167

00:05:34,390 --> 00:05:32,560

they had a lattice structure

168

00:05:36,150 --> 00:05:34,400

and that looked to me something like a

169

00:05:38,150 --> 00:05:36,160

computer matrix because i was

170

00:05:39,909 --> 00:05:38,160

trying to figure out how computers work

171

00:05:40,310 --> 00:05:39,919

computers were new to me anyway back

172

00:05:43,350 --> 00:05:40,320

then

173

00:05:44,950 --> 00:05:43,360

in the early 70s so we had the so i was

174

00:05:46,710 --> 00:05:44,960

interested in consciousness

175

00:05:47,990 --> 00:05:46,720

i looked inside neurons and there was

176

00:05:50,390 --> 00:05:48,000

all these structures that looked like

177

00:05:52,230 --> 00:05:50,400

little computers so i got the idea that

178

00:05:54,550 --> 00:05:52,240

these microtubules as they were called

179

00:05:57,189 --> 00:05:54,560

might be processing information

180

00:05:57,830 --> 00:05:57,199

and uh subservient uh consciousness at a

181

00:06:00,950 --> 00:05:57,840

level

182

00:06:02,710 --> 00:06:00,960

below neurons because as you know almost

183

00:06:03,590 --> 00:06:02,720

everybody else thinks that the brain is

184

00:06:06,150 --> 00:06:03,600

a bunch of

185

00:06:07,590 --> 00:06:06,160

is a computer of neurons each neuron

186

00:06:09,909 --> 00:06:07,600

acting as a simple

187

00:06:11,749 --> 00:06:09,919

on off switch yes or no a bit of one or

188

00:06:12,790 --> 00:06:11,759

a zero and if you get enough complex

189

00:06:14,790 --> 00:06:12,800

computation

190

00:06:17,189 --> 00:06:14,800

among neurons you get consciousness

191

00:06:18,950 --> 00:06:17,199

emerging in some way

192

00:06:20,790 --> 00:06:18,960

but yet there were single cell organisms

193

00:06:23,670 --> 00:06:20,800

that do very clever things they can swim

194

00:06:26,870 --> 00:06:23,680

around find food find a mate have sex

195

00:06:29,029 --> 00:06:26,880

learn and so forth and they were a

196

00:06:31,430 --> 00:06:29,039

single cell so if a single cell

197

00:06:32,390 --> 00:06:31,440

paramecium can do that for example i

198

00:06:34,309 --> 00:06:32,400

thought it's kind of

199

00:06:35,909 --> 00:06:34,319

an insult to a neuron to say it's just a

200

00:06:37,270 --> 00:06:35,919

one or a zero depending on whether it

201
00:06:39,189 --> 00:06:37,280
fires or not

202
00:06:40,469 --> 00:06:39,199
and so i i started i got interested in

203
00:06:44,150 --> 00:06:40,479
these microtubules

204
00:06:45,990 --> 00:06:44,160
inside neurons so uh a year is

205
00:06:47,749 --> 00:06:46,000
a year later a couple years later when i

206
00:06:48,629 --> 00:06:47,759
was looking for a specialty to do in

207
00:06:50,390 --> 00:06:48,639
medicine

208
00:06:51,830 --> 00:06:50,400
i thought about doing pure research and

209
00:06:54,070 --> 00:06:51,840
decided against it

210
00:06:55,110 --> 00:06:54,080
um but i stumbled into anesthesiology

211
00:06:56,870 --> 00:06:55,120
because the

212
00:06:58,950 --> 00:06:56,880
the guy who would become my my future

213
00:06:59,350 --> 00:06:58,960

chairman a guy named bernell brown a

214

00:07:01,830 --> 00:06:59,360

really

215

00:07:03,110 --> 00:07:01,840

brilliant and charismatic character

216

00:07:04,309 --> 00:07:03,120

became a good friend of mine and my

217

00:07:05,510 --> 00:07:04,319

mentor

218

00:07:07,350 --> 00:07:05,520

said if you want to figure out

219

00:07:08,230 --> 00:07:07,360

consciousness figure out how anesthesia

220

00:07:10,870 --> 00:07:08,240

works

221

00:07:12,710 --> 00:07:10,880

and two here's a paper on showing that

222

00:07:14,550 --> 00:07:12,720

anesthesia acts by depolymerizing

223

00:07:16,870 --> 00:07:14,560

microtubules that you're so fond of

224

00:07:17,830 --> 00:07:16,880

what does depolymerizing mean it means

225

00:07:20,150 --> 00:07:17,840

they fall apart

226

00:07:21,909 --> 00:07:20,160

they disassemble so there are lattice

227

00:07:23,990 --> 00:07:21,919

microtubules are lattice polymers of

228

00:07:26,309 --> 00:07:24,000

individual proteins called tubulin

229

00:07:27,110 --> 00:07:26,319

each tubulin is just one protein like a

230

00:07:30,710 --> 00:07:27,120

peanut

231

00:07:33,029 --> 00:07:30,720

shaped protein but by entropy they they

232

00:07:33,909 --> 00:07:33,039

this is really weird how entropy drives

233

00:07:36,710 --> 00:07:33,919

something

234

00:07:38,309 --> 00:07:36,720

so uh elaborately self-organized they

235

00:07:38,870 --> 00:07:38,319

they self-assemble into these hollow

236

00:07:40,469 --> 00:07:38,880

tubes

237

00:07:42,790 --> 00:07:40,479

and grow like like girders or

238

00:07:43,430 --> 00:07:42,800

scaffolding right i was watching this

239

00:07:46,950 --> 00:07:43,440

talk by

240

00:07:48,869 --> 00:07:46,960

anarban i believe yes right right right

241

00:07:50,230 --> 00:07:48,879

and they self-assemble and they grow

242

00:07:51,589 --> 00:07:50,240

they grow cells and they make

243

00:07:54,550 --> 00:07:51,599

neuronal connections and they do

244

00:07:56,469 --> 00:07:54,560

everything uh in terms of cell movement

245

00:08:00,150 --> 00:07:56,479

cell organization

246

00:08:01,589 --> 00:08:00,160

so uh it so if you give enough

247

00:08:03,830 --> 00:08:01,599

anesthesia and it turns out it takes

248

00:08:05,749 --> 00:08:03,840

about five times as much anesthesia

249

00:08:07,670 --> 00:08:05,759

to cause them to disassemble to to

250

00:08:11,029 --> 00:08:07,680

depolymerize into their

251
00:08:13,189 --> 00:08:11,039
to go from these elaborate uh polymers

252
00:08:14,629 --> 00:08:13,199
structures into the individual

253
00:08:16,629 --> 00:08:14,639
individual proteins

254
00:08:18,230 --> 00:08:16,639
uh enough anesthesia will do that well

255
00:08:19,430 --> 00:08:18,240
that's about five times the anesthesia

256
00:08:21,589 --> 00:08:19,440
you need to cause them

257
00:08:22,790 --> 00:08:21,599
to cause unconsciousness so fortunately

258
00:08:24,710 --> 00:08:22,800
we don't uh

259
00:08:26,230 --> 00:08:24,720
cause our microtubules to fall apart we

260
00:08:28,230 --> 00:08:26,240
just affect them in some

261
00:08:31,909 --> 00:08:28,240
more subtle way fortunately although too

262
00:08:37,589 --> 00:08:34,870
so anyway uh brunel uh my future

263
00:08:40,630 --> 00:08:39,110

you can figure out consciousness it has

264

00:08:41,990 --> 00:08:40,640

something to do with microtubules

265

00:08:43,670 --> 00:08:42,000

it's a lot of fun and it's pretty good

266

00:08:45,750 --> 00:08:43,680

money so that was

267

00:08:48,070 --> 00:08:45,760

a long time ago and i went in anesthesia

268

00:08:48,870 --> 00:08:48,080

and here i am 46 years later still doing

269

00:08:51,350 --> 00:08:48,880

it clinically

270

00:08:53,430 --> 00:08:51,360

and still enjoying it and the research

271

00:08:56,070 --> 00:08:53,440

has you know given me an opportunity to

272

00:08:57,829 --> 00:08:56,080

kind of go where i want to go then you

273

00:08:59,350 --> 00:08:57,839

started collaborating with penrose and

274

00:09:01,030 --> 00:08:59,360

i'm curious about the practical aspects

275

00:09:02,710 --> 00:09:01,040

of that we can talk about it later

276

00:09:04,870 --> 00:09:02,720

but i'm super curious to know what is it

277

00:09:06,310 --> 00:09:04,880

like to collaborate with penrose how do

278

00:09:07,670 --> 00:09:06,320

you do it do you use a whiteboard

279

00:09:09,269 --> 00:09:07,680

what's an example of a problem that

280

00:09:10,389 --> 00:09:09,279

you've tackled together recently but

281

00:09:12,630 --> 00:09:10,399

we'll talk about so you

282

00:09:14,949 --> 00:09:12,640

encountered penrose i should say before

283

00:09:15,829 --> 00:09:14,959

i get to roger i should say that i spent

284

00:09:18,630 --> 00:09:15,839

about

285

00:09:20,790 --> 00:09:18,640

20 years working on microtubules as

286

00:09:22,070 --> 00:09:20,800

classical information processing devices

287

00:09:24,150 --> 00:09:22,080

going around to

288

00:09:25,910 --> 00:09:24,160

artificial intelligence meetings neural

289

00:09:26,550 --> 00:09:25,920

net meetings neuroscience meetings

290

00:09:27,910 --> 00:09:26,560

saying

291

00:09:29,750 --> 00:09:27,920

hey to understand the brain you can't

292

00:09:30,630 --> 00:09:29,760

just think of the neuron as a one one or

293

00:09:32,550 --> 00:09:30,640

a zero

294

00:09:34,949 --> 00:09:32,560

you got to go into the deeper level and

295

00:09:37,190 --> 00:09:34,959

again all this additional information

296

00:09:38,790 --> 00:09:37,200

so for example that you know ai

297

00:09:39,509 --> 00:09:38,800

singularity people were saying well you

298

00:09:41,509 --> 00:09:39,519

have

299

00:09:42,550 --> 00:09:41,519

10 to the 11th neurons are switching at

300

00:09:44,949 --> 00:09:42,560

about a thousand

301
00:09:47,030 --> 00:09:44,959
per hertz see about 100 or a thousand

302
00:09:49,670 --> 00:09:47,040
synapses 100 hertz gives you about

303
00:09:51,269 --> 00:09:49,680
10 to the 16th operations per second and

304
00:09:52,870 --> 00:09:51,279
kurtzweil and singularity were saying

305
00:09:53,430 --> 00:09:52,880
well when we get to 10 to the 16th we'll

306
00:09:55,590 --> 00:09:53,440
have

307
00:09:56,470 --> 00:09:55,600
brain equivalence and consciousness but

308
00:09:58,949 --> 00:09:56,480
i said well no

309
00:09:59,509 --> 00:09:58,959
if you have the microtubule subunits

310
00:10:02,550 --> 00:09:59,519
about a

311
00:10:06,389 --> 00:10:02,560
billion of them or uh per neuron

312
00:10:07,509 --> 00:10:06,399
switching at uh 10 megahertz you get 10

313
00:10:10,230 --> 00:10:07,519

to the 16th

314

00:10:10,550 --> 00:10:10,240

operations per second for every neuron

315

00:10:13,110 --> 00:10:10,560

so

316

00:10:14,470 --> 00:10:13,120

uh the goal post for ai was i was

317

00:10:17,110 --> 00:10:14,480

pushing it way down

318

00:10:17,990 --> 00:10:17,120

down the field and uh they didn't like

319

00:10:19,990 --> 00:10:18,000

that you know they

320

00:10:21,110 --> 00:10:20,000

said go away you bother us you know what

321

00:10:22,870 --> 00:10:21,120

are you doing because they wanted the

322

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

singularity to happen in their lifetime

323

00:10:26,630 --> 00:10:25,200

exactly you know give them another you

324

00:10:27,829 --> 00:10:26,640

know a couple billion and they'll have a

325

00:10:30,150 --> 00:10:27,839

brain equivalence

326

00:10:31,430 --> 00:10:30,160

you know in in another few years so i

327

00:10:34,470 --> 00:10:31,440

thought that was bs

328

00:10:35,910 --> 00:10:34,480

um and i thought their their approach to

329

00:10:38,550 --> 00:10:35,920

the brain was an insult

330

00:10:39,670 --> 00:10:38,560

to the brain an insult to neurons and i

331

00:10:42,870 --> 00:10:39,680

was going around uh

332

00:10:44,470 --> 00:10:42,880

doing my thing being pest um

333

00:10:46,230 --> 00:10:44,480

and then one day somebody said ask me a

334

00:10:49,190 --> 00:10:46,240

very good question he said

335

00:10:49,750 --> 00:10:49,200

um let's say you're right wise guy wise

336

00:10:51,910 --> 00:10:49,760

ass

337

00:10:53,190 --> 00:10:51,920

and all this is going on how does that

338

00:10:55,750 --> 00:10:53,200

explain consciousness

339

00:10:57,269 --> 00:10:55,760

how does that explain you know love joy

340

00:11:00,790 --> 00:10:57,279

feelings pinkness

341

00:11:02,470 --> 00:11:00,800

envy taste you know uh what later became

342

00:11:05,590 --> 00:11:02,480

known as the hard problem by

343

00:11:07,110 --> 00:11:05,600

according to david chalmers and i was i

344

00:11:08,550 --> 00:11:07,120

was a bit stunned i had to admit they

345

00:11:11,030 --> 00:11:08,560

were right i really didn't know

346

00:11:12,870 --> 00:11:11,040

and uh i had enjoyed being a pest but i

347

00:11:14,790 --> 00:11:12,880

didn't really have a solution other than

348

00:11:16,710 --> 00:11:14,800

we had to look deeper and the same

349

00:11:18,550 --> 00:11:16,720

person suggested i read this book by

350

00:11:19,350 --> 00:11:18,560

roger penrose called the emperor's new

351
00:11:20,949 --> 00:11:19,360
mind

352
00:11:22,389 --> 00:11:20,959
and i had vaguely heard of penrose but i

353
00:11:24,790 --> 00:11:22,399
didn't really know his work this was

354
00:11:26,470 --> 00:11:24,800
well he wrote the book in 89 and i think

355
00:11:29,910 --> 00:11:26,480
i read it in 91

356
00:11:32,710 --> 00:11:29,920
um or so and uh it was

357
00:11:34,150 --> 00:11:32,720
uh quite a tour de force as you may know

358
00:11:36,310 --> 00:11:34,160
it it covered

359
00:11:38,069 --> 00:11:36,320
the main the main point was it started

360
00:11:41,190 --> 00:11:38,079
off with through girdle's theorem

361
00:11:43,430 --> 00:11:41,200
arguing that um consciousness requires

362
00:11:45,269 --> 00:11:43,440
something other than computation

363
00:11:46,949 --> 00:11:45,279

other than what we think of as classical

364

00:11:51,509 --> 00:11:46,959

computation

365

00:11:55,990 --> 00:11:51,519

something else

366

00:11:59,350 --> 00:11:56,000

because uh girdle's theorem uh

367

00:12:01,190 --> 00:11:59,360

to prove a theorem in mathematics uh you

368

00:12:01,990 --> 00:12:01,200

have to be outside the computational

369

00:12:04,710 --> 00:12:02,000

system

370

00:12:05,670 --> 00:12:04,720

so we extrapolate extrapolated that to

371

00:12:08,470 --> 00:12:05,680

say that

372

00:12:09,110 --> 00:12:08,480

uh to uh for understanding for us to

373

00:12:12,069 --> 00:12:09,120

know any

374

00:12:13,509 --> 00:12:12,079

need something outside of the

375

00:12:15,990 --> 00:12:13,519

computational system

376

00:12:17,430 --> 00:12:16,000

of the brain basically the neurons

377

00:12:20,230 --> 00:12:17,440

firing out fire

378

00:12:21,509 --> 00:12:20,240

and uh i didn't i didn't follow all it

379

00:12:23,110 --> 00:12:21,519

got into the weeds in terms of

380

00:12:25,910 --> 00:12:23,120

philosophy and mathematics

381

00:12:26,550 --> 00:12:25,920

that kind of lost me but intuitively uh

382

00:12:28,069 --> 00:12:26,560

it was

383

00:12:30,150 --> 00:12:28,079

i felt he was onto something and he was

384

00:12:31,990 --> 00:12:30,160

at least questioning and had the same

385

00:12:34,310 --> 00:12:32,000

gut feelings that i did that there was

386

00:12:37,590 --> 00:12:34,320

something more to it than that

387

00:12:37,990 --> 00:12:37,600

and uh but his answer you know what that

388

00:12:41,110 --> 00:12:38,000

something

389

00:12:42,710 --> 00:12:41,120

was what the missing ingredient was

390

00:12:44,389 --> 00:12:42,720

got into quantum physics and a

391

00:12:45,829 --> 00:12:44,399

self-collapse of the wave function and

392

00:12:48,150 --> 00:12:45,839

his own theory

393

00:12:49,110 --> 00:12:48,160

of the measurement problem and in

394

00:12:50,870 --> 00:12:49,120

quantum mechanics

395

00:12:52,949 --> 00:12:50,880

as you as you may know you can have

396

00:12:54,310 --> 00:12:52,959

superpositions of multiple coexisting

397

00:12:56,069 --> 00:12:54,320

possibilities

398

00:12:58,310 --> 00:12:56,079

things can be in two states or places at

399

00:12:59,990 --> 00:12:58,320

the same time and yet when you measure

400

00:13:02,470 --> 00:13:00,000

or observe them

401
00:13:03,829 --> 00:13:02,480
they become one or the other so the very

402
00:13:05,590 --> 00:13:03,839
active measurement

403
00:13:07,190 --> 00:13:05,600
or some people thought the very act of

404
00:13:08,629 --> 00:13:07,200
conscious observation

405
00:13:11,269 --> 00:13:08,639
seemed to cause collapse of the wave

406
00:13:13,350 --> 00:13:11,279
function and the other idea is that

407
00:13:15,509 --> 00:13:13,360
each possibility coexists and continues

408
00:13:17,430 --> 00:13:15,519
and forms its own universe

409
00:13:20,470 --> 00:13:17,440
or that the coherence does it or the

410
00:13:22,150 --> 00:13:20,480
bone theory or this or that uh

411
00:13:23,509 --> 00:13:22,160
and uh they all have their flaws and

412
00:13:26,310 --> 00:13:23,519
they all have their appeals

413
00:13:27,269 --> 00:13:26,320

uh but rogers was that well the first

414

00:13:29,750 --> 00:13:27,279

thing he did that

415

00:13:31,509 --> 00:13:29,760

was really kind of mind-blowing and

416

00:13:33,910 --> 00:13:31,519

still is after all these years is that

417

00:13:35,750 --> 00:13:33,920

he explained superposition

418

00:13:37,430 --> 00:13:35,760

which nobody else has even attempted to

419

00:13:38,949 --> 00:13:37,440

do as far as i can tell

420

00:13:40,550 --> 00:13:38,959

so the question is how can something be

421

00:13:41,829 --> 00:13:40,560

in two places at the same time how can

422

00:13:43,509 --> 00:13:41,839

it be here

423

00:13:45,350 --> 00:13:43,519

and here the same thing in two different

424

00:13:48,310 --> 00:13:45,360

places and

425

00:13:49,910 --> 00:13:48,320

he he he saw that by by resorting to

426

00:13:52,949 --> 00:13:49,920

general relativity

427

00:13:55,030 --> 00:13:52,959

by saying that uh as as you know for

428

00:13:57,189 --> 00:13:55,040

very large objects like the sun

429

00:13:58,069 --> 00:13:57,199

there's curvature of space time this

430

00:14:01,750 --> 00:13:58,079

goes back to

431

00:14:03,750 --> 00:14:01,760

einstein's general relativity and so

432

00:14:05,269 --> 00:14:03,760

einstein had predicted that a star

433

00:14:08,389 --> 00:14:05,279

behind the sun

434

00:14:09,829 --> 00:14:08,399

could be visible in an eclipse because

435

00:14:11,350 --> 00:14:09,839

the space time curvature

436

00:14:13,350 --> 00:14:11,360

would bend the bend the light around the

437

00:14:14,550 --> 00:14:13,360

space-time curvature and we would see it

438

00:14:16,389 --> 00:14:14,560

even though we knew it was behind the

439

00:14:18,150 --> 00:14:16,399

star and in 1919

440

00:14:19,670 --> 00:14:18,160

eddington uh went to the top of the

441

00:14:21,350 --> 00:14:19,680

mountain during the eclipse

442

00:14:23,350 --> 00:14:21,360

and proved einstein right that there was

443

00:14:24,790 --> 00:14:23,360

these these big curvature in space-time

444

00:14:25,509 --> 00:14:24,800

and we could see these stars behind the

445

00:14:29,110 --> 00:14:25,519

sun

446

00:14:30,629 --> 00:14:29,120

in an eclipse so um basically einstein

447

00:14:32,310 --> 00:14:30,639

equated uh

448

00:14:34,470 --> 00:14:32,320

mass with curvature and space-time

449

00:14:36,230 --> 00:14:34,480

geometry for large things

450

00:14:38,069 --> 00:14:36,240

roger applied that to small things and

451
00:14:38,870 --> 00:14:38,079
said a small thing like a quantum

452
00:14:40,790 --> 00:14:38,880
particle

453
00:14:42,230 --> 00:14:40,800
approach on an electron or something at

454
00:14:45,110 --> 00:14:42,240
the quantum level

455
00:14:45,430 --> 00:14:45,120
uh has a has a very tiny curvature and

456
00:14:47,189 --> 00:14:45,440
so

457
00:14:48,790 --> 00:14:47,199
if it's over here there's a curvature

458
00:14:50,310 --> 00:14:48,800
going this way if it's over here there's

459
00:14:52,230 --> 00:14:50,320
a curvature going this way

460
00:14:53,990 --> 00:14:52,240
so it being in two places at once was

461
00:14:56,550 --> 00:14:54,000
actually two separate curvatures

462
00:14:58,470 --> 00:14:56,560
a separation and space time so the

463
00:15:00,310 --> 00:14:58,480

fundamental level of the universe

464

00:15:02,230 --> 00:15:00,320

that he called space-time geometry and

465

00:15:03,910 --> 00:15:02,240

which he cleverly portrayed as these

466

00:15:06,790 --> 00:15:03,920

two-dimensional sheets

467

00:15:08,550 --> 00:15:06,800

could separate and uh you could imagine

468

00:15:09,910 --> 00:15:08,560

that if they continue to separate each

469

00:15:11,509 --> 00:15:09,920

would have its own universe and you'd

470

00:15:13,030 --> 00:15:11,519

have multiple worlds

471

00:15:15,590 --> 00:15:13,040

but he said these separations were

472

00:15:17,829 --> 00:15:15,600

unstable and after time t

473

00:15:18,949 --> 00:15:17,839

would would self-collapse to one or the

474

00:15:21,670 --> 00:15:18,959

other

475

00:15:22,550 --> 00:15:21,680

and and t was was inversely related to

476

00:15:25,030 --> 00:15:22,560

the amount of

477

00:15:25,990 --> 00:15:25,040

separation so a very large separation

478

00:15:27,670 --> 00:15:26,000

would self-collapse

479

00:15:30,629 --> 00:15:27,680

quickly and a small one would take a

480

00:15:32,389 --> 00:15:30,639

long time and and here was the kicker

481

00:15:34,310 --> 00:15:32,399

and when that collapse occurred to one

482

00:15:36,710 --> 00:15:34,320

of the other there was

483

00:15:39,030 --> 00:15:36,720

a moment of consciousness that was

484

00:15:40,069 --> 00:15:39,040

created or occurred or emitted depending

485

00:15:42,870 --> 00:15:40,079

on how you want to describe

486

00:15:45,189 --> 00:15:42,880

it so this was the opposite of the idea

487

00:15:46,710 --> 00:15:45,199

that consciousness caused collapse

488

00:15:48,790 --> 00:15:46,720

in roger's view collapse occurred

489

00:15:51,269 --> 00:15:48,800

spontaneously due to this

490

00:15:53,269 --> 00:15:51,279

property of of the universe and created

491

00:15:56,069 --> 00:15:53,279

consciousness cause consciousness

492

00:15:58,150 --> 00:15:56,079

almost like a quantum of consciousness a

493

00:16:00,949 --> 00:15:58,160

quantum man

494

00:16:02,629 --> 00:16:00,959

and uh and so he he turned the the

495

00:16:04,230 --> 00:16:02,639

so-called copenhagen interpretation and

496

00:16:06,069 --> 00:16:04,240

consciousness causes collapse

497

00:16:08,230 --> 00:16:06,079

around and said collapse occurs

498

00:16:09,990 --> 00:16:08,240

spontaneously and causes consciousness

499

00:16:11,350 --> 00:16:10,000

and he did it with these clever drawings

500

00:16:12,790 --> 00:16:11,360

and not a whole lot you know

501
00:16:14,389 --> 00:16:12,800
there's plenty of math and equations

502
00:16:16,310 --> 00:16:14,399
that i didn't follow

503
00:16:17,590 --> 00:16:16,320
but i got i got to just because he's

504
00:16:19,990 --> 00:16:17,600
more uh creative and

505
00:16:21,110 --> 00:16:20,000
well he's more expressive in terms of uh

506
00:16:25,189 --> 00:16:21,120
illustrations and

507
00:16:28,949 --> 00:16:25,199
his clever cartoon he's extremely visual

508
00:16:31,350 --> 00:16:28,959
yes yes and artistic and uh you know he

509
00:16:33,350 --> 00:16:31,360
he's also involved with m.c escher and

510
00:16:35,269 --> 00:16:33,360
and that's kind of a whole sideline but

511
00:16:37,749 --> 00:16:35,279
but um you know i was able to grow grop

512
00:16:39,910 --> 00:16:37,759
what he was saying intuitively

513
00:16:41,590 --> 00:16:39,920

and uh so he was saying at the end that

514

00:16:43,829 --> 00:16:41,600

well you there needed to be some kind of

515

00:16:47,350 --> 00:16:43,839

quantum computer in the brain that would

516

00:16:49,509 --> 00:16:47,360

self-collapse by the by this threshold

517

00:16:50,710 --> 00:16:49,519

but that neurons firing or firing were

518

00:16:52,310 --> 00:16:50,720

were too big

519

00:16:54,230 --> 00:16:52,320

so he already knew that neurons were too

520

00:16:56,870 --> 00:16:54,240

big but he didn't have a candidate

521

00:16:59,269 --> 00:16:56,880

for a quantum computer and uh so we're

522

00:17:01,430 --> 00:16:59,279

reading this after spending 20 years

523

00:17:03,269 --> 00:17:01,440

uh working on microtubules at a smaller

524

00:17:04,150 --> 00:17:03,279

level and i knew a little bit about

525

00:17:05,669 --> 00:17:04,160

quantum because

526

00:17:08,470 --> 00:17:05,679

there had been a guy named frolic

527

00:17:09,669 --> 00:17:08,480

herbert frolic in the 60s and 70s

528

00:17:12,630 --> 00:17:09,679

who claimed that there was quantum

529

00:17:16,150 --> 00:17:12,640

coherence in in geometric

530

00:17:16,829 --> 00:17:16,160

biological lattices uh that were in a in

531

00:17:43,909 --> 00:17:16,839

a

532

00:17:45,990 --> 00:17:43,919

being these frolic uh

533

00:17:47,029 --> 00:17:46,000

oscillators coherent devices is he still

534

00:17:49,590 --> 00:17:47,039

alive

535

00:17:51,029 --> 00:17:49,600

no he died in 1991 he got a long time

536

00:17:52,789 --> 00:17:51,039

ago actually i see i see

537

00:17:54,950 --> 00:17:52,799

we were going to have a conference for

538

00:17:56,470 --> 00:17:54,960

him uh we had arranged a nato advanced

539

00:17:57,750 --> 00:17:56,480

workshop to bring in a lot of people

540

00:17:59,990 --> 00:17:57,760

talking about his

541

00:18:02,230 --> 00:18:00,000

his theory but unfortunately he died uh

542

00:18:03,750 --> 00:18:02,240

a couple months before the conference

543

00:18:06,150 --> 00:18:03,760

we had which we had anyway it was a

544

00:18:08,310 --> 00:18:06,160

great conference but um

545

00:18:09,350 --> 00:18:08,320

now uh but he died in uh i think it was

546

00:18:11,510 --> 00:18:09,360

91.

547

00:18:13,909 --> 00:18:11,520

but i but i have something called frolic

548

00:18:14,789 --> 00:18:13,919

residences right which president follow

549

00:18:16,950 --> 00:18:14,799

coherence

550

00:18:18,230 --> 00:18:16,960

they just came out actually in the

551
00:18:21,029 --> 00:18:18,240
fizzrev a

552
00:18:22,230 --> 00:18:21,039
uh my wife just gave me the reference uh

553
00:18:25,110 --> 00:18:22,240
a new paper by

554
00:18:26,230 --> 00:18:25,120
a guy uh aristid delgario at university

555
00:18:28,470 --> 00:18:26,240
of central florida

556
00:18:30,630 --> 00:18:28,480
about frolic coherence and it's it's a

557
00:18:33,110 --> 00:18:30,640
brand new treatment and it's very pro

558
00:18:34,310 --> 00:18:33,120
pro frolic and actually i know uh rsd

559
00:18:35,430 --> 00:18:34,320
actually we're working together on

560
00:18:38,310 --> 00:18:35,440
another project

561
00:18:40,150 --> 00:18:38,320
so yeah frolic coherence uh actually

562
00:18:40,470 --> 00:18:40,160
suffices for the kind of quantum state

563
00:18:43,669 --> 00:18:40,480

that

564

00:18:46,390 --> 00:18:43,679

right

565

00:18:48,150 --> 00:18:46,400

uh structure and i i thought it applied

566

00:18:51,430 --> 00:18:48,160

to microtubules so

567

00:18:54,789 --> 00:18:51,440

anyway i wrote to uh to roger and when

568

00:18:55,990 --> 00:18:54,799

after i read his book and and said that

569

00:18:59,029 --> 00:18:56,000

i really enjoyed it

570

00:19:00,710 --> 00:18:59,039

and uh thought that uh microtubules

571

00:19:03,029 --> 00:19:00,720

which i described in a letter

572

00:19:04,789 --> 00:19:03,039

might be the quantum computer inside the

573

00:19:07,350 --> 00:19:04,799

brain that he needed

574

00:19:08,710 --> 00:19:07,360

and uh and that i by the way was going

575

00:19:12,070 --> 00:19:08,720

to be in england for a meeting

576

00:19:13,669 --> 00:19:12,080

a couple months hence and be happy to

577

00:19:14,230 --> 00:19:13,679

discuss it with them and i was uh

578

00:19:17,190 --> 00:19:14,240

thrilled

579

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

and delighted to get a uh a letter the

580

00:19:22,549 --> 00:19:19,520

old-fashioned kind in the mail

581

00:19:23,590 --> 00:19:22,559

yes happy to meet you come meet me at

582

00:19:26,870 --> 00:19:23,600

the

583

00:19:30,150 --> 00:19:26,880

and such a day and time

584

00:19:31,590 --> 00:19:30,160

and so i did and uh he actually uh

585

00:19:33,350 --> 00:19:31,600

i think he met me at the train station

586

00:19:36,230 --> 00:19:33,360

we walked over and

587

00:19:37,430 --> 00:19:36,240

uh sat in his office for several hours

588

00:19:39,750 --> 00:19:37,440

actually

589

00:19:41,110 --> 00:19:39,760

and uh i did almost all the talking he

590

00:19:43,190 --> 00:19:41,120

just asked me a few questions about

591

00:19:46,070 --> 00:19:43,200

microtubules and i brought a book that i

592

00:19:47,270 --> 00:19:46,080

had uh written about microtubules and

593

00:19:48,870 --> 00:19:47,280

several articles

594

00:19:50,789 --> 00:19:48,880

and uh when we went through all the

595

00:19:52,150 --> 00:19:50,799

illustrations what sorts of questions

596

00:19:53,590 --> 00:19:52,160

did he ask you

597

00:19:55,430 --> 00:19:53,600

he said the first day first thing he

598

00:19:56,310 --> 00:19:55,440

asked me was are these things real or

599

00:19:59,669 --> 00:19:56,320

biological

600

00:20:01,029 --> 00:19:59,679

or or matt or or computer simulations

601
00:20:02,789 --> 00:20:01,039
i said oh they're definitely real

602
00:20:04,390 --> 00:20:02,799
they're all they're all living cells

603
00:20:05,669 --> 00:20:04,400
make up mitosis and i show them lots of

604
00:20:08,870 --> 00:20:05,679
pictures

605
00:20:09,830 --> 00:20:08,880
and uh and so he was particularly

606
00:20:13,510 --> 00:20:09,840
interested in that

607
00:20:15,190 --> 00:20:13,520
in the geometry of the a lattice

608
00:20:16,950 --> 00:20:15,200
now microtubules can form in two

609
00:20:19,430 --> 00:20:16,960
different types of lattices

610
00:20:20,230 --> 00:20:19,440
the a lattice or the b lattice and the a

611
00:20:23,270 --> 00:20:20,240
lattice

612
00:20:24,630 --> 00:20:23,280
has a fibonacci geometry and roger is at

613
00:20:27,270 --> 00:20:24,640

heart

614

00:20:28,870 --> 00:20:27,280

geometrist your geometry and the

615

00:20:31,669 --> 00:20:28,880

fibonacci giant

616

00:20:33,190 --> 00:20:31,679

you have these spiral helical windings

617

00:20:35,990 --> 00:20:33,200

of the tubulins

618

00:20:37,750 --> 00:20:36,000

and if you go if you follow one pathway

619

00:20:38,630 --> 00:20:37,760

they repeats every three every three

620

00:20:40,549 --> 00:20:38,640

tubulins

621

00:20:43,190 --> 00:20:40,559

another every five and another every

622

00:20:43,990 --> 00:20:43,200

eight and then 13 and 21 the fibonacci

623

00:20:45,830 --> 00:20:44,000

series

624

00:20:47,350 --> 00:20:45,840

so the in the a lattice the the

625

00:20:50,149 --> 00:20:47,360

fibonacci geometry was

626

00:20:50,710 --> 00:20:50,159

was intrinsic to the lattice and he said

627

00:20:53,270 --> 00:20:50,720

if that's

628

00:20:54,710 --> 00:20:53,280

if alas could be could be a quantum

629

00:20:55,350 --> 00:20:54,720

device just because of the young teller

630

00:20:59,350 --> 00:20:55,360

effect

631

00:21:02,070 --> 00:20:59,360

and and so forth and uh

632

00:21:03,909 --> 00:21:02,080

i also was looking deeper inside each

633

00:21:06,230 --> 00:21:03,919

tubulin to these

634

00:21:07,750 --> 00:21:06,240

pi resonance aromatic amino acids

635

00:21:08,230 --> 00:21:07,760

because i knew that's where anesthetics

636

00:21:11,830 --> 00:21:08,240

act

637

00:21:16,070 --> 00:21:11,840

and so forth so anyway he liked the idea

638

00:21:18,070 --> 00:21:16,080

and uh although um i didn't think at the

639

00:21:19,590 --> 00:21:18,080

time going back to the meeting in oxford

640

00:21:21,190 --> 00:21:19,600

i didn't know if anything would come of

641

00:21:23,190 --> 00:21:21,200

it although he did mention

642

00:21:25,430 --> 00:21:23,200

that he was going to a conference at

643

00:21:26,310 --> 00:21:25,440

cambridge with dan dennett and pat

644

00:21:30,070 --> 00:21:26,320

churchlin two

645

00:21:32,789 --> 00:21:30,080

philosophers of mine uh big names and uh

646

00:21:33,510 --> 00:21:32,799

that uh you know it was gonna be about

647

00:21:35,830 --> 00:21:33,520

consciousness

648

00:21:37,029 --> 00:21:35,840

and i thought gee i'd be really fun to

649

00:21:37,830 --> 00:21:37,039

go to but i was going to a different

650

00:21:41,430 --> 00:21:37,840

conference

651
00:21:42,950 --> 00:21:41,440
he thanked me we said goodbye

652
00:21:44,950 --> 00:21:42,960
and i said well that was cool i got to

653
00:21:47,669 --> 00:21:44,960
meet roger penrose and i didn't

654
00:21:49,110 --> 00:21:47,679
think anything would come of it and uh

655
00:21:50,390 --> 00:21:49,120
two weeks later i was back in london

656
00:21:51,750 --> 00:21:50,400
heading back to the states

657
00:21:54,070 --> 00:21:51,760
and had dinner with a friend and he said

658
00:21:56,070 --> 00:21:54,080
hey guess what my friend went to this

659
00:21:57,510 --> 00:21:56,080
meeting in cambridge and roger penrose

660
00:21:59,350 --> 00:21:57,520
was talking about you and your damn

661
00:22:01,909 --> 00:21:59,360
microtubules oh great

662
00:22:03,270 --> 00:22:01,919
and uh i was thrilled i was just tickled

663
00:22:05,510 --> 00:22:03,280

to death so um

664

00:22:07,029 --> 00:22:05,520

i said well that's even better and then

665

00:22:07,590 --> 00:22:07,039

a few months later i got invited to a

666

00:22:10,149 --> 00:22:07,600

meeting

667

00:22:11,110 --> 00:22:10,159

uh that roger had arranged to get me

668

00:22:14,549 --> 00:22:11,120

invited to

669

00:22:16,710 --> 00:22:14,559

it was obvious in sweden

670

00:22:17,909 --> 00:22:16,720

a very limited uh basically speakers

671

00:22:20,789 --> 00:22:17,919

only meeting

672

00:22:22,390 --> 00:22:20,799

north of the arctic circle and in in the

673

00:22:25,110 --> 00:22:22,400

midnight sun which was

674

00:22:27,029 --> 00:22:25,120

dan dana was there and uh petra story

675

00:22:30,310 --> 00:22:27,039

and a few other people

676

00:22:31,270 --> 00:22:30,320

and um roger and his wife vanessa and uh

677

00:22:34,070 --> 00:22:31,280

we were there for

678

00:22:35,350 --> 00:22:34,080

about five days and uh you know the

679

00:22:37,430 --> 00:22:35,360

meetings were doing today but

680

00:22:39,430 --> 00:22:37,440

with no no darkness we just stayed up

681

00:22:40,470 --> 00:22:39,440

and talked and went skiing at night and

682

00:22:41,830 --> 00:22:40,480

walked and

683

00:22:43,510 --> 00:22:41,840

played ping pong and did all kinds of

684

00:22:45,909 --> 00:22:43,520

things like no darkness

685

00:22:47,830 --> 00:22:45,919

pardon me you said with no darkness it

686

00:22:49,190 --> 00:22:47,840

was above the polar circle in sweden

687

00:22:49,669 --> 00:22:49,200

during the midnight sun there it was

688

00:22:52,950 --> 00:22:49,679

like

689

00:22:56,149 --> 00:22:52,960

okay july or august uh way way north

690

00:22:58,630 --> 00:22:56,159

so uh mid no uh you know midnight sun

691

00:23:00,789 --> 00:22:58,640

and we actually went skiing at night uh

692

00:23:03,029 --> 00:23:00,799

on a place on the

693

00:23:04,070 --> 00:23:03,039

i think it was the norwegian swedish

694

00:23:07,110 --> 00:23:04,080

border

695

00:23:09,510 --> 00:23:07,120

and uh it was a lot of fun and

696

00:23:11,029 --> 00:23:09,520

got to know him a little bit and at that

697

00:23:11,669 --> 00:23:11,039

meeting i invited him to a conference

698

00:23:13,510 --> 00:23:11,679

that i was or

699

00:23:15,430 --> 00:23:13,520

i was organized the first tucson

700

00:23:17,510 --> 00:23:15,440

conference the science of consciousness

701
00:23:19,029 --> 00:23:17,520
in tucson and it was the first

702
00:23:21,669 --> 00:23:19,039
interdisciplinary conference

703
00:23:23,669 --> 00:23:21,679
and i invited him and bribed him with a

704
00:23:25,590 --> 00:23:23,679
trip to the grand canyon

705
00:23:27,029 --> 00:23:25,600
and uh not that i needed to bride him

706
00:23:29,029 --> 00:23:27,039
but he he was

707
00:23:30,149 --> 00:23:29,039
happy to to go and so he was at the

708
00:23:32,710 --> 00:23:30,159
first conference

709
00:23:34,830 --> 00:23:32,720
which we held in 1994 the science of con

710
00:23:36,230 --> 00:23:34,840
or he's called then toward a science of

711
00:23:37,909 --> 00:23:36,240
consciousness

712
00:23:38,950 --> 00:23:37,919
and later we changed to the science of

713
00:23:39,909 --> 00:23:38,960

consciousness so we've been doing that

714

00:23:42,549 --> 00:23:39,919

every year

715

00:23:44,470 --> 00:23:42,559

either in tucson or elsewhere since 94.

716

00:23:46,630 --> 00:23:44,480

so he's the first one he's been back to

717

00:23:48,390 --> 00:23:46,640

probably five or six of them was it the

718

00:23:49,350 --> 00:23:48,400

first one that 28 year old david

719

00:23:51,830 --> 00:23:49,360

chalmers was there

720

00:23:53,190 --> 00:23:51,840

and you went on a hike yeah david

721

00:23:56,149 --> 00:23:53,200

chalmers and his famous talk

722

00:23:57,350 --> 00:23:56,159

yes uh so let me tell you since you

723

00:23:58,149 --> 00:23:57,360

mentioned it i'll tell you the story

724

00:24:00,390 --> 00:23:58,159

about that

725

00:24:01,830 --> 00:24:00,400

so i was i was the main organizer i got

726

00:24:03,909 --> 00:24:01,840

uh al cassini

727

00:24:05,269 --> 00:24:03,919

my friend for psychology and alex l

728

00:24:08,310 --> 00:24:05,279

scott from mathematics

729

00:24:09,909 --> 00:24:08,320

to organize it and uh

730

00:24:12,470 --> 00:24:09,919

the internet had just happened so we had

731

00:24:14,470 --> 00:24:12,480

email but most of the correspondence was

732

00:24:18,310 --> 00:24:14,480

by fax and this and that

733

00:24:20,070 --> 00:24:18,320

and the idea at the time was to have the

734

00:24:21,430 --> 00:24:20,080

first day on philosophy the second day

735

00:24:22,549 --> 00:24:21,440

on neuroscience the third day in

736

00:24:24,470 --> 00:24:22,559

cognitive science

737

00:24:26,230 --> 00:24:24,480

the fourth day on math and physics and

738

00:24:28,630 --> 00:24:26,240

biology and the fifth day on phenomenal

739

00:24:29,830 --> 00:24:28,640

experience which in retrospect was a

740

00:24:31,110 --> 00:24:29,840

huge mistake

741

00:24:33,190 --> 00:24:31,120

because what you really want to do is

742

00:24:33,830 --> 00:24:33,200

integrate you know different different

743

00:24:35,990 --> 00:24:33,840

approaches

744

00:24:37,430 --> 00:24:36,000

on a given topic i see it i think but

745

00:24:39,990 --> 00:24:37,440

that's so that's the way uh

746

00:24:41,750 --> 00:24:40,000

you know out of naivete we set it up so

747

00:24:43,190 --> 00:24:41,760

the first morning was philosophy and the

748

00:24:44,630 --> 00:24:43,200

first two speakers were well-known

749

00:24:47,510 --> 00:24:44,640

philosophers

750

00:24:49,029 --> 00:24:47,520

who got up and and uh literally read

751
00:24:51,590 --> 00:24:49,039
their talks

752
00:24:53,590 --> 00:24:51,600
their papers with no slides and that's

753
00:24:55,029 --> 00:24:53,600
that's what philosophers did back then

754
00:24:57,190 --> 00:24:55,039
some of them still do but they've come a

755
00:24:59,990 --> 00:24:57,200
long way and uh

756
00:25:02,390 --> 00:25:00,000
and and after the first two talks

757
00:25:03,909 --> 00:25:02,400
everybody in the audience is

758
00:25:05,190 --> 00:25:03,919
they're going to sleep they're like

759
00:25:06,549 --> 00:25:05,200
totally you know the energy the

760
00:25:08,230 --> 00:25:06,559
philosophers dug it but everybody else

761
00:25:10,789 --> 00:25:08,240
was like what the hell

762
00:25:11,669 --> 00:25:10,799
but then the third talk was was chalmers

763
00:25:14,549 --> 00:25:11,679

and he was

764

00:25:15,669 --> 00:25:14,559

an unknown postdoc who had kind of

765

00:25:18,710 --> 00:25:15,679

lobbied me by

766

00:25:20,230 --> 00:25:18,720

email to give a plenary talk every it

767

00:25:21,909 --> 00:25:20,240

was either plenty of your posters and he

768

00:25:24,149 --> 00:25:21,919

said i don't give a poster

769

00:25:25,990 --> 00:25:24,159

and his his abstract was about the hard

770

00:25:28,390 --> 00:25:26,000

problem versus the easy problems

771

00:25:29,510 --> 00:25:28,400

and problems i said okay what the heck

772

00:25:32,630 --> 00:25:29,520

so he

773

00:25:33,430 --> 00:25:32,640

he was the unknown third speaker and so

774

00:25:35,909 --> 00:25:33,440

he got up

775

00:25:36,630 --> 00:25:35,919

and uh woke everybody up out of their

776

00:25:38,789 --> 00:25:36,640

stupor

777

00:25:39,909 --> 00:25:38,799

uh because he gave a great talk exciting

778

00:25:41,669 --> 00:25:39,919

talk

779

00:25:44,630 --> 00:25:41,679

he you know was hit he had hair down at

780

00:25:46,950 --> 00:25:44,640

his waist and strutted back and forth

781

00:25:48,549 --> 00:25:46,960

with an australian accent you know kind

782

00:25:50,870 --> 00:25:48,559

of looking like mick jagger

783

00:25:52,149 --> 00:25:50,880

prancing back and forth saying yeah

784

00:25:53,830 --> 00:25:52,159

memory attention

785

00:25:55,590 --> 00:25:53,840

all this they're difficult but they're

786

00:25:55,990 --> 00:25:55,600

relatively easy compared to why we have

787

00:25:58,310 --> 00:25:56,000

conscious

788

00:26:00,310 --> 00:25:58,320

experience well we have qualia so he

789

00:26:01,510 --> 00:26:00,320

just went off on the hard problem

790

00:26:03,350 --> 00:26:01,520

and was that the first time he

791

00:26:06,630 --> 00:26:03,360

introduced it publicly

792

00:26:08,710 --> 00:26:06,640

yes yes and uh

793

00:26:09,990 --> 00:26:08,720

so after after his talk was the coffee

794

00:26:11,510 --> 00:26:10,000

break and i went around like

795

00:26:13,350 --> 00:26:11,520

a playwright on broadway you know

796

00:26:14,710 --> 00:26:13,360

listening in and people go oh the hard

797

00:26:15,430 --> 00:26:14,720

problem the hard problem that's why

798

00:26:17,669 --> 00:26:15,440

we're here

799

00:26:19,350 --> 00:26:17,679

and he really galvanized the movement so

800

00:26:21,110 --> 00:26:19,360

from that point on i think there was a

801
00:26:22,789 --> 00:26:21,120
a kind of a unified field of

802
00:26:24,789 --> 00:26:22,799
consciousness studies

803
00:26:26,149 --> 00:26:24,799
uh from that that talk on and we became

804
00:26:29,669 --> 00:26:26,159
good friends afterwards and he

805
00:26:31,110 --> 00:26:29,679
uh dave uh tagged along to the grand

806
00:26:31,750 --> 00:26:31,120
canyon with roger and a bunch of other

807
00:26:33,990 --> 00:26:31,760
people

808
00:26:34,870 --> 00:26:34,000
and um you know we've been friends ever

809
00:26:36,310 --> 00:26:34,880
since

810
00:26:38,870 --> 00:26:36,320
how has your theory of consciousness

811
00:26:40,870 --> 00:26:38,880
been modified by penrose

812
00:26:42,390 --> 00:26:40,880
well my theory was just a more com

813
00:26:44,390 --> 00:26:42,400

computational

814

00:26:46,950 --> 00:26:44,400

some would say ad nauseam you know more

815

00:26:49,830 --> 00:26:46,960

more complication at a deeper level

816

00:26:51,590 --> 00:26:49,840

so it was hierarchical and it was at a

817

00:26:51,990 --> 00:26:51,600

molecular level but it didn't it didn't

818

00:26:53,590 --> 00:26:52,000

utilize

819

00:26:55,350 --> 00:26:53,600

the quantum i knew about frolic but i

820

00:26:57,110 --> 00:26:55,360

didn't really and i said yeah and that

821

00:26:58,630 --> 00:26:57,120

gives you unified coherence which

822

00:27:00,710 --> 00:26:58,640

consciousness had

823

00:27:01,669 --> 00:27:00,720

but uh it wasn't quantified in any way

824

00:27:06,710 --> 00:27:01,679

so roger

825

00:27:08,390 --> 00:27:06,720

uh uh you know when we uh when we met

826

00:27:10,230 --> 00:27:08,400

and said you know we can kind of put

827

00:27:13,830 --> 00:27:10,240

this together in a theory

828

00:27:16,710 --> 00:27:13,840

and he said yeah well uh so he handed me

829

00:27:18,549 --> 00:27:16,720

uh in a quick actually a couple couple

830

00:27:20,149 --> 00:27:18,559

weeks afterwards or maybe a month later

831

00:27:21,990 --> 00:27:20,159

we met up again in denmark

832

00:27:24,230 --> 00:27:22,000

a long story but i had a couple weeks

833

00:27:25,669 --> 00:27:24,240

off and i took my son and we we hung out

834

00:27:27,990 --> 00:27:25,679

in denmark where i had done my

835

00:27:29,830 --> 00:27:28,000

my sabbatical where roger and vanessa

836

00:27:31,510 --> 00:27:29,840

also hung out because

837

00:27:32,950 --> 00:27:31,520

strange story their dentist was there

838

00:27:34,950 --> 00:27:32,960

from years ago they used to go there and

839

00:27:37,029 --> 00:27:34,960

see their dentist and hang out in

840

00:27:38,470 --> 00:27:37,039

in denmark and uh there was a conference

841

00:27:40,230 --> 00:27:38,480

and i got roger invited the conference

842

00:27:41,029 --> 00:27:40,240

so we stayed at a house together on lake

843

00:27:43,750 --> 00:27:41,039

lumbee

844

00:27:45,510 --> 00:27:43,760

and uh and began to develop a theory and

845

00:27:48,070 --> 00:27:45,520

he would give me kind of an assignment

846

00:27:49,750 --> 00:27:48,080

and uh you know i felt like a student

847

00:27:51,510 --> 00:27:49,760

which i was really in terms of physics

848

00:27:54,230 --> 00:27:51,520

and math and i'd you know

849

00:27:55,830 --> 00:27:54,240

stay up late and do this algebra

850

00:27:57,350 --> 00:27:55,840

basically and come back with an answer

851
00:27:57,750 --> 00:27:57,360
he's okay so now we have to do this and

852
00:27:59,510 --> 00:27:57,760
that

853
00:28:01,269 --> 00:27:59,520
what was an example of one of those

854
00:28:04,389 --> 00:28:01,279
exercises was it related to t

855
00:28:05,350 --> 00:28:04,399
equals \hbar over e and calculating yeah

856
00:28:09,430 --> 00:28:05,360
it was almost all

857
00:28:12,710 --> 00:28:09,440
related to to that so roger had given me

858
00:28:14,710 --> 00:28:12,720
that equation going back to the to when

859
00:28:16,310 --> 00:28:14,720
he was in tucson for the uh the

860
00:28:17,269 --> 00:28:16,320
conference i said well how do we

861
00:28:19,269 --> 00:28:17,279
quantify that

862
00:28:21,029 --> 00:28:19,279
and he said well we have to we have to

863
00:28:24,310 --> 00:28:21,039

put the uh

864

00:28:25,430 --> 00:28:24,320

we have to put microtubules into this

865

00:28:28,870 --> 00:28:25,440

equation

866

00:28:31,909 --> 00:28:28,880

uh t equals uh h bar over e sub g

867

00:28:32,230 --> 00:28:31,919

and uh i said okay well how do we do

868

00:28:35,430 --> 00:28:32,240

that

869

00:28:36,789 --> 00:28:35,440

collapse would occur

870

00:28:38,230 --> 00:28:36,799

and i thought that we would have to

871

00:28:40,630 --> 00:28:38,240

relate that some way to something in the

872

00:28:42,389 --> 00:28:40,640

brain like 40 hertz oscillations

873

00:28:44,230 --> 00:28:42,399

back then gamma synchrony 40 hertz

874

00:28:47,110 --> 00:28:44,240

oscillations was the big thing

875

00:28:48,389 --> 00:28:47,120

so uh when you had coherent 40 hertz geg

876

00:28:50,470 --> 00:28:48,399

you had consciousness that's

877

00:28:52,149 --> 00:28:50,480

that's and regarding these oscillations

878

00:28:53,510 --> 00:28:52,159

is it just that the neurons are firing

879

00:28:56,149 --> 00:28:53,520

at the same time

880

00:28:57,669 --> 00:28:56,159

40 000 times a second no this is 40

881

00:28:59,430 --> 00:28:57,679

hertz just 40 times a second

882

00:29:00,870 --> 00:28:59,440

but it's not firing it's not firing

883

00:29:02,870 --> 00:29:00,880

actually that's that's one of the uh

884

00:29:05,909 --> 00:29:02,880

that's one of the problems people

885

00:29:06,549 --> 00:29:05,919

uh say that but neurons you take one

886

00:29:08,950 --> 00:29:06,559

neuron

887

00:29:10,470 --> 00:29:08,960

it's integrate and fire it's the basic

888

00:29:12,070 --> 00:29:10,480

hodgkin huxley neuron

889

00:29:15,029 --> 00:29:12,080

so you have the dendrites and soma that

890

00:29:18,070 --> 00:29:15,039

receive inputs from the synapses

891

00:29:21,430 --> 00:29:18,080

and and the story goes that

892

00:29:23,269 --> 00:29:21,440

strictly by membrane potentials uh these

893

00:29:25,510 --> 00:29:23,279

thresholds are integrated these

894

00:29:27,110 --> 00:29:25,520

potentials are integrated to a threshold

895

00:29:28,549 --> 00:29:27,120

at what was called the axon hillock

896

00:29:30,470 --> 00:29:28,559

where the axon begins or now it's called

897

00:29:32,470 --> 00:29:30,480

the axon initiation segment

898

00:29:33,669 --> 00:29:32,480

and if if the threshold is met there'll

899

00:29:36,710 --> 00:29:33,679

be a firing

900

00:29:38,470 --> 00:29:36,720

and the axon would depolarize and

901
00:29:40,549 --> 00:29:38,480
you get the signal down to the next

902
00:29:42,710 --> 00:29:40,559
synapse whatever that may be

903
00:29:44,549 --> 00:29:42,720
and uh because it was an all or none if

904
00:29:47,190 --> 00:29:44,559
it fired it fired

905
00:29:47,750 --> 00:29:47,200
that was considered the the the binary

906
00:29:50,470 --> 00:29:47,760
the bit

907
00:29:51,029 --> 00:29:50,480
the fundamental unit of firing but

908
00:29:53,269 --> 00:29:51,039
actually

909
00:29:54,950 --> 00:29:53,279
eeg comes mostly from local field

910
00:29:55,750 --> 00:29:54,960
potentials which come from the dendrites

911
00:29:57,190 --> 00:29:55,760
in the soma

912
00:29:59,750 --> 00:29:57,200
from the integration phase from the

913
00:30:01,110 --> 00:29:59,760

integrate and fire in the hodgkin huxley

914

00:30:03,269 --> 00:30:01,120

not not the firing

915

00:30:05,190 --> 00:30:03,279

but it's more convenient for ai and for

916

00:30:07,750 --> 00:30:05,200

neuroscientists to consider

917

00:30:09,830 --> 00:30:07,760

bits to consider firings to be the bits

918

00:30:13,029 --> 00:30:09,840

it fits better with the computer uh

919

00:30:15,590 --> 00:30:13,039

analogy and uh and so people say that

920

00:30:16,070 --> 00:30:15,600

in fact christophe koch and crick and

921

00:30:17,750 --> 00:30:16,080

coke

922

00:30:20,549 --> 00:30:17,760

francis crick and christoph koch back

923

00:30:22,310 --> 00:30:20,559

then in in 90 actually came out the idea

924

00:30:23,590 --> 00:30:22,320

that 40 hertz was the

925

00:30:25,350 --> 00:30:23,600

was the neural correlate of

926
00:30:28,070 --> 00:30:25,360
consciousness but

927
00:30:29,430 --> 00:30:28,080
they were they were also uh committed to

928
00:30:31,350 --> 00:30:29,440
the idea that spikes

929
00:30:32,470 --> 00:30:31,360
firings were they were the currency of

930
00:30:34,789 --> 00:30:32,480
consciousness

931
00:30:35,669 --> 00:30:34,799
so when it was realized that uh that it

932
00:30:38,630 --> 00:30:35,679
was um

933
00:30:40,310 --> 00:30:38,640
that that firings that eeg came from the

934
00:30:41,029 --> 00:30:40,320
local field potentials on the dendritic

935
00:30:43,669 --> 00:30:41,039
side

936
00:30:45,190 --> 00:30:43,679
uh from integration not the firings they

937
00:30:46,470 --> 00:30:45,200
dropped 40 hertz they said well it can't

938
00:30:48,230 --> 00:30:46,480

be in other words they had to choose

939

00:30:49,990 --> 00:30:48,240

between firings

940

00:30:52,470 --> 00:30:50,000

and 40 hertz as the neural coral of

941

00:30:54,149 --> 00:30:52,480

consciousness and they went with firings

942

00:30:54,950 --> 00:30:54,159

and spikes and dropped the 40 hertz i

943

00:30:57,590 --> 00:30:54,960

think that was

944

00:30:58,870 --> 00:30:57,600

a big mistake but in any case it was it

945

00:31:00,310 --> 00:30:58,880

was 40 yards but

946

00:31:02,070 --> 00:31:00,320

so we were we were thinking well we had

947

00:31:04,310 --> 00:31:02,080

to maintain the quantum coherence state

948

00:31:05,509 --> 00:31:04,320

for 25 milliseconds to get 40 hertz 40

949

00:31:07,190 --> 00:31:05,519

times a second

950

00:31:08,950 --> 00:31:07,200

and in retrospect that was a mistake on

951
00:31:11,509 --> 00:31:08,960
our part because um

952
00:31:12,950 --> 00:31:11,519
that's way too long for a quantum state

953
00:31:14,710 --> 00:31:12,960
we thought well you could do it

954
00:31:16,870 --> 00:31:14,720
you know nature figured it out and so

955
00:31:19,990 --> 00:31:16,880
forth but it was really

956
00:31:22,630 --> 00:31:20,000
uh you don't need that it turns out

957
00:31:23,750 --> 00:31:22,640
um to make the long well i'll i'll come

958
00:31:26,789 --> 00:31:23,760
back to that point but

959
00:31:27,590 --> 00:31:26,799
but going back to the uh to quantifying

960
00:31:31,269 --> 00:31:27,600
this

961
00:31:31,990 --> 00:31:31,279
by uh t equals \hbar over e sub g or e

962
00:31:34,549 --> 00:31:32,000
sub g equals

963
00:31:35,350 --> 00:31:34,559

h bar over t the same thing to relate

964

00:31:38,310 --> 00:31:35,360

the time

965

00:31:38,950 --> 00:31:38,320

to the e sub g so what is the e sub g so

966

00:31:41,750 --> 00:31:38,960

e sub g

967

00:31:42,630 --> 00:31:41,760

is the amount of mass in superposition

968

00:31:45,110 --> 00:31:42,640

the amount of mass

969

00:31:47,190 --> 00:31:45,120

separated from itself and when that meat

970

00:31:48,950 --> 00:31:47,200

reaches the threshold

971

00:31:50,710 --> 00:31:48,960

at a time t or if you can sustain that

972

00:31:51,430 --> 00:31:50,720

until time t you'll have a moment of

973

00:31:54,149 --> 00:31:51,440

consciousness

974

00:31:55,269 --> 00:31:54,159

the amount of mass of what well of

975

00:31:56,389 --> 00:31:55,279

anything but in this case of

976

00:31:59,669 --> 00:31:56,399

microtubules

977

00:32:00,070 --> 00:31:59,679

of micro of tubulin and uh and that's

978

00:32:02,630 --> 00:32:00,080

another

979

00:32:03,990 --> 00:32:02,640

good question so uh if you start with it

980

00:32:06,070 --> 00:32:04,000

with with a protein

981

00:32:07,909 --> 00:32:06,080

it's got all these atoms and rings and

982

00:32:11,029 --> 00:32:07,919

electrons and protons and

983

00:32:11,909 --> 00:32:11,039

this and that so but all the mass is in

984

00:32:14,710 --> 00:32:11,919

the nuclei

985

00:32:15,669 --> 00:32:14,720

you know the electrons so basically the

986

00:32:19,110 --> 00:32:15,679

the electrons

987

00:32:21,190 --> 00:32:19,120

uh uh have all the the uh cool electron

988

00:32:22,950 --> 00:32:21,200

dipole oscillations and quantum stuff

989

00:32:25,110 --> 00:32:22,960

that anesthesia comes in and blocks and

990

00:32:26,710 --> 00:32:25,120

that causes loss of consciousness

991

00:32:28,149 --> 00:32:26,720

but if you just look at the electrons

992

00:32:29,590 --> 00:32:28,159

the mass was too low to get a

993

00:32:31,590 --> 00:32:29,600

significant e sub g

994

00:32:33,269 --> 00:32:31,600

so you have to displace the nuclei to

995

00:32:36,149 --> 00:32:33,279

get sufficient e sub g

996

00:32:37,110 --> 00:32:36,159

the the electrons what a thousandth the

997

00:32:40,310 --> 00:32:37,120

uh

998

00:32:43,110 --> 00:32:40,320

the the the mass of a

999

00:32:44,710 --> 00:32:43,120

of a nucleus for example so we said okay

1000

00:32:47,430 --> 00:32:44,720

we got to deal with the nuclei

1001
00:32:49,430 --> 00:32:47,440
but then the nuclei or okay we have to

1002
00:32:51,190 --> 00:32:49,440
deal with the superposition of a protein

1003
00:32:52,549 --> 00:32:51,200
so roger gave me this assignment he said

1004
00:32:54,630 --> 00:32:52,559
you can look at it three ways

1005
00:32:55,990 --> 00:32:54,640
you can look at the protein being

1006
00:32:58,470 --> 00:32:56,000
separated from itself

1007
00:32:59,990 --> 00:32:58,480
partially by let's say ten percent of

1008
00:33:02,549 --> 00:33:00,000
its mass

1009
00:33:03,669 --> 00:33:02,559
so uh it ten percent ten percent is just

1010
00:33:04,950 --> 00:33:03,679
an example right now or

1011
00:33:07,190 --> 00:33:04,960
he well that's when we use the

1012
00:33:08,470 --> 00:33:07,200
calculation okay because we're initially

1013
00:33:09,990 --> 00:33:08,480

we're thinking of a conformational

1014

00:33:11,110 --> 00:33:10,000

change open and close open and close

1015

00:33:13,029 --> 00:33:11,120

the difference what you're doing right

1016

00:33:15,190 --> 00:33:13,039

now with your hands is that the tubulin

1017

00:33:16,950 --> 00:33:15,200

flexing yes okay we thought there had to

1018

00:33:18,310 --> 00:33:16,960

be a conformational change

1019

00:33:20,630 --> 00:33:18,320

it turns out you don't need that but

1020

00:33:22,310 --> 00:33:20,640

that was the original thought

1021

00:33:24,710 --> 00:33:22,320

and the difference in the flux is about

1022

00:33:27,669 --> 00:33:24,720

10 so we calculated the

1023

00:33:29,190 --> 00:33:27,679

the e sub g uh of a protein separated

1024

00:33:30,630 --> 00:33:29,200

from itself by ten percent of its

1025

00:33:32,310 --> 00:33:30,640

diameter

1026

00:33:33,669 --> 00:33:32,320

and he said okay you do it that way and

1027

00:33:35,350 --> 00:33:33,679

he gave me this this formula these

1028

00:33:38,310 --> 00:33:35,360

formulas basically algebra

1029

00:33:40,149 --> 00:33:38,320

and which i was able to do and he said

1030

00:33:42,950 --> 00:33:40,159

we also have to do it at the level of

1031

00:33:43,909 --> 00:33:42,960

the nucleus take the atomic nucleus of

1032

00:33:46,230 --> 00:33:43,919

each atom

1033

00:33:47,909 --> 00:33:46,240

uh so you have an electron out here but

1034

00:33:50,549 --> 00:33:47,919

the nucleus is here

1035

00:33:51,110 --> 00:33:50,559

and the nucleus can be separated from

1036

00:33:53,350 --> 00:33:51,120

itself

1037

00:33:54,950 --> 00:33:53,360

by its diameter so instead of being one

1038

00:33:56,470 --> 00:33:54,960

sphere it'd be two spheres

1039

00:33:58,470 --> 00:33:56,480

literally next to each you have complete

1040

00:34:00,710 --> 00:33:58,480

separation so that gives a different

1041

00:34:02,549 --> 00:34:00,720

different type of equation than partial

1042

00:34:05,509 --> 00:34:02,559

separation so that was two so it was

1043

00:34:06,070 --> 00:34:05,519

the protein by 10 partial separation the

1044

00:34:08,550 --> 00:34:06,080

new the

1045

00:34:09,270 --> 00:34:08,560

all those nuclei within the protein 110

1046

00:34:12,790 --> 00:34:09,280

000

1047

00:34:16,149 --> 00:34:12,800

uh atomic weight separated

1048

00:34:17,669 --> 00:34:16,159

by their diameter and the third way was

1049

00:34:21,030 --> 00:34:17,679

going even smaller

1050

00:34:23,829 --> 00:34:21,040

to the protons and neutrons the nucleons

1051

00:34:24,869 --> 00:34:23,839

separated from themselves so he gave me

1052

00:34:28,069 --> 00:34:24,879

the equations

1053

00:34:29,669 --> 00:34:28,079

and uh and i spent some time you know

1054

00:34:32,389 --> 00:34:29,679

doing the calculations

1055

00:34:33,909 --> 00:34:32,399

and came up with the result that

1056

00:34:35,109 --> 00:34:33,919

separation the level of the atomic

1057

00:34:36,629 --> 00:34:35,119

nuclei

1058

00:34:38,149 --> 00:34:36,639

was the dominant effect gave you the

1059

00:34:41,829 --> 00:34:38,159

highest energy and would

1060

00:34:43,909 --> 00:34:41,839

occur before the others so we knew so

1061

00:34:45,190 --> 00:34:43,919

we knew how to calculate for the

1062

00:34:46,550 --> 00:34:45,200

superposition

1063

00:34:48,950 --> 00:34:46,560

and then you just multiply that by the

1064

00:34:52,149 --> 00:34:48,960

number of nuclei and we get the

1065

00:34:53,510 --> 00:34:52,159

the uh the e sub g for a tubulin protein

1066

00:34:55,270 --> 00:34:53,520

yeah when you're talking about the

1067

00:34:57,750 --> 00:34:55,280

atomic nuclei is that

1068

00:34:59,589 --> 00:34:57,760

okay the proteins are made up of well

1069

00:35:01,190 --> 00:34:59,599

mostly carbon we use carbon

1070

00:35:02,950 --> 00:35:01,200

you know it's mostly carbon carbon

1071

00:35:04,790 --> 00:35:02,960

chemistry but you know there's

1072

00:35:05,430 --> 00:35:04,800

phosphorus there's oxygen there's other

1073

00:35:07,910 --> 00:35:05,440

stuff but

1074

00:35:08,870 --> 00:35:07,920

but basically we we used we calculated

1075

00:35:10,310 --> 00:35:08,880

based on carbon

1076
00:35:12,470 --> 00:35:10,320
because the vast majority of the nuclei

1077
00:35:13,190 --> 00:35:12,480
are carbon why do you want the energy to

1078
00:35:16,310 --> 00:35:13,200
be high

1079
00:35:19,190 --> 00:35:16,320
because t equals \hbar over e so

1080
00:35:20,630 --> 00:35:19,200
high e would make a lower t and don't

1081
00:35:21,430 --> 00:35:20,640
you want the t to last for quite some

1082
00:35:23,190 --> 00:35:21,440
time

1083
00:35:24,470 --> 00:35:23,200
you do but you got to go with you know

1084
00:35:27,030 --> 00:35:24,480
with what nature gives you

1085
00:35:28,310 --> 00:35:27,040
and and the the dot the high energy is

1086
00:35:28,870 --> 00:35:28,320
going to be the dominant effect it's

1087
00:35:30,150 --> 00:35:28,880
going to happen

1088
00:35:32,390 --> 00:35:30,160

first so that's going to trigger the

1089

00:35:33,109 --> 00:35:32,400

collapse before the other effects you

1090

00:35:34,710 --> 00:35:33,119

know

1091

00:35:36,230 --> 00:35:34,720

if you avoided that it might collapse

1092

00:35:38,069 --> 00:35:36,240

from the the separation of the whole

1093

00:35:39,349 --> 00:35:38,079

protein or separation of the nucleons

1094

00:35:41,670 --> 00:35:39,359

but the separation of the nuclei is

1095

00:35:42,390 --> 00:35:41,680

going to happen first and and and that's

1096

00:35:44,790 --> 00:35:42,400

going to that's

1097

00:35:46,630 --> 00:35:44,800

what's going to you know rule the what's

1098

00:35:48,550 --> 00:35:46,640

going on so you had to deal with that

1099

00:35:50,310 --> 00:35:48,560

so that was the first thing we learned

1100

00:35:53,670 --> 00:35:50,320

so the next question was

1101

00:35:57,030 --> 00:35:53,680

okay let's say that's right uh how many

1102

00:36:00,870 --> 00:35:57,040

uh how many um

1103

00:36:03,190 --> 00:36:00,880

how many tubulins how many microtubules

1104

00:36:04,310 --> 00:36:03,200

uh would you need to have a

1105

00:36:06,710 --> 00:36:04,320

superposition

1106

00:36:07,589 --> 00:36:06,720

for t so what would the e sub g a number

1107

00:36:10,230 --> 00:36:07,599

of tubulins

1108

00:36:11,990 --> 00:36:10,240

be to have a t equal 25 milliseconds

1109

00:36:13,670 --> 00:36:12,000

which is what we thought probably needed

1110

00:36:15,349 --> 00:36:13,680

and it turns out it's a pretty small

1111

00:36:18,069 --> 00:36:15,359

number it's only like i forget

1112

00:36:19,190 --> 00:36:18,079

20 20 neurons worth if all the neurons

1113

00:36:21,990 --> 00:36:19,200

in one microtubule

1114

00:36:24,150 --> 00:36:22,000

if all the if all the microtubules in

1115

00:36:26,230 --> 00:36:24,160

one neuron were in superposition

1116

00:36:27,190 --> 00:36:26,240

you would only need and because t is a

1117

00:36:31,270 --> 00:36:27,200

long time

1118

00:36:34,150 --> 00:36:31,280

uh you don't need

1119

00:36:35,190 --> 00:36:34,160

very much e sub g but you have to avoid

1120

00:36:36,550 --> 00:36:35,200

decoherence

1121

00:36:38,630 --> 00:36:36,560

for a long time but we weren't

1122

00:36:39,510 --> 00:36:38,640

considering that yet we're putting that

1123

00:36:41,589 --> 00:36:39,520

aside

1124

00:36:42,550 --> 00:36:41,599

so for 25 milliseconds you only needed a

1125

00:36:45,109 --> 00:36:42,560

few uh

1126
00:36:46,950 --> 00:36:45,119
like 20 neurons worth so we thought well

1127
00:36:47,510 --> 00:36:46,960
maybe only a fraction of the turbulence

1128
00:36:49,750 --> 00:36:47,520
are involved

1129
00:36:51,109 --> 00:36:49,760
but that seemed kind of that's seemed

1130
00:36:54,069 --> 00:36:51,119
kind of odd

1131
00:36:55,750 --> 00:36:54,079
um later we realized actually and

1132
00:36:57,990 --> 00:36:55,760
several people suggested this

1133
00:37:00,069 --> 00:36:58,000
to us that you know you don't really

1134
00:37:01,589 --> 00:37:00,079
need these the quantum state to last 25

1135
00:37:04,630 --> 00:37:01,599
milliseconds to have 25

1136
00:37:06,310 --> 00:37:04,640
millisecond events in the brain and much

1137
00:37:08,790 --> 00:37:06,320
later we came around to the

1138
00:37:09,829 --> 00:37:08,800

to the idea that the the quantum

1139

00:37:13,190 --> 00:37:09,839

superpositions

1140

00:37:14,710 --> 00:37:13,200

involve much more of the brain much more

1141

00:37:16,790 --> 00:37:14,720

tubulin

1142

00:37:18,390 --> 00:37:16,800

for a much shorter time so because it's

1143

00:37:22,150 --> 00:37:18,400

inversely related

1144

00:37:25,910 --> 00:37:22,160

so um basically for example if

1145

00:37:29,349 --> 00:37:25,920

uh if you say that there are uh

1146

00:37:31,109 --> 00:37:29,359

um 10 to the 10th uh

1147

00:37:33,109 --> 00:37:31,119

so there's about 10 bananas at 10 of the

1148

00:37:36,550 --> 00:37:33,119

eighth turbulence per neuron

1149

00:37:39,670 --> 00:37:36,560

and if if uh if you have the uh

1150

00:37:43,510 --> 00:37:39,680

the t not be 25 milliseconds but be

1151
00:37:45,270 --> 00:37:43,520
say 10 megahertz a tenth of a millionth

1152
00:37:47,910 --> 00:37:45,280
of a second

1153
00:37:48,550 --> 00:37:47,920
then you need a much larger amount of

1154
00:37:50,630 --> 00:37:48,560
tubulin

1155
00:37:53,190 --> 00:37:50,640
much larger number of microtubules much

1156
00:37:56,310 --> 00:37:53,200
larger proportion of the brain

1157
00:37:57,910 --> 00:37:56,320
is still small so for example for 10

1158
00:37:59,190 --> 00:37:57,920
megahertz for oscillation for these

1159
00:38:00,710 --> 00:37:59,200
quantum events to be happening 10

1160
00:38:03,430 --> 00:38:00,720
million times a second

1161
00:38:05,589 --> 00:38:03,440
you need about 10 to the minus fifth of

1162
00:38:08,870 --> 00:38:05,599
the total tubulins in the brain

1163
00:38:11,990 --> 00:38:08,880

which was uh billions and uh uh

1164

00:38:12,790 --> 00:38:12,000

well i forget millions and millions of

1165

00:38:14,310 --> 00:38:12,800

neurons

1166

00:38:16,310 --> 00:38:14,320

i have to go back and look it up but

1167

00:38:18,390 --> 00:38:16,320

it's it's a much more reasonable number

1168

00:38:19,510 --> 00:38:18,400

than just 20.

1169

00:38:21,510 --> 00:38:19,520

if i understand what you're saying is

1170

00:38:23,109 --> 00:38:21,520

that we need you know how some people

1171

00:38:24,390 --> 00:38:23,119

say we only use one percent of the brain

1172

00:38:26,310 --> 00:38:24,400

what you're suggesting that's probably

1173

00:38:29,750 --> 00:38:26,320

true actually for consciousness

1174

00:38:31,829 --> 00:38:29,760

but it's not the same one percent yes

1175

00:38:33,270 --> 00:38:31,839

this could be here and then it's here it

1176

00:38:33,990 --> 00:38:33,280

actually can quite literally move around

1177

00:38:35,670 --> 00:38:34,000

the brain

1178

00:38:37,109 --> 00:38:35,680

right so you may use only one percent at

1179

00:38:38,870 --> 00:38:37,119

one time but over

1180

00:38:41,510 --> 00:38:38,880

your lifetime or even maybe a day you're

1181

00:38:44,630 --> 00:38:41,520

using most of it if not all of it

1182

00:38:46,470 --> 00:38:44,640

right and if you were to use more that's

1183

00:38:48,069 --> 00:38:46,480

well if you were to use 100 that's

1184

00:38:48,470 --> 00:38:48,079

categorized as a seizure and it's not

1185

00:38:51,190 --> 00:38:48,480

actually

1186

00:38:52,230 --> 00:38:51,200

salutary well seizures are bad and

1187

00:38:55,109 --> 00:38:52,240

seizures are

1188

00:38:55,990 --> 00:38:55,119

when all the the spikes the firings are

1189

00:38:58,150 --> 00:38:56,000

coordinated

1190

00:39:00,069 --> 00:38:58,160

and that's not conscious so that's

1191

00:39:01,910 --> 00:39:00,079

that's uh that's a pathology that's

1192

00:39:03,270 --> 00:39:01,920

that's when the all the neurons are

1193

00:39:04,790 --> 00:39:03,280

firing it's unclear what's

1194

00:39:06,550 --> 00:39:04,800

actually happening in the integration

1195

00:39:08,790 --> 00:39:06,560

side uh

1196

00:39:10,310 --> 00:39:08,800

but i think yeah but but that's that's

1197

00:39:12,310 --> 00:39:10,320

not really the same thing but

1198

00:39:13,990 --> 00:39:12,320

but basically we did make a relationship

1199

00:39:15,270 --> 00:39:14,000

between the not between the fraction of

1200

00:39:16,710 --> 00:39:15,280

the brain the number of tubulins

1201
00:39:18,870 --> 00:39:16,720
involved

1202
00:39:20,310 --> 00:39:18,880
the the the frequency and the intensity

1203
00:39:23,030 --> 00:39:20,320
of experience

1204
00:39:24,710 --> 00:39:23,040
and we based that on on a couple things

1205
00:39:29,030 --> 00:39:24,720
extrapolated for example

1206
00:39:32,150 --> 00:39:29,040
uh meditators uh trained meditators have

1207
00:39:33,190 --> 00:39:32,160
really high eeg compared to uh normal

1208
00:39:36,310 --> 00:39:33,200
people

1209
00:39:38,870 --> 00:39:36,320
and uh and as a baseline or when they're

1210
00:39:40,310 --> 00:39:38,880
baseline and when they meditate both and

1211
00:39:42,470 --> 00:39:40,320
this was done in uh

1212
00:39:43,670 --> 00:39:42,480
richard davidson's lab i don't know 15

1213
00:39:45,589 --> 00:39:43,680

20 years ago

1214

00:39:47,109 --> 00:39:45,599
and the dalai lama sent his best

1215

00:39:48,310 --> 00:39:47,119
meditators over and they studied him

1216

00:39:51,349 --> 00:39:48,320
with eeg

1217

00:39:52,550 --> 00:39:51,359
and at baseline uh their i forgot the

1218

00:39:54,150 --> 00:39:52,560
frequent the baseline they were much

1219

00:39:55,510 --> 00:39:54,160
higher and when they meditated they were

1220

00:39:57,990 --> 00:39:55,520
like off the charts

1221

00:39:58,630 --> 00:39:58,000
as an aside what does he use to qualify

1222

00:40:01,829 --> 00:39:58,640
them as a

1223

00:40:04,630 --> 00:40:01,839
as the best meditators that was

1224

00:40:05,109 --> 00:40:04,640
whoever his choice okay i got it i got

1225

00:40:07,430 --> 00:40:05,119
it

1226

00:40:09,109 --> 00:40:07,440

i don't know we'll give him we'll give

1227

00:40:11,990 --> 00:40:09,119

him that he should know

1228

00:40:12,550 --> 00:40:12,000

so uh so based on that eeg gets gets

1229

00:40:14,710 --> 00:40:12,560

higher

1230

00:40:16,069 --> 00:40:14,720

and uh there are some other inklings of

1231

00:40:17,670 --> 00:40:16,079

that you know if

1232

00:40:19,510 --> 00:40:17,680

if you're in a car accident and the car

1233

00:40:21,670 --> 00:40:19,520

is spinning uh

1234

00:40:22,950 --> 00:40:21,680

supposedly the external world slows down

1235

00:40:24,230 --> 00:40:22,960

everything slows down

1236

00:40:26,230 --> 00:40:24,240

and that could be because you're having

1237

00:40:28,390 --> 00:40:26,240

more conscious moments per second

1238

00:40:29,589 --> 00:40:28,400

than you were before the accident

1239

00:40:31,270 --> 00:40:29,599

occurred and

1240

00:40:32,710 --> 00:40:31,280

great athletes like michael jordan said

1241

00:40:34,390 --> 00:40:32,720

when he's playing well

1242

00:40:35,910 --> 00:40:34,400

it's because the other team is in slow

1243

00:40:38,790 --> 00:40:35,920

motion and so

1244

00:40:40,309 --> 00:40:38,800

uh i recall i recall you saying this i

1245

00:40:42,230 --> 00:40:40,319

spoke to a neil seth i'm sure you've

1246

00:40:43,910 --> 00:40:42,240

heard of him yes i know neil yeah

1247

00:40:46,230 --> 00:40:43,920

i asked him about this about the time

1248

00:40:47,589 --> 00:40:46,240

slowing effects and if it is indeed a

1249

00:40:49,589 --> 00:40:47,599

real effect or if it's just your

1250

00:40:51,510 --> 00:40:49,599

perception of time slows down

1251
00:40:53,510 --> 00:40:51,520
and he said what's been done is you

1252
00:40:55,910 --> 00:40:53,520
measure people on bungee jumps

1253
00:40:57,910 --> 00:40:55,920
and you show them perhaps a clock and

1254
00:40:59,430 --> 00:40:57,920
they're not able to recall

1255
00:41:01,190 --> 00:40:59,440
milliseconds at a higher rate than

1256
00:41:03,109 --> 00:41:01,200
people who are not under the bungee

1257
00:41:04,470 --> 00:41:03,119
yeah you know i know that study that's

1258
00:41:08,550 --> 00:41:04,480
david eagleman's study

1259
00:41:10,630 --> 00:41:08,560
and it's it was kind of a it was like uh

1260
00:41:12,710 --> 00:41:10,640
i don't know i'm not sure i believe it i

1261
00:41:13,910 --> 00:41:12,720
don't think so just a few minor studies

1262
00:41:15,990 --> 00:41:13,920
that haven't decisively

1263
00:41:17,190 --> 00:41:16,000

made the case okay continue we don't

1264

00:41:20,230 --> 00:41:17,200

really know but

1265

00:41:22,470 --> 00:41:20,240

but it seems to me that consciousness

1266

00:41:23,990 --> 00:41:22,480

the the the intensity of experience is

1267

00:41:25,190 --> 00:41:24,000

related to the frequency of the events

1268

00:41:27,750 --> 00:41:25,200

that you're having

1269

00:41:29,190 --> 00:41:27,760

so if you're if you're excited uh if

1270

00:41:30,550 --> 00:41:29,200

you're in an altered state

1271

00:41:32,309 --> 00:41:30,560

if you're doing something you really

1272

00:41:34,790 --> 00:41:32,319

love uh

1273

00:41:35,430 --> 00:41:34,800

you're having more conscious moments per

1274

00:41:38,470 --> 00:41:35,440

second

1275

00:41:40,470 --> 00:41:38,480

if you can measure it but to you the

1276

00:41:42,390 --> 00:41:40,480

external world slows down

1277

00:41:44,230 --> 00:41:42,400

and when you're on psychedelics it seems

1278

00:41:46,150 --> 00:41:44,240

like the brain isn't

1279

00:41:47,270 --> 00:41:46,160

firing as much or using as many neurons

1280

00:41:49,030 --> 00:41:47,280

is that correct

1281

00:41:51,190 --> 00:41:49,040

that's a very good question yeah so

1282

00:41:55,349 --> 00:41:51,200

that's the study of

1283

00:41:57,510 --> 00:41:55,359

uh robin carhart harris from 2012

1284

00:41:58,790 --> 00:41:57,520

and he presented that at the tucson

1285

00:42:02,470 --> 00:41:58,800

conference

1286

00:42:02,870 --> 00:42:02,480

and uh amazing study um what they did

1287

00:42:05,190 --> 00:42:02,880

was

1288

00:42:07,030 --> 00:42:05,200

they they put people in an mri scanner

1289

00:42:10,470 --> 00:42:07,040

they also did eeg

1290

00:42:13,109 --> 00:42:10,480

so it works for mri but in the

1291

00:42:15,990 --> 00:42:13,119

in the mri scanner and in the eeg they

1292

00:42:17,589 --> 00:42:16,000

then gave them intravenous psilocybin

1293

00:42:19,670 --> 00:42:17,599

which is the active ingredient in magic

1294

00:42:22,150 --> 00:42:19,680

mushrooms psychedelic mushrooms

1295

00:42:24,150 --> 00:42:22,160

and then later you know they they had

1296

00:42:24,790 --> 00:42:24,160

them report what they were experiencing

1297

00:42:29,510 --> 00:42:24,800

at the time

1298

00:42:31,109 --> 00:42:29,520

and later they reported their experience

1299

00:42:32,550 --> 00:42:31,119

and they were all basically having a

1300

00:42:33,589 --> 00:42:32,560

psychedelic experience they're basically

1301

00:42:35,990 --> 00:42:33,599

all tripping

1302

00:42:37,589 --> 00:42:36,000

at the time and in the scanner they kind

1303

00:42:38,390 --> 00:42:37,599

of i think they expected their their

1304

00:42:40,870 --> 00:42:38,400

brains to

1305

00:42:41,750 --> 00:42:40,880

kind of light up like pinball machines

1306

00:42:43,510 --> 00:42:41,760

but they didn't

1307

00:42:46,150 --> 00:42:43,520

their brains look cold and dark like

1308

00:42:48,390 --> 00:42:46,160

they were unconscious almost comatose

1309

00:42:49,829 --> 00:42:48,400

and in the eeg they expected i'm not

1310

00:42:52,870 --> 00:42:49,839

sure what they expected but what they

1311

00:42:57,430 --> 00:42:52,880

got was almost flatline eeg

1312

00:42:58,950 --> 00:42:57,440

and it was it was paradoxical and

1313

00:43:00,710 --> 00:42:58,960

those debate those results are still

1314

00:43:03,270 --> 00:43:00,720

being debated what i think

1315

00:43:04,230 --> 00:43:03,280

and robin didn't like this idea and uh a

1316

00:43:07,109 --> 00:43:04,240

lot of people don't

1317

00:43:08,950 --> 00:43:07,119

but uh what i thought was that under

1318

00:43:11,990 --> 00:43:08,960

those circumstances

1319

00:43:16,230 --> 00:43:12,000

um consciousness is has

1320

00:43:19,190 --> 00:43:16,240

gone into the microtubule quantum states

1321

00:43:21,270 --> 00:43:19,200

almost completely and the membranes

1322

00:43:24,630 --> 00:43:21,280

which perform cognition

1323

00:43:25,430 --> 00:43:24,640

are violent are quiet silent you don't

1324

00:43:29,430 --> 00:43:25,440

need uh

1325

00:43:32,390 --> 00:43:29,440

membranes

1326

00:43:33,270 --> 00:43:32,400

you don't have to well you need what i'm

1327

00:43:34,790 --> 00:43:33,280

let me back up

1328

00:43:37,349 --> 00:43:34,800

what the brain needs energy for is to

1329

00:43:39,270 --> 00:43:37,359

maintain uh membrane potentials

1330

00:43:40,870 --> 00:43:39,280

the quantum the quantum microtubule

1331

00:43:42,069 --> 00:43:40,880

stuff is very low energy you don't need

1332

00:43:44,870 --> 00:43:42,079

much energy

1333

00:43:45,910 --> 00:43:44,880

so um if you're tripping and you don't

1334

00:43:47,670 --> 00:43:45,920

have to do anything

1335

00:43:49,030 --> 00:43:47,680

cognitive you don't have to drive a car

1336

00:43:50,790 --> 00:43:49,040

you have to talk to anybody

1337

00:43:52,950 --> 00:43:50,800

you're just laying there in your own

1338

00:43:54,870 --> 00:43:52,960

mind your membranes can be

1339

00:43:56,470 --> 00:43:54,880

can be can be quiet consciousness has

1340

00:43:57,190 --> 00:43:56,480

gone to a deeper level into the quantum

1341

00:43:59,349 --> 00:43:57,200

state

1342

00:44:00,550 --> 00:43:59,359

so you don't require energy for membrane

1343

00:44:03,510 --> 00:44:00,560

membrane potentials

1344

00:44:04,069 --> 00:44:03,520

for firing and uh you know by the same

1345

00:44:05,589 --> 00:44:04,079

token

1346

00:44:07,109 --> 00:44:05,599

you wouldn't want somebody in that

1347

00:44:07,990 --> 00:44:07,119

condition driving you home their

1348

00:44:09,430 --> 00:44:08,000

cognition

1349

00:44:11,270 --> 00:44:09,440

wouldn't be very good if they're if

1350

00:44:12,710 --> 00:44:11,280

they're deep into a quantum

1351
00:44:15,349 --> 00:44:12,720
consciousness state

1352
00:44:16,630 --> 00:44:15,359
so that was my explanation for why

1353
00:44:19,670 --> 00:44:16,640
people who are tripping

1354
00:44:22,309 --> 00:44:19,680
have low uh what

1355
00:44:24,069 --> 00:44:22,319
their brains appear to be silent and

1356
00:44:25,190 --> 00:44:24,079
dormant and their eeg is flat

1357
00:44:27,030 --> 00:44:25,200
it's because everything's gone to a

1358
00:44:28,390 --> 00:44:27,040
deeper level and if you get to that

1359
00:44:30,950 --> 00:44:28,400
level you find

1360
00:44:31,589 --> 00:44:30,960
much much faster and more active

1361
00:44:33,430 --> 00:44:31,599
activity

1362
00:44:35,030 --> 00:44:33,440
at the quantum level but the classical

1363
00:44:37,510 --> 00:44:35,040

level things are

1364

00:44:38,470 --> 00:44:37,520

on hold okay so let me make a layman

1365

00:44:41,589 --> 00:44:38,480

rudimentary

1366

00:44:42,470 --> 00:44:41,599

analogy let's imagine that what the eeg

1367

00:44:44,470 --> 00:44:42,480

is measuring

1368

00:44:45,910 --> 00:44:44,480

is the rate at which or the speed at

1369

00:44:47,349 --> 00:44:45,920

which you're moving about or a group of

1370

00:44:48,470 --> 00:44:47,359

people are moving about in a room let's

1371

00:44:49,990 --> 00:44:48,480

say this

1372

00:44:51,270 --> 00:44:50,000

and they measure at like five kilometers

1373

00:44:51,750 --> 00:44:51,280

per hour they're walking but what you're

1374

00:44:53,510 --> 00:44:51,760

saying is

1375

00:44:54,630 --> 00:44:53,520

when you're under an altered state of

1376

00:44:56,069 --> 00:44:54,640

consciousness it's like you're going

1377

00:44:56,630 --> 00:44:56,079

into a deeper room let's say the

1378

00:44:58,230 --> 00:44:56,640

basement

1379

00:44:59,829 --> 00:44:58,240

and now you're moving rapidly but the

1380

00:45:01,430 --> 00:44:59,839

eeg is showing a small amount because

1381

00:45:03,589 --> 00:45:01,440

it's only measuring what's in this room

1382

00:45:05,430 --> 00:45:03,599

is that somewhat correct yeah you kind

1383

00:45:05,750 --> 00:45:05,440

of go into the basement you go into the

1384

00:45:07,990 --> 00:45:05,760

uh

1385

00:45:09,990 --> 00:45:08,000

the underground where it's all quantum

1386

00:45:12,069 --> 00:45:10,000

and the energy is very very low

1387

00:45:13,510 --> 00:45:12,079

and you've do you've dissociated from

1388

00:45:16,390 --> 00:45:13,520

what's happening at the membrane

1389

00:45:18,790 --> 00:45:16,400

you've you've gone you've gone deep uh

1390

00:45:19,990 --> 00:45:18,800

into the i like to call it the quantum

1391

00:45:22,470 --> 00:45:20,000

underground is the actual

1392

00:45:24,630 --> 00:45:22,480

decoherence-free subspace where quantum

1393

00:45:26,390 --> 00:45:24,640

stuff stuff is happening in biology

1394

00:45:28,950 --> 00:45:26,400

but the membranes are on vacation the

1395

00:45:30,630 --> 00:45:28,960

membranes don't have to depolarize you

1396

00:45:32,390 --> 00:45:30,640

don't have to trigger firings

1397

00:45:34,230 --> 00:45:32,400

you're not doing anything actively other

1398

00:45:36,710 --> 00:45:34,240

than thinking other than being conscious

1399

00:45:37,349 --> 00:45:36,720

your body you you're not moving anything

1400

00:45:39,190 --> 00:45:37,359

you're not

1401
00:45:41,510 --> 00:45:39,200
doing performing any cognitive function

1402
00:45:45,190 --> 00:45:43,589
and by the way um i'm gonna digress a

1403
00:45:46,550 --> 00:45:45,200
little bit but in some recent work i've

1404
00:45:49,829 --> 00:45:46,560
been doing

1405
00:45:51,670 --> 00:45:49,839
with allison watri at ucsd who studies

1406
00:45:53,349 --> 00:45:51,680
these cerebral organoids we're trying to

1407
00:45:54,309 --> 00:45:53,359
design experiments to see if cerebral

1408
00:45:56,470 --> 00:45:54,319
organoids

1409
00:45:58,390 --> 00:45:56,480
can be conscious we've kind of come to

1410
00:45:59,750 --> 00:45:58,400
the conclusion that

1411
00:46:01,829 --> 00:45:59,760
that there's cognition and there's

1412
00:46:04,950 --> 00:46:01,839
consciousness cognition

1413
00:46:06,470 --> 00:46:04,960

is you know stuff that we do uh that

1414

00:46:08,309 --> 00:46:06,480

could be conscious or not conscious

1415

00:46:09,910 --> 00:46:08,319

driving for example walking

1416

00:46:11,510 --> 00:46:09,920

sometimes you're walking and or i'm

1417

00:46:12,790 --> 00:46:11,520

walking my mind's wandering i'm

1418

00:46:15,349 --> 00:46:12,800

somewhere else

1419

00:46:15,990 --> 00:46:15,359

uh i'm technically paying attention but

1420

00:46:17,829 --> 00:46:16,000

uh to

1421

00:46:19,430 --> 00:46:17,839

the sidewalk and whatnot but i'm not

1422

00:46:20,870 --> 00:46:19,440

that conscious of it then all of a

1423

00:46:22,790 --> 00:46:20,880

sudden something happens

1424

00:46:24,150 --> 00:46:22,800

i see somebody or horn honks and then my

1425

00:46:26,870 --> 00:46:24,160

consciousness returns

1426
00:46:28,950 --> 00:46:26,880
to my cognition so cognition can be

1427
00:46:30,870 --> 00:46:28,960
either conscious or non-conscious

1428
00:46:32,150 --> 00:46:30,880
so we're thinking that we're the way

1429
00:46:34,230 --> 00:46:32,160
we're expressing now is that

1430
00:46:35,990 --> 00:46:34,240
consciousness is supervening

1431
00:46:37,510 --> 00:46:36,000
on cognition and kind of takes over

1432
00:46:39,510 --> 00:46:37,520
cognition and

1433
00:46:41,430 --> 00:46:39,520
when it needs to so you can be on

1434
00:46:42,069 --> 00:46:41,440
autopilot most of the time driving or

1435
00:46:44,630 --> 00:46:42,079
walking or

1436
00:46:46,069 --> 00:46:44,640
doing whatever without consciousness and

1437
00:46:47,829 --> 00:46:46,079
then suddenly you need it

1438
00:46:49,109 --> 00:46:47,839

and it shows up and supervenes on

1439

00:46:50,790 --> 00:46:49,119

cognition

1440

00:46:52,390 --> 00:46:50,800

is this the opposite of the prevailing

1441

00:46:53,670 --> 00:46:52,400

view that cognition supervenes on

1442

00:46:55,030 --> 00:46:53,680

consciousness rather than the other way

1443

00:46:57,030 --> 00:46:55,040

around

1444

00:46:58,550 --> 00:46:57,040

if that's the prevailing view yes it

1445

00:46:59,109 --> 00:46:58,560

would be is that what the prevailing

1446

00:47:00,950 --> 00:46:59,119

view is

1447

00:47:03,349 --> 00:47:00,960

no i'm well i'm asking you you know much

1448

00:47:05,670 --> 00:47:03,359

more i don't actually i've never

1449

00:47:06,950 --> 00:47:05,680

uh i've heard the term super venue it's

1450

00:47:09,430 --> 00:47:06,960

it it's a

1451
00:47:10,390 --> 00:47:09,440
it's a term in philosophy and but i

1452
00:47:11,430 --> 00:47:10,400
always thought it applied to

1453
00:47:13,430 --> 00:47:11,440
consciousness

1454
00:47:14,550 --> 00:47:13,440
supervising like and kind of taking over

1455
00:47:16,230 --> 00:47:14,560
cognition

1456
00:47:17,910 --> 00:47:16,240
it could go the other way around if you

1457
00:47:19,349 --> 00:47:17,920
know but no i think consciousness

1458
00:47:21,270 --> 00:47:19,359
supervenies on cognition

1459
00:47:23,030 --> 00:47:21,280
and in fact we can't measure

1460
00:47:25,430 --> 00:47:23,040
consciousness in the brain

1461
00:47:26,710 --> 00:47:25,440
or organoids or anything but what we

1462
00:47:30,150 --> 00:47:26,720
might be able to measure

1463
00:47:33,270 --> 00:47:30,160

is the effect of consciousness on

1464

00:47:35,349 --> 00:47:33,280

cognition because cognition

1465

00:47:37,750 --> 00:47:35,359

can be computable so go back to roger

1466

00:47:41,349 --> 00:47:37,760

rogers point about uh

1467

00:47:42,630 --> 00:47:41,359

consciously non-computable well

1468

00:47:44,630 --> 00:47:42,640

if you had something you could observe

1469

00:47:46,470 --> 00:47:44,640

in the brain that was computable

1470

00:47:48,230 --> 00:47:46,480

and then consciousness came in you would

1471

00:47:49,750 --> 00:47:48,240

you would see deviation

1472

00:47:51,430 --> 00:47:49,760

from computable behavior in

1473

00:47:52,950 --> 00:47:51,440

hodgkin-huxley neurons

1474

00:47:55,270 --> 00:47:52,960

and that's exactly what we're trying to

1475

00:47:57,990 --> 00:47:55,280

do in this study we're proposing

1476

00:48:00,470 --> 00:47:58,000

that is to look for it for for the

1477

00:48:02,309 --> 00:48:00,480

shadow of consciousness to look for

1478

00:48:04,309 --> 00:48:02,319

the shadow consciousness casts on

1479

00:48:05,990 --> 00:48:04,319

cognition deviation from

1480

00:48:08,150 --> 00:48:06,000

computable behavior in neurons and

1481

00:48:10,630 --> 00:48:08,160

hodgkin-huxley neurons for example

1482

00:48:12,230 --> 00:48:10,640

because of consciousness and to see if

1483

00:48:13,990 --> 00:48:12,240

that goes away with anesthesia

1484

00:48:15,510 --> 00:48:14,000

so anesthesia should make you more

1485

00:48:19,589 --> 00:48:15,520

computable

1486

00:48:21,430 --> 00:48:19,599

more automatic more autopilot-like

1487

00:48:23,829 --> 00:48:21,440

and we do see that type of behavior

1488

00:48:25,190 --> 00:48:23,839

under anesthesia without consciousness

1489

00:48:27,270 --> 00:48:25,200

so that's a way of looking at

1490

00:48:28,230 --> 00:48:27,280

consciousness by looking at the effect

1491

00:48:30,790 --> 00:48:28,240

it has on

1492

00:48:31,589 --> 00:48:30,800

cognition as another aside is there a

1493

00:48:35,589 --> 00:48:31,599

way of using

1494

00:48:39,270 --> 00:48:35,599

anesthesia to make a truth serum

1495

00:48:42,150 --> 00:48:39,280

you know uh pentethal was used for that

1496

00:48:42,790 --> 00:48:42,160

uh brevitol back in the old days and it

1497

00:48:48,150 --> 00:48:42,800

it

1498

00:48:51,030 --> 00:48:48,160

you could you could kind of uh uh

1499

00:48:51,990 --> 00:48:51,040

inhibit the just you can kind of inhibit

1500

00:48:54,950 --> 00:48:52,000

what is normally

1501

00:48:55,750 --> 00:48:54,960

uh inhibitory and and kind of just

1502

00:48:58,790 --> 00:48:55,760

disinhibit

1503

00:49:00,150 --> 00:48:58,800

the subject and get the truth out of it

1504

00:49:02,230 --> 00:49:00,160

i was never really impressed with that

1505

00:49:02,790 --> 00:49:02,240

and as an anesthesiologist i wasn't that

1506

00:49:06,069 --> 00:49:02,800

interested

1507

00:49:07,349 --> 00:49:06,079

in it because uh because you know well

1508

00:49:08,549 --> 00:49:07,359

we don't use pentathlon anymore but

1509

00:49:10,710 --> 00:49:08,559

propofol

1510

00:49:11,910 --> 00:49:10,720

and it's chewing light doses they are a

1511

00:49:14,150 --> 00:49:11,920

little disinhibited

1512

00:49:15,750 --> 00:49:14,160

and you just before they go to sleep

1513

00:49:18,950 --> 00:49:15,760

when they're waking up they may

1514

00:49:21,510 --> 00:49:18,960

say something uh uh

1515

00:49:22,549 --> 00:49:21,520

that's personal or you know but yeah

1516

00:49:25,829 --> 00:49:22,559

let's make it

1517

00:49:27,510 --> 00:49:25,839

through that as fast as possible and uh

1518

00:49:29,829 --> 00:49:27,520

so i'm not interested in using it using

1519

00:49:31,030 --> 00:49:29,839

that but but you can disinhibit somebody

1520

00:49:33,190 --> 00:49:31,040

at just the right dose

1521

00:49:34,470 --> 00:49:33,200

but it's very very transitory unless you

1522

00:49:36,630 --> 00:49:34,480

try to keep it their level

1523

00:49:37,910 --> 00:49:36,640

and then they're they're unconscious so

1524

00:49:39,990 --> 00:49:37,920

um

1525

00:49:41,670 --> 00:49:40,000

uh but you you mentioned psychedelics

1526
00:49:42,630 --> 00:49:41,680
before and when another experiment i

1527
00:49:45,829 --> 00:49:42,640
like to do is

1528
00:49:47,510 --> 00:49:45,839
i would predict well we predict to have

1529
00:49:49,510 --> 00:49:47,520
evidence that anesthesia slows and

1530
00:49:51,349 --> 00:49:49,520
dampens these oscillations

1531
00:49:53,109 --> 00:49:51,359
and that psychedelics would increase the

1532
00:49:55,589 --> 00:49:53,119
frequency and uh

1533
00:49:57,510 --> 00:49:55,599
we're going to try and look at that also

1534
00:49:59,270 --> 00:49:57,520
increase the frequency oscillations

1535
00:50:00,630 --> 00:49:59,280
increase the frequency of consciousness

1536
00:50:02,549 --> 00:50:00,640
which would account

1537
00:50:05,190 --> 00:50:02,559
at least in part for the psychedelic

1538
00:50:08,470 --> 00:50:06,790

okay now as for collaborating with

1539

00:50:10,069 --> 00:50:08,480

penrose do you mind giving an example of

1540

00:50:11,510 --> 00:50:10,079

a recent one how does it look

1541

00:50:13,349 --> 00:50:11,520

what sorts of problems do you work on

1542

00:50:15,910 --> 00:50:13,359

let's take a recent example

1543

00:50:17,670 --> 00:50:15,920

well right now we're trying to finish a

1544

00:50:19,349 --> 00:50:17,680

chapter for a book

1545

00:50:21,349 --> 00:50:19,359

called quantum quantum mechanics and

1546

00:50:24,309 --> 00:50:21,359

consciousness edited by

1547

00:50:25,030 --> 00:50:24,319

shang gao i got this one from you uh

1548

00:50:29,510 --> 00:50:25,040

that's

1549

00:50:31,589 --> 00:50:29,520

you were editors

1550

00:50:32,549 --> 00:50:31,599

yeah but but that was a mistake that's

1551

00:50:34,309 --> 00:50:32,559

not really our book

1552

00:50:36,069 --> 00:50:34,319

they used our name but we had nothing

1553

00:50:37,430 --> 00:50:36,079

well i i hope it's your book because it

1554

00:50:38,950 --> 00:50:37,440

took me quite a bit of time just to get

1555

00:50:41,430 --> 00:50:38,960

through a bit of it

1556

00:50:42,069 --> 00:50:41,440

is it any good i've never read it oh

1557

00:50:43,910 --> 00:50:42,079

okay

1558

00:50:45,109 --> 00:50:43,920

that's definitely not your book yeah

1559

00:50:46,470 --> 00:50:45,119

well

1560

00:50:48,150 --> 00:50:46,480

i was primarily interested in the

1561

00:50:48,950 --> 00:50:48,160

article by you and penrose okay and

1562

00:50:53,030 --> 00:50:48,960

that's it

1563

00:50:54,630 --> 00:50:53,040

i'll stand by that but um but uh

1564

00:50:56,790 --> 00:50:54,640

we're we're writing a chapter now for a

1565

00:50:58,150 --> 00:50:56,800

book uh by shanghai called quantum

1566

00:51:00,549 --> 00:50:58,160

mechanics and consciousness and

1567

00:51:02,230 --> 00:51:00,559

and dave chalmers has has an article and

1568

00:51:04,549 --> 00:51:02,240

a lot of people have articles

1569

00:51:05,510 --> 00:51:04,559

and uh um you know i was thrilled to

1570

00:51:07,990 --> 00:51:05,520

write another article

1571

00:51:09,109 --> 00:51:08,000

with roger but he's dif he's difficult

1572

00:51:10,630 --> 00:51:09,119

to work with

1573

00:51:12,230 --> 00:51:10,640

because he's very meticulous he's got

1574

00:51:13,829 --> 00:51:12,240

like 20 things going on and everything

1575

00:51:15,750 --> 00:51:13,839

has to be perfect so

1576

00:51:18,870 --> 00:51:15,760

to make a long story short the the

1577

00:51:22,069 --> 00:51:18,880

chapter is three years late

1578

00:51:25,670 --> 00:51:22,079

and the absolute drop dead deadline is

1579

00:51:27,670 --> 00:51:25,680

uh uh sunday this sunday and uh

1580

00:51:28,870 --> 00:51:27,680

my part i you know i keep working on but

1581

00:51:31,589 --> 00:51:28,880

i'm basically uh

1582

00:51:33,109 --> 00:51:31,599

waiting on his part and uh he's actually

1583

00:51:34,870 --> 00:51:33,119

putting in some new stuff

1584

00:51:36,950 --> 00:51:34,880

about retroactivity backward time

1585

00:51:39,589 --> 00:51:36,960

effects and uh

1586

00:51:41,349 --> 00:51:39,599

effect and uh and so it's worth waiting

1587

00:51:44,630 --> 00:51:41,359

for and i hope the uh

1588

00:51:48,230 --> 00:51:44,640

the editor feels that way also but um

1589

00:51:51,510 --> 00:51:48,240

uh so that and now we do it with email

1590

00:51:54,470 --> 00:51:51,520

we first started we did it with uh faxes

1591

00:51:56,470 --> 00:51:54,480

and uh i still somewhere have uh rolls

1592

00:51:58,150 --> 00:51:56,480

and rolls of fax paper with his original

1593

00:52:00,549 --> 00:51:58,160

artworks and drawings that i'm

1594

00:52:01,589 --> 00:52:00,559

trying to preserve and uh occasional

1595

00:52:03,829 --> 00:52:01,599

phone calls

1596

00:52:05,270 --> 00:52:03,839

and uh it was slow going when i first

1597

00:52:07,829 --> 00:52:05,280

started collaborating

1598

00:52:09,430 --> 00:52:07,839

uh with roger uh his wife vanessa said

1599

00:52:09,910 --> 00:52:09,440

uh you know i encourage you but you

1600

00:52:13,990 --> 00:52:09,920

should know

1601
00:52:15,990 --> 00:52:14,000
be prepared it'll be very slow going uh

1602
00:52:17,430 --> 00:52:16,000
everything has to be just right before

1603
00:52:18,950 --> 00:52:17,440
he signs off on it

1604
00:52:21,750 --> 00:52:18,960
and he's very meticulous and he's way

1605
00:52:23,670 --> 00:52:21,760
over committed so just be patient

1606
00:52:25,190 --> 00:52:23,680
and i'm glad he told me that she told me

1607
00:52:28,390 --> 00:52:25,200
that because it turned out

1608
00:52:30,710 --> 00:52:28,400
to be true in fact it led to

1609
00:52:32,790 --> 00:52:30,720
an interesting uh we had been working on

1610
00:52:34,790 --> 00:52:32,800
the original uh

1611
00:52:36,549 --> 00:52:34,800
article that i mentioned earlier and

1612
00:52:37,910 --> 00:52:36,559
calculating all this stuff

1613
00:52:39,750 --> 00:52:37,920

for about a year i didn't even have a

1614

00:52:42,549 --> 00:52:39,760

didn't have a manuscript

1615

00:52:44,150 --> 00:52:42,559

but in the meantime uh pat churchlin who

1616

00:52:44,829 --> 00:52:44,160

had been at that conference that roger

1617

00:52:47,829 --> 00:52:44,839

went to

1618

00:52:49,910 --> 00:52:47,839

um uh back at cambridge uh

1619

00:52:51,829 --> 00:52:49,920

and a grad student came out with kind of

1620

00:52:53,750 --> 00:52:51,839

a preemptive attack piece

1621

00:52:55,589 --> 00:52:53,760

in the journal of consciousness studies

1622

00:52:57,750 --> 00:52:55,599

attempting to refute our

1623

00:52:59,829 --> 00:52:57,760

ideas before we even published anything

1624

00:53:02,069 --> 00:52:59,839

is this tag mark and

1625

00:53:03,829 --> 00:53:02,079

that was later that was another uh bogus

1626
00:53:04,790 --> 00:53:03,839
uh attack well i'll come i'll come to

1627
00:53:07,349 --> 00:53:04,800
him uh

1628
00:53:09,109 --> 00:53:07,359
but um now this is pat churchlin and a

1629
00:53:13,430 --> 00:53:09,119
grad student rick rush

1630
00:53:15,109 --> 00:53:13,440
and uh um she uh

1631
00:53:16,790 --> 00:53:15,119
materialist reductionist

1632
00:53:18,549 --> 00:53:16,800
computationalist

1633
00:53:20,950 --> 00:53:18,559
and they spent the first part of their

1634
00:53:22,470 --> 00:53:20,960
article uh attacking the uh

1635
00:53:24,230 --> 00:53:22,480
the girdle's theorem and

1636
00:53:26,309 --> 00:53:24,240
non-computability in the second half

1637
00:53:29,030 --> 00:53:26,319
attacking microtubules

1638
00:53:29,670 --> 00:53:29,040

and uh so and they're really snotty

1639

00:53:32,230 --> 00:53:29,680

about it

1640

00:53:33,589 --> 00:53:32,240

and uh the the title of their article

1641

00:53:35,510 --> 00:53:33,599

you know roger's famous for a lot of

1642

00:53:38,150 --> 00:53:35,520

things including penrose tilings

1643

00:53:40,829 --> 00:53:38,160

tiling a plane with geometry and so the

1644

00:53:42,150 --> 00:53:40,839

title of their article was uh penrose's

1645

00:53:45,829 --> 00:53:42,160

toilings

1646

00:53:47,670 --> 00:53:45,839

were gaps

1647

00:53:49,510 --> 00:53:47,680

because there are no gaps in his tilings

1648

00:53:50,549 --> 00:53:49,520

but there's toilings in terms of his

1649

00:53:52,549 --> 00:53:50,559

ideas

1650

00:53:54,230 --> 00:53:52,559

and the first gaps were about the

1651
00:53:56,390 --> 00:53:54,240
girdle's theorem that they attacked

1652
00:53:57,670 --> 00:53:56,400
the second was about microtubules well

1653
00:53:58,630 --> 00:53:57,680
let's give it to them that's a clever

1654
00:54:03,190 --> 00:53:58,640
title

1655
00:54:06,549 --> 00:54:03,200
said for example that uh

1656
00:54:07,670 --> 00:54:06,559
the penrose hammer off hypothesis was no

1657
00:54:11,349 --> 00:54:07,680
better supported

1658
00:54:15,270 --> 00:54:11,359
than one in a gazillion

1659
00:54:17,990 --> 00:54:15,280
caterpillar with hookah hypotheses

1660
00:54:18,390 --> 00:54:18,000
a reference to uh alice in wonderland

1661
00:54:20,710 --> 00:54:18,400
that

1662
00:54:22,470 --> 00:54:20,720
uh this is a quite literally a pipe

1663
00:54:23,670 --> 00:54:22,480

dream pipe dream they're basically

1664

00:54:26,309 --> 00:54:23,680

saying we're

1665

00:54:27,589 --> 00:54:26,319

we're bsing everybody you know that's

1666

00:54:29,190 --> 00:54:27,599

basically what they were saying and they

1667

00:54:31,670 --> 00:54:29,200

were we're full of them

1668

00:54:33,270 --> 00:54:31,680

so that was pretty snotty and but it was

1669

00:54:36,630 --> 00:54:33,280

sufficiently snotty to uh

1670

00:54:39,270 --> 00:54:36,640

provoke roger into into responding

1671

00:54:40,950 --> 00:54:39,280

fully and the uh the editor the

1672

00:54:41,430 --> 00:54:40,960

publisher of the journal said you can

1673

00:54:44,069 --> 00:54:41,440

have

1674

00:54:46,470 --> 00:54:44,079

or you can reply on the next issue but

1675

00:54:48,950 --> 00:54:46,480

i'll need a manuscript in two weeks

1676

00:54:50,150 --> 00:54:48,960

and so i said oh my gosh you know it's

1677

00:54:52,309 --> 00:54:50,160

been a year we don't have a manuscript

1678

00:54:53,829 --> 00:54:52,319

how can we possibly do this in two weeks

1679

00:54:55,990 --> 00:54:53,839

well we got on the phone and roger said

1680

00:54:57,750 --> 00:54:56,000

i'll tell you what i can i can answer

1681

00:55:00,230 --> 00:54:57,760

all the girdle serum stuff

1682

00:55:01,670 --> 00:55:00,240

you answer all the microtubule stuff put

1683

00:55:04,470 --> 00:55:01,680

the two parts together

1684

00:55:06,549 --> 00:55:04,480

write a common abstract and i can do my

1685

00:55:06,950 --> 00:55:06,559

part in in two weeks i said i could do

1686

00:55:12,470 --> 00:55:06,960

my

1687

00:55:13,990 --> 00:55:12,480

the microtubule stuff was was pretty

1688

00:55:16,150 --> 00:55:14,000

easy actually

1689

00:55:18,390 --> 00:55:16,160

for example their main point what they

1690

00:55:20,710 --> 00:55:18,400

thought was their killer argument

1691

00:55:23,109 --> 00:55:20,720

was that uh there's a drug called

1692

00:55:26,390 --> 00:55:23,119

colchicine which is used in gout

1693

00:55:26,950 --> 00:55:26,400

gout is arthritis where immune cells go

1694

00:55:29,589 --> 00:55:26,960

into

1695

00:55:30,390 --> 00:55:29,599

joints like the big toe the great toe

1696

00:55:31,910 --> 00:55:30,400

and uh

1697

00:55:33,510 --> 00:55:31,920

and cause tremendous inflammation and

1698

00:55:36,710 --> 00:55:33,520

swelling and pain it's very

1699

00:55:39,910 --> 00:55:36,720

it's very painful and um

1700

00:55:41,430 --> 00:55:39,920

and yet uh when you take because it deep

1701
00:55:43,109 --> 00:55:41,440
polymerizes the microtubules and that

1702
00:55:45,510 --> 00:55:43,119
paralyzes the immune cells

1703
00:55:47,430 --> 00:55:45,520
from migrating into the joint so the

1704
00:55:49,109 --> 00:55:47,440
microtubules are depolymerized

1705
00:55:50,710 --> 00:55:49,119
and they said see microtubules are deep

1706
00:55:52,630 --> 00:55:50,720
polymerized and you don't people

1707
00:55:54,470 --> 00:55:52,640
who with gout who take colchicine don't

1708
00:55:56,230 --> 00:55:54,480
lose consciousness therefore

1709
00:55:57,510 --> 00:55:56,240
microtubules must be unnecessary for

1710
00:55:59,109 --> 00:55:57,520
consciousness

1711
00:56:00,549 --> 00:55:59,119
right but it doesn't cross the blood

1712
00:56:01,990 --> 00:56:00,559
brain it's just not

1713
00:56:04,069 --> 00:56:02,000

right coaching does not cross the

1714

00:56:05,990 --> 00:56:04,079

blood-brain barrier uh

1715

00:56:07,430 --> 00:56:06,000

number two it only affects microtubules

1716

00:56:09,030 --> 00:56:07,440

they're wrapped they're constantly

1717

00:56:10,309 --> 00:56:09,040

assembling and disassembling and those

1718

00:56:12,710 --> 00:56:10,319

in the brain don't

1719

00:56:14,789 --> 00:56:12,720

they're quite stable okay which is why

1720

00:56:16,309 --> 00:56:14,799

uh you can store memory in them

1721

00:56:17,829 --> 00:56:16,319

and i found a paper where somebody

1722

00:56:20,789 --> 00:56:17,839

actually injected colchicine

1723

00:56:22,309 --> 00:56:20,799

into the uh into the the brain of

1724

00:56:23,589 --> 00:56:22,319

animals and just wiped them out they

1725

00:56:25,750 --> 00:56:23,599

were demolished

1726

00:56:27,190 --> 00:56:25,760

so i answered that and uh there's some

1727

00:56:27,589 --> 00:56:27,200

other stuff and roger ants the girls

1728

00:56:30,549 --> 00:56:27,599

there

1729

00:56:31,750 --> 00:56:30,559

put an abstract together and uh we wrote

1730

00:56:35,430 --> 00:56:31,760

this paper uh

1731

00:56:38,150 --> 00:56:35,440

uh gaps what gaps response to aggression

1732

00:56:38,789 --> 00:56:38,160

that was our first paper in 95. and then

1733

00:56:41,589 --> 00:56:38,799

uh

1734

00:56:42,390 --> 00:56:41,599

next year we had two papers in 96 and

1735

00:56:46,950 --> 00:56:42,400

then

1736

00:56:50,390 --> 00:56:46,960

rehashed that as an

1737

00:56:53,430 --> 00:56:50,400

updated version in 2018 and uh

1738

00:56:54,630 --> 00:56:53,440

2016. and now this this paper which uh

1739

00:56:57,750 --> 00:56:54,640

we're writing uh

1740

00:56:57,990 --> 00:56:57,760

right now so maybe half a dozen papers

1741

00:57:01,829 --> 00:56:58,000

over

1742

00:57:05,270 --> 00:57:04,549

now going to this backward time right

1743

00:57:07,510 --> 00:57:05,280

aspect

1744

00:57:09,030 --> 00:57:07,520

i heard you mention libits experiments

1745

00:57:10,150 --> 00:57:09,040

and that they don't necessarily show a

1746

00:57:11,829 --> 00:57:10,160

lack of free will

1747

00:57:13,430 --> 00:57:11,839

but perhaps the free will propagates

1748

00:57:14,710 --> 00:57:13,440

backward in time now can you explain

1749

00:57:17,109 --> 00:57:14,720

that

1750

00:57:18,789 --> 00:57:17,119

well libbet did these experiments in uh

1751

00:57:19,270 --> 00:57:18,799

well he did two sets of experiments the

1752

00:57:20,870 --> 00:57:19,280

first

1753

00:57:23,270 --> 00:57:20,880

set of experiments that roger wrote

1754

00:57:24,069 --> 00:57:23,280

about in his uh book the emperor's new

1755

00:57:25,910 --> 00:57:24,079

mind

1756

00:57:27,430 --> 00:57:25,920

uh were sensory experiments where he had

1757

00:57:30,549 --> 00:57:27,440

people uh

1758

00:57:32,069 --> 00:57:30,559

uh under in neurosurgery he worked with

1759

00:57:34,630 --> 00:57:32,079

a neurosurgeon named bertram

1760

00:57:35,270 --> 00:57:34,640

uh epstein who by the way was the the

1761

00:57:39,190 --> 00:57:35,280

husband

1762

00:57:40,950 --> 00:57:39,200

of uh diane sorry bertram feinstein

1763

00:57:42,309 --> 00:57:40,960

who was the husband of dianne feinstein

1764

00:57:44,630 --> 00:57:42,319

the the governor

1765

00:57:46,470 --> 00:57:44,640

sorry the senator from california she's

1766

00:57:48,630 --> 00:57:46,480

still around he passed away years ago

1767

00:57:49,670 --> 00:57:48,640

but he was a neurosurgeon and live at

1768

00:57:52,630 --> 00:57:49,680

work with him

1769

00:57:54,390 --> 00:57:52,640

and so he had patients that he did uh

1770

00:57:56,309 --> 00:57:54,400

neurosurgery on well awake

1771

00:57:57,750 --> 00:57:56,319

so he would drill a hole and numb it up

1772

00:57:59,030 --> 00:57:57,760

with local anesthetic and once you get

1773

00:57:59,750 --> 00:57:59,040

into the brain you can operate on the

1774

00:58:01,910 --> 00:57:59,760

brain

1775

00:58:03,349 --> 00:58:01,920

it doesn't hurt but you you make you

1776

00:58:05,270 --> 00:58:03,359

numb up the hole

1777

00:58:06,549 --> 00:58:05,280

and you can access the brain and for

1778

00:58:09,349 --> 00:58:06,559

example for the

1779

00:58:09,910 --> 00:58:09,359

the for the finger on the opposite hand

1780

00:58:11,349 --> 00:58:09,920

so

1781

00:58:13,030 --> 00:58:11,359

libya did experiments like he would

1782

00:58:13,510 --> 00:58:13,040

stimulate the finger and record from the

1783

00:58:20,470 --> 00:58:13,520

brain

1784

00:58:23,510 --> 00:58:20,480

and uh and then uh

1785

00:58:26,710 --> 00:58:23,520

see uh when the when the subject

1786

00:58:30,230 --> 00:58:26,720

was conscious of feeling the finger

1787

00:58:31,990 --> 00:58:30,240

so um you would expect or i would expect

1788

00:58:33,270 --> 00:58:32,000

not knowing anything beforehand that if

1789

00:58:34,309 --> 00:58:33,280

you stimulate the brain you feel it

1790

00:58:35,910 --> 00:58:34,319

immediately

1791

00:58:37,349 --> 00:58:35,920

if you stimulate the finger it would be

1792

00:58:37,990 --> 00:58:37,359

a delay because it had to get to the

1793

00:58:39,270 --> 00:58:38,000

brain

1794

00:58:41,190 --> 00:58:39,280

well if you stimulate the finger there

1795

00:58:43,829 --> 00:58:41,200

is a delay but it's only 30 milliseconds

1796

00:58:45,829 --> 00:58:43,839

evoke potential so it's pretty fast but

1797

00:58:47,510 --> 00:58:45,839

if you stimulate the brain directly

1798

00:58:49,190 --> 00:58:47,520

you need to have ongoing activity and it

1799

00:58:50,549 --> 00:58:49,200

takes about a half a second 500

1800

00:58:51,589 --> 00:58:50,559

milliseconds

1801
00:58:54,549 --> 00:58:51,599
because you don't get the evoked

1802
00:58:56,150 --> 00:58:54,559
potential but if it continues for 500

1803
00:59:00,150 --> 00:58:56,160
milliseconds

1804
00:59:02,390 --> 00:59:00,160
this evoked potential

1805
00:59:04,309 --> 00:59:02,400
okay so if you stimulate the finger the

1806
00:59:05,510 --> 00:59:04,319
signal you get a spike that's the evoked

1807
00:59:07,030 --> 00:59:05,520
potential

1808
00:59:08,710 --> 00:59:07,040
if you stimulate it here you don't get

1809
00:59:10,150 --> 00:59:08,720
the evoked potential you just get

1810
00:59:13,670 --> 00:59:10,160
you know ongoing activity looks like

1811
00:59:15,829 --> 00:59:13,680
gamma but if you do it for half a second

1812
00:59:17,589 --> 00:59:15,839
the patient subject has the conscious

1813
00:59:18,069 --> 00:59:17,599

experience at the time of the evoked

1814

00:59:20,630 --> 00:59:18,079

potential

1815

00:59:22,470 --> 00:59:20,640

30 milliseconds so somehow at 30

1816

00:59:24,630 --> 00:59:22,480

milliseconds the brain

1817

00:59:26,710 --> 00:59:24,640

knows whether or not there's going to be

1818

00:59:27,829 --> 00:59:26,720

500 milliseconds of ongoing activity

1819

00:59:30,470 --> 00:59:27,839

afterwards

1820

00:59:31,030 --> 00:59:30,480

if there is he or she reports it at 30

1821

00:59:33,030 --> 00:59:31,040

milliseconds

1822

00:59:34,549 --> 00:59:33,040

that's interesting okay if there isn't

1823

00:59:36,789 --> 00:59:34,559

then he or she does

1824

00:59:39,670 --> 00:59:36,799

and so libbet concluded that there was a

1825

00:59:41,829 --> 00:59:39,680

signal going backwards in time

1826
00:59:43,510 --> 00:59:41,839
from the time of the uh what he called

1827
00:59:45,109 --> 00:59:43,520
neuronal adequacy

1828
00:59:47,430 --> 00:59:45,119
and then send this information back

1829
00:59:48,870 --> 00:59:47,440
we're in time now roger wrote about this

1830
00:59:51,270 --> 00:59:48,880
in emperor's neuron because

1831
00:59:51,990 --> 00:59:51,280
um that hap that can happen in quantum

1832
00:59:54,549 --> 00:59:52,000
physics

1833
00:59:57,589 --> 00:59:54,559
which is temporarily non-local is this

1834
00:59:59,670 --> 00:59:57,599
related to the subcutaneous rabbit

1835
01:00:01,990 --> 00:59:59,680
have you heard of that were you someone

1836
01:00:04,150 --> 01:00:02,000
yes but this is related to that yes

1837
01:00:06,630 --> 01:00:04,160
and also the color five phenomenon where

1838
01:00:09,829 --> 01:00:06,640

the color bounces back and forth and

1839

01:00:11,589 --> 01:00:09,839

it goes from uh red to blue and you go

1840

01:00:12,630 --> 01:00:11,599

red blue red blue and you can guess then

1841

01:00:14,470 --> 01:00:12,640

it goes red red

1842

01:00:15,990 --> 01:00:14,480

and you know you're not fooled and

1843

01:00:17,829 --> 01:00:16,000

that's because you seem to know what's

1844

01:00:20,069 --> 01:00:17,839

going on and the cutaneous rabbits the

1845

01:00:21,430 --> 01:00:20,079

the same thing i actually wrote a wrote

1846

01:00:22,150 --> 01:00:21,440

a chapter about i can send it to you

1847

01:00:28,630 --> 01:00:22,160

about

1848

01:00:31,270 --> 01:00:28,640

and all those can be accounted for

1849

01:00:32,710 --> 01:00:31,280

by you somehow know know what's coming

1850

01:00:35,670 --> 01:00:32,720

and

1851
01:00:37,109 --> 01:00:35,680
this is very important because um if you

1852
01:00:37,670 --> 01:00:37,119
and i are talking and you ask me a

1853
01:00:39,670 --> 01:00:37,680
question

1854
01:00:42,069 --> 01:00:39,680
and if someone were measuring the

1855
01:00:45,030 --> 01:00:42,079
activity in my brain

1856
01:00:47,349 --> 01:00:45,040
for what you said it'll happen and say

1857
01:00:49,589 --> 01:00:47,359
300 to 500 milliseconds after

1858
01:00:52,309 --> 01:00:49,599
they get to my ears but i will have

1859
01:00:54,630 --> 01:00:52,319
responded to you at 100 milliseconds

1860
01:00:55,990 --> 01:00:54,640
this is very very standard neuroscience

1861
01:00:58,349 --> 01:00:56,000
what neuroscience says

1862
01:00:59,829 --> 01:00:58,359
about that is that i respond

1863
01:01:01,910 --> 01:00:59,839

non-consciously

1864

01:01:03,910 --> 01:01:01,920

and have a false illusion of answering

1865

01:01:07,030 --> 01:01:03,920

consciously after the fact

1866

01:01:10,150 --> 01:01:07,040

the consciousness is epi phenomenal my

1867

01:01:12,390 --> 01:01:10,160

cognitive autopilot non-conscious self

1868

01:01:14,150 --> 01:01:12,400

answers you and then a little later my

1869

01:01:16,710 --> 01:01:14,160

conscious self says oh i said that

1870

01:01:18,549 --> 01:01:16,720

you know i'm in control and it means

1871

01:01:21,190 --> 01:01:18,559

that consciousness is epi phenomenal

1872

01:01:21,750 --> 01:01:21,200

and illusion illusory that's what dennis

1873

01:01:23,910 --> 01:01:21,760

says

1874

01:01:25,750 --> 01:01:23,920

that's what all you know all the big of

1875

01:01:27,670 --> 01:01:25,760

the big name philosophers say

1876

01:01:28,870 --> 01:01:27,680

unless they have some way to to weasel

1877

01:01:30,870 --> 01:01:28,880

out of it

1878

01:01:32,390 --> 01:01:30,880

and but if you have backward time it

1879

01:01:34,549 --> 01:01:32,400

means that you can have

1880

01:01:37,430 --> 01:01:34,559

you can you can do all that and you can

1881

01:01:39,589 --> 01:01:37,440

still respond consciously in real time

1882

01:01:41,510 --> 01:01:39,599

has dennett ever publicly commented

1883

01:01:43,510 --> 01:01:41,520

specifically on yours or penrose's

1884

01:01:47,030 --> 01:01:43,520

theories

1885

01:01:48,710 --> 01:01:47,040

no and he won't in fact uh i've argued

1886

01:01:50,630 --> 01:01:48,720

with him at several meetings and all he

1887

01:01:52,069 --> 01:01:50,640

does is yell at me without listening to

1888

01:01:55,430 --> 01:01:52,079

what i'm saying

1889

01:01:56,549 --> 01:01:55,440

and uh in fact what do you think that is

1890

01:01:57,910 --> 01:01:56,559

because he doesn't know anything about

1891

01:01:59,430 --> 01:01:57,920

the brain he doesn't know the damn thing

1892

01:02:01,430 --> 01:01:59,440

about the brain he admits it he doesn't

1893

01:02:02,870 --> 01:02:01,440

know a neuron from all the ground

1894

01:02:05,589 --> 01:02:02,880

and so all these you know he knows

1895

01:02:07,109 --> 01:02:05,599

computers and that's how computers work

1896

01:02:09,190 --> 01:02:07,119

and unfortunately that's true about

1897

01:02:12,309 --> 01:02:09,200

about a lot of a lot of people

1898

01:02:13,029 --> 01:02:12,319

so uh we actually uh my colleague tom

1899

01:02:14,549 --> 01:02:13,039

bever is

1900

01:02:17,029 --> 01:02:14,559

putting a course to get we're putting a

1901

01:02:19,589 --> 01:02:17,039

course together on conscious studies and

1902

01:02:21,349 --> 01:02:19,599

and tom asked dan dana whom he knows

1903

01:02:24,150 --> 01:02:21,359

some years ago if he would and he just

1904

01:02:24,870 --> 01:02:24,160

blew him off so he's not interested and

1905

01:02:26,150 --> 01:02:24,880

uh

1906

01:02:28,549 --> 01:02:26,160

you know they have their position they

1907

01:02:30,470 --> 01:02:28,559

don't want to be bothered with the facts

1908

01:02:31,750 --> 01:02:30,480

i've been arguing with dan for years and

1909

01:02:33,990 --> 01:02:31,760

uh

1910

01:02:37,510 --> 01:02:34,000

you can't argue with the guy you know

1911

01:02:40,390 --> 01:02:37,520

what do you disagree with penrose on

1912

01:02:42,150 --> 01:02:40,400

could be minor it could be metaphysical

1913

01:02:43,910 --> 01:02:42,160

uh i'm not sure i agree but i

1914

01:02:45,190 --> 01:02:43,920

i would say that i uh i'm not saying i

1915

01:02:48,309 --> 01:02:45,200

disagree necessarily but i

1916

01:02:49,750 --> 01:02:48,319

i i tend to go further than he does in

1917

01:02:52,150 --> 01:02:49,760

certain things like

1918

01:02:53,029 --> 01:02:52,160

you know the spiritual implications of

1919

01:02:55,190 --> 01:02:53,039

of his whole

1920

01:02:56,390 --> 01:02:55,200

platonic values and universal

1921

01:02:58,069 --> 01:02:56,400

consciousness

1922

01:02:59,750 --> 01:02:58,079

that he does he just doesn't he just

1923

01:03:01,510 --> 01:02:59,760

won't talk about it he says i don't find

1924

01:03:04,470 --> 01:03:01,520

it useful to talk about

1925

01:03:06,150 --> 01:03:04,480

uh and uh the backward time effect he's

1926

01:03:07,510 --> 01:03:06,160

still a little bit reluctant to go as

1927

01:03:09,170 --> 01:03:07,520

far as i go

1928

01:03:11,589 --> 01:03:09,180

but um uh

1929

01:03:14,789 --> 01:03:11,599

[Music]

1930

01:03:16,549 --> 01:03:14,799

stuff about anesthesia he's you know he

1931

01:03:17,829 --> 01:03:16,559

i think that once i've explained what

1932

01:03:19,990 --> 01:03:17,839

i'm trying to i kind of get ahead of

1933

01:03:21,430 --> 01:03:20,000

myself in saying things and then once i

1934

01:03:23,190 --> 01:03:21,440

i kind of backfill on what i was trying

1935

01:03:23,829 --> 01:03:23,200

to say he tends to go that's happened in

1936

01:03:27,910 --> 01:03:23,839

our recent

1937

01:03:29,829 --> 01:03:27,920

give you an example um

1938

01:03:32,150 --> 01:03:29,839

i we're talking about the hodgkin-huxley

1939

01:03:35,190 --> 01:03:32,160

neuron and you integrate and fire

1940

01:03:38,390 --> 01:03:35,200

and it's and um that is computable

1941

01:03:40,549 --> 01:03:38,400

when the threshold is met firing happens

1942

01:03:43,910 --> 01:03:40,559

but if you put electrodes and this was

1943

01:03:45,109 --> 01:03:43,920

done in 2006 by non-dorfdol in germany

1944

01:03:47,829 --> 01:03:45,119

they put electrodes in

1945

01:03:49,109 --> 01:03:47,839

in pyramidal cells of awake cats and

1946

01:03:52,710 --> 01:03:49,119

what they fi

1947

01:03:54,309 --> 01:03:52,720

conscious they find that there's a

1948

01:03:56,630 --> 01:03:54,319

tremendous variability

1949

01:03:58,390 --> 01:03:56,640

from from firing to firing so the

1950

01:04:00,630 --> 01:03:58,400

threshold is changing something

1951
01:04:02,549 --> 01:04:00,640
other than the membrane potential than

1952
01:04:05,029 --> 01:04:02,559
the input so something other

1953
01:04:06,549 --> 01:04:05,039
than the measurable inputs that are

1954
01:04:10,230 --> 01:04:06,559
triggering the firing which

1955
01:04:11,990 --> 01:04:10,240
controls behavior and uh uh

1956
01:04:13,510 --> 01:04:12,000
they that sounds groundbreaking because

1957
01:04:15,109 --> 01:04:13,520
usually it's thought of as

1958
01:04:16,870 --> 01:04:15,119
you just input a certain voltage

1959
01:04:19,990 --> 01:04:16,880
electric field and then it will

1960
01:04:21,750 --> 01:04:20,000
fire correct the synaptic inputs come in

1961
01:04:23,430 --> 01:04:21,760
they change the voltage on the membrane

1962
01:04:26,230 --> 01:04:23,440
of the dendrites in the soma

1963
01:04:27,510 --> 01:04:26,240

and when that uh accumulated integrated

1964

01:04:29,750 --> 01:04:27,520

membrane potential

1965

01:04:31,190 --> 01:04:29,760

gets to the exon initiation segment it's

1966

01:04:33,190 --> 01:04:31,200

compared to a threshold

1967

01:04:34,950 --> 01:04:33,200

and if the threshold is met firing

1968

01:04:37,029 --> 01:04:34,960

occurs that's the standard

1969

01:04:41,029 --> 01:04:37,039

hodgkin-huxley neuron

1970

01:04:43,430 --> 01:04:41,039

but in a neuron in an awake animal

1971

01:04:45,430 --> 01:04:43,440

that firing threshold is highly variable

1972

01:04:47,029 --> 01:04:45,440

there's some other factor

1973

01:04:49,109 --> 01:04:47,039

and so i started calling that a

1974

01:04:51,750 --> 01:04:49,119

non-computable factor

1975

01:04:52,150 --> 01:04:51,760

and uh roger uh didn't understand what i

1976

01:04:53,829 --> 01:04:52,160

was trying

1977

01:04:56,470 --> 01:04:53,839

you you say no non-computability has to

1978

01:04:58,549 --> 01:04:56,480

do something deep in quantum physics

1979

01:05:00,150 --> 01:04:58,559

and i was saying yes i i know and but it

1980

01:05:01,349 --> 01:05:00,160

has to come into the brain somewhere

1981

01:05:03,270 --> 01:05:01,359

and so that's where i thought it was

1982

01:05:04,710 --> 01:05:03,280

coming in so uh

1983

01:05:06,150 --> 01:05:04,720

he's come up he's come around to that

1984

01:05:06,470 --> 01:05:06,160

now and we're going to include that in

1985

01:05:11,430 --> 01:05:06,480

our

1986

01:05:15,190 --> 01:05:11,440

non-computability in neurons

1987

01:05:16,870 --> 01:05:15,200

and uh that's the d as a as a deviation

1988

01:05:20,230 --> 01:05:16,880

from hodgkin-huxley

1989

01:05:22,390 --> 01:05:20,240

uh behavior and uh which is also what i

1990

01:05:25,589 --> 01:05:22,400

was saying before deviation from

1991

01:05:27,670 --> 01:05:25,599

from cognitive uh autopilot function

1992

01:05:29,029 --> 01:05:27,680

because the hodgkin huxley behavior

1993

01:05:30,950 --> 01:05:29,039

would be fine for walking down the

1994

01:05:32,789 --> 01:05:30,960

street doing things that don't require

1995

01:05:35,029 --> 01:05:32,799

you know non-computable consciousness or

1996

01:05:37,670 --> 01:05:35,039

intuition insight

1997

01:05:38,549 --> 01:05:37,680

that platonic values uh values that sort

1998

01:05:40,630 --> 01:05:38,559

of thing

1999

01:05:41,670 --> 01:05:40,640

so um i think he's coming here he's

2000

01:05:44,069 --> 01:05:41,680

seeing

2001
01:05:45,910 --> 01:05:44,079
i'm trying to put his non-computability

2002
01:05:46,710 --> 01:05:45,920
into the brain specifically at the end

2003
01:05:48,870 --> 01:05:46,720
of integration

2004
01:05:50,549 --> 01:05:48,880
in pyramidal neurons where at the end of

2005
01:05:52,789 --> 01:05:50,559
this orchestrated period

2006
01:05:53,589 --> 01:05:52,799
and reduction and that can uh change the

2007
01:05:55,829 --> 01:05:53,599
firing

2008
01:05:56,870 --> 01:05:55,839
depending on your conscious thoughts so

2009
01:05:58,870 --> 01:05:56,880
rather than

2010
01:06:00,870 --> 01:05:58,880
responding reflexively to something or

2011
01:06:02,150 --> 01:06:00,880
somebody you think about it or you have

2012
01:06:04,789 --> 01:06:02,160
a conscious

2013
01:06:05,910 --> 01:06:04,799

uh thought or intuition or feeling well

2014

01:06:06,710 --> 01:06:05,920

i just lit a feeling i better do

2015

01:06:08,150 --> 01:06:06,720

something different

2016

01:06:10,150 --> 01:06:08,160

you know i don't want to do that i'm not

2017

01:06:12,549 --> 01:06:10,160

sure why but so it's

2018

01:06:13,670 --> 01:06:12,559

intuition it's inside its creativity

2019

01:06:14,789 --> 01:06:13,680

which are things comes out of this

2020

01:06:17,029 --> 01:06:14,799

non-computability

2021

01:06:18,870 --> 01:06:17,039

and i think it manifests in terms of

2022

01:06:20,309 --> 01:06:18,880

altering the firing capability of these

2023

01:06:22,309 --> 01:06:20,319

neurons

2024

01:06:24,150 --> 01:06:22,319

okay i'm going to take a look at some of

2025

01:06:27,190 --> 01:06:24,160

the questions that we have here

2026

01:06:28,630 --> 01:06:27,200

actually for now you know this podcast

2027

01:06:31,270 --> 01:06:28,640

or this series

2028

01:06:32,390 --> 01:06:31,280

has a tendency to get somewhat technical

2029

01:06:34,549 --> 01:06:32,400

so

2030

01:06:36,630 --> 01:06:34,559

i thought how about this time instead of

2031

01:06:38,630 --> 01:06:36,640

leaving it unexplained how about i

2032

01:06:39,990 --> 01:06:38,640

or you try to explain some of these

2033

01:06:42,309 --> 01:06:40,000

abstracts and

2034

01:06:44,309 --> 01:06:42,319

seemingly inscrutable terminologies and

2035

01:06:46,950 --> 01:06:44,319

then perhaps someone can understand

2036

01:06:48,069 --> 01:06:46,960

a full quote and maybe by understanding

2037

01:06:48,630 --> 01:06:48,079

the parts they can understand it as a

2038

01:06:49,829 --> 01:06:48,640

whole

2039

01:06:55,750 --> 01:06:49,839

i'm basically taking quotes from your

2040

01:06:59,990 --> 01:06:58,150

okay how would microtubule quantum

2041

01:07:00,630 --> 01:07:00,000

computations which are isolated from the

2042

01:07:03,990 --> 01:07:00,640

environment

2043

01:07:06,549 --> 01:07:04,000

input and output

2044

01:07:07,349 --> 01:07:06,559

one possibility is that orc or suggests

2045

01:07:09,589 --> 01:07:07,359

that

2046

01:07:11,430 --> 01:07:09,599

perhaps phases of isolated quantum

2047

01:07:13,510 --> 01:07:11,440

computing alternate with phases of

2048

01:07:16,390 --> 01:07:13,520

classical environmental interaction

2049

01:07:17,829 --> 01:07:16,400

eg at gamma synchrony isolated from the

2050

01:07:18,470 --> 01:07:17,839

environment do you mind explaining that

2051
01:07:22,549 --> 01:07:18,480
concept

2052
01:07:23,589 --> 01:07:22,559
for people well uh for quantum devices

2053
01:07:26,150 --> 01:07:23,599
and technology

2054
01:07:27,430 --> 01:07:26,160
have to be isolated from interaction

2055
01:07:28,710 --> 01:07:27,440
with the environment which is thought to

2056
01:07:30,950 --> 01:07:28,720
be random

2057
01:07:32,390 --> 01:07:30,960
and noisy and to do that they do things

2058
01:07:33,829 --> 01:07:32,400
at absolute near absolute zero

2059
01:07:35,029 --> 01:07:33,839
temperature to avoid any thermal

2060
01:07:37,829 --> 01:07:35,039
oscillations

2061
01:07:40,069 --> 01:07:37,839
so in biology we think that inside the

2062
01:07:43,430 --> 01:07:40,079
tubulins

2063
01:07:45,589 --> 01:07:43,440

in the high resonance groups um

2064

01:07:47,349 --> 01:07:45,599

you have a uh yeah that's one you'll

2065

01:07:48,390 --> 01:07:47,359

have to explain to pi resonance so why

2066

01:07:51,510 --> 01:07:48,400

don't we go to that first

2067

01:07:54,710 --> 01:07:51,520

all right so let me back up so the basic

2068

01:07:57,670 --> 01:07:54,720

uh molecule in living systems

2069

01:07:58,390 --> 01:07:57,680

uh is the the organic ring the benzene

2070

01:08:02,150 --> 01:07:58,400

ring

2071

01:08:04,789 --> 01:08:02,160

carbons in a hexagon

2072

01:08:06,549 --> 01:08:04,799

and each carbon has in pure benzene each

2073

01:08:09,430 --> 01:08:06,559

carbon has one hydrogen

2074

01:08:10,630 --> 01:08:09,440

and that leaves two more bonds uh so one

2075

01:08:13,670 --> 01:08:10,640

bond goes to

2076

01:08:14,069 --> 01:08:13,680

uh three more bonds per for carbon one

2077

01:08:17,829 --> 01:08:14,079

go

2078

01:08:19,910 --> 01:08:17,839

carbons and you have an extra electro

2079

01:08:21,110 --> 01:08:19,920

you have an extra bond so you have three

2080

01:08:23,590 --> 01:08:21,120

extra electrons

2081

01:08:25,829 --> 01:08:23,600

in a carbon ring so what do they do they

2082

01:08:27,749 --> 01:08:25,839

form these delocalized clouds above and

2083

01:08:31,030 --> 01:08:27,759

below the carbon ring

2084

01:08:33,990 --> 01:08:31,040

and this is a quantum area it's nonpolar

2085

01:08:35,829 --> 01:08:34,000

so there's no charge um but it's neutral

2086

01:08:37,349 --> 01:08:35,839

because the the positive charge is in

2087

01:08:39,349 --> 01:08:37,359

the is a nuclei

2088

01:08:41,669 --> 01:08:39,359

so you have this electron cloud above

2089

01:08:44,870 --> 01:08:41,679

and below and it's a quantum

2090

01:08:47,030 --> 01:08:44,880

entity it takes up space small space

2091

01:08:48,149 --> 01:08:47,040

volume and if you put two of these

2092

01:08:49,990 --> 01:08:48,159

together

2093

01:08:52,630 --> 01:08:50,000

the the electron cloud in one the

2094

01:08:54,229 --> 01:08:52,640

electro negativity will repel the

2095

01:08:56,709 --> 01:08:54,239

electrons over here

2096

01:08:58,149 --> 01:08:56,719

so you get a dipole and you get a an

2097

01:08:59,990 --> 01:08:58,159

induced dipole

2098

01:09:01,669 --> 01:09:00,000

and there's a dipole in this one and

2099

01:09:05,349 --> 01:09:01,679

there's a dipole in this one

2100

01:09:07,030 --> 01:09:05,359

and this one induces this one and then

2101

01:09:09,590 --> 01:09:07,040

this one induces back so you get an

2102

01:09:11,030 --> 01:09:09,600

oscillation of these dipoles

2103

01:09:12,630 --> 01:09:11,040

when you say oscillation in the dipole

2104

01:09:14,470 --> 01:09:12,640

you mean oscillation in the charge so

2105

01:09:16,229 --> 01:09:14,480

that it's more positive on one side than

2106

01:09:17,590 --> 01:09:16,239

the negative and it switches or what the

2107

01:09:20,470 --> 01:09:17,600

net charge is

2108

01:09:21,749 --> 01:09:20,480

is is neutral but the dipole means

2109

01:09:24,149 --> 01:09:21,759

you're pushing

2110

01:09:26,390 --> 01:09:24,159

in in each cloud the electrons tend to

2111

01:09:27,749 --> 01:09:26,400

migrate to one side or the other

2112

01:09:29,030 --> 01:09:27,759

depending on what's near them so if

2113

01:09:29,990 --> 01:09:29,040

there's another cloud near them they're

2114

01:09:31,990 --> 01:09:30,000

both neutral

2115

01:09:33,349 --> 01:09:32,000

the electrons in one are going to repel

2116

01:09:34,789 --> 01:09:33,359

the other one so they tend to do this

2117

01:09:36,390 --> 01:09:34,799

they tend to oscillate

2118

01:09:37,829 --> 01:09:36,400

and that's just two of them now one of

2119

01:09:39,269 --> 01:09:37,839

them doesn't do that

2120

01:09:41,510 --> 01:09:39,279

and i should also say that if you get a

2121

01:09:42,950 --> 01:09:41,520

bunch of benzene and put them together

2122

01:09:44,550 --> 01:09:42,960

if they're not spaced properly they're

2123

01:09:47,349 --> 01:09:44,560

flammable that's gasoline

2124

01:09:49,110 --> 01:09:47,359

but if if you put them so they're spaced

2125

01:09:50,789 --> 01:09:49,120

in a geometric array

2126

01:09:52,390 --> 01:09:50,799

for example in a planar sheet that's

2127

01:09:53,669 --> 01:09:52,400

graphene and graphene has a lot of

2128

01:09:55,189 --> 01:09:53,679

quantum properties

2129

01:09:57,189 --> 01:09:55,199

but if you put them in a lattice where

2130

01:09:59,590 --> 01:09:57,199

there's space they can oscillate and

2131

01:10:01,990 --> 01:09:59,600

that's basically frolic coherence

2132

01:10:04,149 --> 01:10:02,000

so they're in a nonpolar region they're

2133

01:10:06,310 --> 01:10:04,159

isolated from the environment

2134

01:10:08,630 --> 01:10:06,320

but the question was okay let's say you

2135

01:10:11,030 --> 01:10:08,640

have that in this isolated environment

2136

01:10:12,870 --> 01:10:11,040

how do you communicate input and output

2137

01:10:15,830 --> 01:10:12,880

with the outside world

2138

01:10:16,950 --> 01:10:15,840

and uh that's a very good question and

2139

01:10:20,390 --> 01:10:16,960

our answer to that

2140

01:10:21,990 --> 01:10:20,400

came from a science fiction book by a

2141

01:10:24,470 --> 01:10:22,000

guy named paul benioff

2142

01:10:25,990 --> 01:10:24,480

who was one of the inventors of quantum

2143

01:10:29,110 --> 01:10:26,000

computers

2144

01:10:32,790 --> 01:10:29,120

deutsche benioff and i forget who

2145

01:10:34,149 --> 01:10:32,800

uh feynman are generally uh

2146

01:10:36,149 --> 01:10:34,159

credited with you know inventing the

2147

01:10:39,590 --> 01:10:36,159

concept upon computers

2148

01:10:41,669 --> 01:10:39,600

and uh benioff uh was a roger knew

2149

01:10:42,950 --> 01:10:41,679

and actually spoke at our 2003 quantum

2150

01:10:44,870 --> 01:10:42,960

mind conference

2151
01:10:46,470 --> 01:10:44,880
i had written a sci-fi book and he

2152
01:10:50,630 --> 01:10:46,480
talked about it in his talk

2153
01:10:52,470 --> 01:10:50,640
and he had a quantum computer robot and

2154
01:10:53,830 --> 01:10:52,480
it went through phases of quantum and

2155
01:10:55,910 --> 01:10:53,840
then collapsed to the

2156
01:10:56,950 --> 01:10:55,920
answer and that would communicate with

2157
01:10:59,750 --> 01:10:56,960
the environment

2158
01:11:00,229 --> 01:10:59,760
and during that phase you get inputs so

2159
01:11:03,189 --> 01:11:00,239
you get

2160
01:11:03,910 --> 01:11:03,199
output input then quantum again process

2161
01:11:06,229 --> 01:11:03,920
collapse

2162
01:11:07,910 --> 01:11:06,239
so the alternating phases of quantum and

2163
01:11:10,790 --> 01:11:07,920

classical quantum classical

2164

01:11:11,990 --> 01:11:10,800

and during the classical uh you'd have

2165

01:11:14,470 --> 01:11:12,000

interaction with the

2166

01:11:15,990 --> 01:11:14,480

both uh output and input now when we

2167

01:11:19,189 --> 01:11:16,000

said that for 40 hertz

2168

01:11:20,229 --> 01:11:19,199

uh i would change it now to say the same

2169

01:11:22,070 --> 01:11:20,239

thing happens

2170

01:11:23,510 --> 01:11:22,080

at say 10 megahertz because we think the

2171

01:11:24,550 --> 01:11:23,520

orca war events are happening much

2172

01:11:27,189 --> 01:11:24,560

faster

2173

01:11:28,149 --> 01:11:27,199

so uh after each event uh you're in the

2174

01:11:31,350 --> 01:11:28,159

classical phase

2175

01:11:33,030 --> 01:11:31,360

you you uh express the outputs and that

2176

01:11:33,910 --> 01:11:33,040

can trigger the neuron to fire or do

2177

01:11:35,669 --> 01:11:33,920

whatever

2178

01:11:37,590 --> 01:11:35,679

and receive inputs then you go back into

2179

01:11:39,669 --> 01:11:37,600

the quantum phase so you're alternating

2180

01:11:41,430 --> 01:11:39,679

between quantum and classical phases

2181

01:11:43,590 --> 01:11:41,440

roughly 10 million times a second

2182

01:11:45,270 --> 01:11:43,600

okay there's a hydrophobic property of

2183

01:11:47,350 --> 01:11:45,280

the benzene rings i believe

2184

01:11:49,350 --> 01:11:47,360

hydrophobic non-po nonpolar right

2185

01:11:51,189 --> 01:11:49,360

there's no charge so let's explain

2186

01:11:52,229 --> 01:11:51,199

those terms hydrophobic why is that

2187

01:11:53,510 --> 01:11:52,239

important and then non-polar they're

2188

01:11:54,790 --> 01:11:53,520

pretty much the same thing actually

2189

01:11:57,430 --> 01:11:54,800

hydrophobic means

2190

01:11:58,229 --> 01:11:57,440

water aversive so no water water is

2191

01:12:00,310 --> 01:11:58,239

polar

2192

01:12:02,229 --> 01:12:00,320

so basically think of it think of the

2193

01:12:03,910 --> 01:12:02,239

the brain or the body as a bunch of

2194

01:12:05,430 --> 01:12:03,920

different solubility compartments if

2195

01:12:07,669 --> 01:12:05,440

you're an anesthesiologist or

2196

01:12:08,630 --> 01:12:07,679

a pharmacologist or giving drugs to a

2197

01:12:11,430 --> 01:12:08,640

patient

2198

01:12:13,350 --> 01:12:11,440

you'd be you'd need to know uh where in

2199

01:12:15,669 --> 01:12:13,360

the body of the drug is going to go

2200

01:12:17,430 --> 01:12:15,679

and if it's polar if it's charged then

2201

01:12:19,990 --> 01:12:17,440

it's going to be very soluble in water

2202

01:12:22,149 --> 01:12:20,000

and blood and tend to go to charged

2203

01:12:22,790 --> 01:12:22,159

surfaces like receptors on the surfaces

2204

01:12:25,030 --> 01:12:22,800

of

2205

01:12:26,870 --> 01:12:25,040

neurons and so forth if however you're

2206

01:12:28,229 --> 01:12:26,880

giving a drug like an anesthetic which

2207

01:12:31,510 --> 01:12:28,239

is non-polar

2208

01:12:33,189 --> 01:12:31,520

which is lipid-like oil-like

2209

01:12:34,870 --> 01:12:33,199

it doesn't like to be in water it's very

2210

01:12:36,550 --> 01:12:34,880

insoluble so it traverses the blood

2211

01:12:39,669 --> 01:12:36,560

quickly and goes to fat

2212

01:12:42,390 --> 01:12:39,679

membranes and proteins that have these

2213

01:12:43,030 --> 01:12:42,400

non-polar regions inside of them and

2214

01:12:49,590 --> 01:12:43,040

that's where

2215

01:12:51,350 --> 01:12:49,600

and in the non-polar regions uh is where

2216

01:12:53,830 --> 01:12:51,360

the quantum stuff can happen

2217

01:12:54,950 --> 01:12:53,840

without being exposed to at least the

2218

01:12:57,270 --> 01:12:54,960

polar charges

2219

01:12:58,070 --> 01:12:57,280

so you've reduced the the degrees of

2220

01:13:00,630 --> 01:12:58,080

freedom

2221

01:13:02,149 --> 01:13:00,640

and created what uh is called in the

2222

01:13:05,350 --> 01:13:02,159

quantum computing business a

2223

01:13:07,270 --> 01:13:05,360

decoherence-free subspace temporarily

2224

01:13:08,790 --> 01:13:07,280

where you can do quantum stuff without

2225

01:13:09,830 --> 01:13:08,800

without getting messed up by the

2226

01:13:12,950 --> 01:13:09,840

environment by the

2227

01:13:15,030 --> 01:13:12,960

classical environment okay forgive me if

2228

01:13:17,189 --> 01:13:15,040

i'm misunderstanding this but there's a

2229

01:13:18,630 --> 01:13:17,199

the microtubule has three layers if i

2230

01:13:20,630 --> 01:13:18,640

remember correctly there's a water

2231

01:13:22,790 --> 01:13:20,640

tube inside and then there's the tubulin

2232

01:13:24,070 --> 01:13:22,800

on the outside i've only read about the

2233

01:13:24,310 --> 01:13:24,080

a lattice so i don't know much about the

2234

01:13:25,990 --> 01:13:24,320

b

2235

01:13:27,910 --> 01:13:26,000

lattice and then there's apparently

2236

01:13:30,950 --> 01:13:27,920

another layer i just saw

2237

01:13:32,390 --> 01:13:30,960

anarban right okay enervan

2238

01:13:33,430 --> 01:13:32,400

give a talk on this but i don't know

2239

01:13:35,430 --> 01:13:33,440

much about what's going on the outer

2240

01:13:37,110 --> 01:13:35,440

layer so is compu is quantum computation

2241

01:13:38,149 --> 01:13:37,120

happening on the layer with the tubulin

2242

01:13:40,470 --> 01:13:38,159

or is it inside

2243

01:13:43,030 --> 01:13:40,480

where the water is okay so when you say

2244

01:13:45,270 --> 01:13:43,040

inside so micro tubes are hollow tubes

2245

01:13:46,950 --> 01:13:45,280

so you have an outside which is this

2246

01:13:47,669 --> 01:13:46,960

charge is coming out and it's basically

2247

01:13:50,229 --> 01:13:47,679

water

2248

01:13:51,189 --> 01:13:50,239

around it then you have the wall of the

2249

01:13:54,790 --> 01:13:51,199

microtubule

2250

01:13:56,790 --> 01:13:54,800

which is about uh four nanometers thick

2251
01:13:58,390 --> 01:13:56,800
it can be very long but four ma and then

2252
01:14:01,830 --> 01:13:58,400
you have the inner core

2253
01:14:03,270 --> 01:14:01,840
which is 15 nanometers of again water

2254
01:14:05,830 --> 01:14:03,280
ordered water and then you have the

2255
01:14:08,790 --> 01:14:05,840
other wall so you have a house water

2256
01:14:10,550 --> 01:14:08,800
huh well the water in the water and eye

2257
01:14:12,950 --> 01:14:10,560
there's also ions

2258
01:14:14,470 --> 01:14:12,960
in in the interior of the microtubule

2259
01:14:16,630 --> 01:14:14,480
may be completely ordered

2260
01:14:17,510 --> 01:14:16,640
because you have charges coming out from

2261
01:14:21,590 --> 01:14:17,520
the in

2262
01:14:22,390 --> 01:14:21,600
then more ordered water more ordered

2263
01:14:23,990 --> 01:14:22,400

water and

2264

01:14:26,070 --> 01:14:24,000

the the water may become part of the

2265

01:14:30,070 --> 01:14:26,080

quantum state in that

2266

01:14:33,750 --> 01:14:30,080

uh that's okay that's another another uh

2267

01:14:37,350 --> 01:14:33,760

can of worms yeah yeah in fact uh i

2268

01:14:40,870 --> 01:14:37,360

co-authored a paper in 94.95 about

2269

01:14:43,750 --> 01:14:40,880

the uh about quantum states in the water

2270

01:14:44,550 --> 01:14:43,760

but in uh and that may be true but but

2271

01:14:46,870 --> 01:14:44,560

we think it's

2272

01:14:48,630 --> 01:14:46,880

originating in the nonpolar insi

2273

01:14:49,830 --> 01:14:48,640

nonpolarization inside the wall of the

2274

01:14:51,910 --> 01:14:49,840

microtubule

2275

01:14:53,350 --> 01:14:51,920

uh where it's sheltered from the water

2276

01:14:55,270 --> 01:14:53,360

either on the outside of the microtubule

2277

01:14:57,110 --> 01:14:55,280

on the inside of the microtubule

2278

01:14:58,790 --> 01:14:57,120

in the nonpolar regions which is exactly

2279

01:15:00,630 --> 01:14:58,800

where anesthetics go

2280

01:15:02,390 --> 01:15:00,640

and uh so we've coined this term the

2281

01:15:04,709 --> 01:15:02,400

quantum underground where anesthesia

2282

01:15:07,270 --> 01:15:04,719

goes the anesthetic nonpolar molecules

2283

01:15:08,470 --> 01:15:07,280

go and reside to block consciousness and

2284

01:15:09,990 --> 01:15:08,480

essentially affect

2285

01:15:11,750 --> 01:15:10,000

very little else the brain is still

2286

01:15:13,590 --> 01:15:11,760

active under anesthesia and all it's all

2287

01:15:15,350 --> 01:15:13,600

that's gone really is consciousness

2288

01:15:17,590 --> 01:15:15,360

when someone has alzheimer's it affects

2289

01:15:19,030 --> 01:15:17,600

the tau proteins correct

2290

01:15:21,750 --> 01:15:19,040

child proteins are microtubule

2291

01:15:24,149 --> 01:15:21,760

associated proteins and uh the top

2292

01:15:26,630 --> 01:15:24,159

proteins uh

2293

01:15:28,550 --> 01:15:26,640

basically microtubules disassemble and

2294

01:15:30,070 --> 01:15:28,560

become unstable that's i think that's a

2295

01:15:31,030 --> 01:15:30,080

big part problem with alzheimer's

2296

01:15:34,390 --> 01:15:31,040

disease

2297

01:15:35,990 --> 01:15:34,400

and the towel tau binding at specific

2298

01:15:39,030 --> 01:15:36,000

places on the microtubules

2299

01:15:41,030 --> 01:15:39,040

can encode memory and uh and when

2300

01:15:42,790 --> 01:15:41,040

the microtubules disassemble whether the

2301

01:15:44,229 --> 01:15:42,800

towel falls off first

2302

01:15:45,750 --> 01:15:44,239

and then that destabilizes the

2303

01:15:46,709 --> 01:15:45,760

microtubules or the microtubules

2304

01:15:48,310 --> 01:15:46,719

destabilize

2305

01:15:50,070 --> 01:15:48,320

and then the towel falls off you lose

2306

01:15:51,990 --> 01:15:50,080

the microtubules you lose synapses

2307

01:15:54,630 --> 01:15:52,000

because the microtubules make synapses

2308

01:15:55,669 --> 01:15:54,640

you lose the tau memory function on the

2309

01:15:58,790 --> 01:15:55,679

microtubules

2310

01:16:00,390 --> 01:15:58,800

so it's all bad and i've

2311

01:16:01,990 --> 01:16:00,400

been wanting to do a study using

2312

01:16:03,430 --> 01:16:02,000

ultrasound into the brain

2313

01:16:05,350 --> 01:16:03,440

which we think can re-polymerize

2314

01:16:07,430 --> 01:16:05,360

microtubules and we've been

2315

01:16:09,110 --> 01:16:07,440

we've been studying my ultrasound of the

2316

01:16:12,229 --> 01:16:09,120

brain for a while and showing that it

2317

01:16:15,189 --> 01:16:12,239

it can enhance mood and is safe

2318

01:16:17,030 --> 01:16:15,199

and we're gearing up to do a study on

2319

01:16:20,870 --> 01:16:17,040

alzheimer's and dementia

2320

01:16:21,590 --> 01:16:20,880

can you use this to form a treatment for

2321

01:16:23,189 --> 01:16:21,600

alzheimer's

2322

01:16:25,030 --> 01:16:23,199

that is let's say you hope sorry to the

2323

01:16:26,390 --> 01:16:25,040

stability of tau it helps

2324

01:16:28,070 --> 01:16:26,400

well it's the stability of the

2325

01:16:30,070 --> 01:16:28,080

microtubules i think uh

2326

01:16:31,910 --> 01:16:30,080

the tau is a microtubule associated

2327

01:16:33,669 --> 01:16:31,920

protein right everybody gets worked up

2328

01:16:34,070 --> 01:16:33,679

about tau they can measure talent spinal

2329

01:16:35,590 --> 01:16:34,080

fluid

2330

01:16:37,110 --> 01:16:35,600

they can do this but they're not they're

2331

01:16:38,870 --> 01:16:37,120

not thinking about what the tau

2332

01:16:40,790 --> 01:16:38,880

does when it's not messed up when it's

2333

01:16:41,590 --> 01:16:40,800

doing its you know it's functioning

2334

01:16:43,110 --> 01:16:41,600

properly

2335

01:16:44,709 --> 01:16:43,120

and what it is is a microtubule

2336

01:16:48,390 --> 01:16:44,719

associated protein

2337

01:16:51,110 --> 01:16:48,400

and and and sits on microtubule lattices

2338

01:16:51,590 --> 01:16:51,120

uh at specific locations which seems to

2339

01:17:02,550 --> 01:16:51,600

to

2340

01:17:03,830 --> 01:17:02,560

plays a role that's lost in alzheimer's

2341

01:17:05,590 --> 01:17:03,840

okay you mentioned that there's some

2342

01:17:07,110 --> 01:17:05,600

self-similar property of conductance at

2343

01:17:09,910 --> 01:17:07,120

the different levels of scales

2344

01:17:11,270 --> 01:17:09,920

now sorry i just copy this down i don't

2345

01:17:12,470 --> 01:17:11,280

know if this is an exact quote

2346

01:17:14,070 --> 01:17:12,480

what does that mean that there's

2347

01:17:15,510 --> 01:17:14,080

self-similar properties of conductance

2348

01:17:17,510 --> 01:17:15,520

at different levels

2349

01:17:19,030 --> 01:17:17,520

so honorable bonjour party whom you

2350

01:17:20,149 --> 01:17:19,040

mentioned several times who is a good

2351

01:17:22,550 --> 01:17:20,159

friend of mine

2352

01:17:23,590 --> 01:17:22,560

uh has done amazing work on microtubules

2353

01:17:27,430 --> 01:17:23,600

over the years going back

2354

01:17:29,030 --> 01:17:27,440

from 2009 he published in 2013 2014 and

2355

01:17:32,149 --> 01:17:29,040

then more recently

2356

01:17:35,830 --> 01:17:32,159

and basically he used yeah there you go

2357

01:17:37,590 --> 01:17:35,840

uh that image has gotten around a lot um

2358

01:17:39,030 --> 01:17:37,600

and basically for the audience in case

2359

01:17:40,310 --> 01:17:39,040

they can't see this

2360

01:17:41,510 --> 01:17:40,320

is one of the slides i was going to ask

2361

01:17:42,950 --> 01:17:41,520

you to explain at some point but we can

2362

01:17:45,990 --> 01:17:42,960

do that after

2363

01:17:47,510 --> 01:17:46,000

it's three low i haven't memorized

2364

01:17:50,950 --> 01:17:47,520

actually on the left you have

2365

01:17:52,630 --> 01:17:50,960

three levels of scale and then uh you

2366

01:17:54,709 --> 01:17:52,640

use different types of uh

2367

01:17:56,870 --> 01:17:54,719

uh nanopros scanning tunneling

2368

01:17:58,310 --> 01:17:56,880

microscopes atomic force electrodes this

2369

01:18:00,950 --> 01:17:58,320

and that and

2370

01:18:03,110 --> 01:18:00,960

uh so you're putting electrodes on a

2371

01:18:04,950 --> 01:18:03,120

microtubule now normally microtubule

2372

01:18:06,310 --> 01:18:04,960

all proteins are are insulators they

2373

01:18:08,550 --> 01:18:06,320

don't conduct very well

2374

01:18:10,390 --> 01:18:08,560

what honor bond did was he he put

2375

01:18:12,070 --> 01:18:10,400

electrodes and then he swept

2376

01:18:14,550 --> 01:18:12,080

and then he stimulated with alternating

2377

01:18:14,950 --> 01:18:14,560

current and he swept the current from

2378

01:18:17,750 --> 01:18:14,960

zero

2379

01:18:18,630 --> 01:18:17,760

up to i i forget how high terror

2380

01:18:22,229 --> 01:18:18,640

megahertz

2381

01:18:25,030 --> 01:18:22,239

oh okay you're right and he found at

2382

01:18:26,149 --> 01:18:25,040

certain frequencies that you would get

2383

01:18:27,590 --> 01:18:26,159

conducted

2384

01:18:29,189 --> 01:18:27,600

at certain critical frequencies

2385

01:18:31,189 --> 01:18:29,199

microtubules would be would conduct

2386

01:18:34,149 --> 01:18:31,199

would be would would have the

2387

01:18:35,590 --> 01:18:34,159

resonances or conductances in a triplet

2388

01:18:39,510 --> 01:18:35,600

of triplet patterns

2389

01:18:40,870 --> 01:18:39,520

repeated about every

2390

01:18:43,189 --> 01:18:40,880

not quite every three orders of

2391

01:18:44,149 --> 01:18:43,199

magnitude uh i see what you're saying i

2392

01:18:45,910 --> 01:18:44,159

see what you're saying

2393

01:18:47,110 --> 01:18:45,920

okay and so what is the significance of

2394

01:18:48,870 --> 01:18:47,120

it resonating what does that mean when

2395

01:18:49,750 --> 01:18:48,880

it resonates so you're sending it an ac

2396

01:18:52,390 --> 01:18:49,760

current

2397

01:18:53,910 --> 01:18:52,400

yeah okay now is that much like when you

2398

01:18:56,870 --> 01:18:53,920

put water in the microwave and the water

2399

01:19:01,669 --> 01:18:59,669

now i keep water out of this water water

2400

01:19:03,830 --> 01:19:01,679

is the enemy here there may be uh

2401
01:19:05,830 --> 01:19:03,840
because it's polar these electrodes are

2402
01:19:07,669 --> 01:19:05,840
attached directly to the microtubule

2403
01:19:09,110 --> 01:19:07,679
so i think the conductance is happening

2404
01:19:12,950 --> 01:19:09,120
through the the pi

2405
01:19:14,470 --> 01:19:12,960
resonance inside the uh and and

2406
01:19:16,630 --> 01:19:14,480
inside the wall of the microtubule in

2407
01:19:17,350 --> 01:19:16,640
this helical pathway uh he's measuring

2408
01:19:21,189 --> 01:19:17,360
conductance

2409
01:19:23,669 --> 01:19:21,199
i see yeah and the the uh and the at

2410
01:19:24,390 --> 01:19:23,679
certain frequencies the microtubules

2411
01:19:28,390 --> 01:19:24,400
conducted

2412
01:19:29,110 --> 01:19:28,400
the significance of this it's

2413
01:19:32,390 --> 01:19:29,120

interesting

2414

01:19:34,470 --> 01:19:32,400

geometrically visually but what is well

2415

01:19:36,470 --> 01:19:34,480

it's a it's he called it ballistic

2416

01:19:38,149 --> 01:19:36,480

conductance he couldn't prove quantum

2417

01:19:40,470 --> 01:19:38,159

because there's a classical interface

2418

01:19:42,149 --> 01:19:40,480

between the electron electrode and the

2419

01:19:44,310 --> 01:19:42,159

surface of the microtubule

2420

01:19:45,350 --> 01:19:44,320

but within the you know within the the

2421

01:19:46,470 --> 01:19:45,360

pi resonance

2422

01:19:47,830 --> 01:19:46,480

it was probably something like

2423

01:19:49,189 --> 01:19:47,840

superconductivity or some kind of

2424

01:19:50,709 --> 01:19:49,199

quantum state

2425

01:19:52,630 --> 01:19:50,719

frolic resident or something like that

2426

01:19:53,990 --> 01:19:52,640

so it's a quantum state at critical

2427

01:19:54,790 --> 01:19:54,000

resonance frequencies that

2428

01:19:56,870 --> 01:19:54,800

have something to do with the

2429

01:20:00,149 --> 01:19:56,880

vibrational frequencies of the

2430

01:20:05,030 --> 01:20:03,270

is there a way to use anesthesia to test

2431

01:20:06,470 --> 01:20:05,040

the consciousness of someone so for

2432

01:20:08,149 --> 01:20:06,480

example you mentioned there

2433

01:20:09,750 --> 01:20:08,159

are these buddhist monks who claim to

2434

01:20:11,750 --> 01:20:09,760

have a higher level of consciousness

2435

01:20:13,270 --> 01:20:11,760

so can you take someone who has a lower

2436

01:20:14,790 --> 01:20:13,280

level of consciousness give them a

2437

01:20:17,350 --> 01:20:14,800

certain amount of anesthesia

2438

01:20:18,229 --> 01:20:17,360

see how much does it take to put them

2439

01:20:20,310 --> 01:20:18,239

asleep

2440

01:20:21,830 --> 01:20:20,320

and then see if you need more to put

2441

01:20:22,550 --> 01:20:21,840

someone who claims to be higher in

2442

01:20:24,709 --> 01:20:22,560

consciousness

2443

01:20:25,669 --> 01:20:24,719

i don't think it's because i'm not sure

2444

01:20:27,990 --> 01:20:25,679

there'd be an effect

2445

01:20:29,910 --> 01:20:28,000

actually i don't think you know i don't

2446

01:20:32,790 --> 01:20:29,920

think a uh

2447

01:20:34,270 --> 01:20:32,800

well i don't know whether a a meditator

2448

01:20:36,390 --> 01:20:34,280

or a genius or some

2449

01:20:37,990 --> 01:20:36,400

extraordinary person requires any more

2450

01:20:39,750 --> 01:20:38,000

anesthesia than anybody else i i don't

2451
01:20:41,270 --> 01:20:39,760
know that it could be but

2452
01:20:43,669 --> 01:20:41,280
that would seem to be you know trying to

2453
01:20:45,030 --> 01:20:43,679
split hairs at a level where

2454
01:20:47,030 --> 01:20:45,040
you know i'm more interested in knowing

2455
01:20:49,350 --> 01:20:47,040
how anesthesia works on anybody or

2456
01:20:50,229 --> 01:20:49,360
an animal or an organoid or a mouse or

2457
01:20:52,070 --> 01:20:50,239
any human

2458
01:20:53,510 --> 01:20:52,080
and we still don't know that i mean

2459
01:20:54,149 --> 01:20:53,520
that's a very good question you asked

2460
01:20:55,750 --> 01:20:54,159
but

2461
01:20:57,110 --> 01:20:55,760
it's kind of like we're not there yet to

2462
01:20:57,830 --> 01:20:57,120
you now we want to know how it works on

2463
01:21:00,629 --> 01:20:57,840

anybody

2464

01:21:01,350 --> 01:21:00,639

much less you know uh the dalai lama or

2465

01:21:04,310 --> 01:21:01,360

something like that

2466

01:21:06,070 --> 01:21:04,320

what are frolic resonances frolic

2467

01:21:07,350 --> 01:21:06,080

coherences are fully resonant follow

2468

01:21:08,629 --> 01:21:07,360

coherences

2469

01:21:10,229 --> 01:21:08,639

what i talked about before where you

2470

01:21:11,430 --> 01:21:10,239

have these nonpolar dipoles that

2471

01:21:13,669 --> 01:21:11,440

oscillate

2472

01:21:14,870 --> 01:21:13,679

and they couple to the mechanical

2473

01:21:17,510 --> 01:21:14,880

vibration

2474

01:21:19,830 --> 01:21:17,520

also the key here is that everybody says

2475

01:21:23,110 --> 01:21:19,840

the brain is too warm wet and noisy for

2476
01:21:23,750 --> 01:21:23,120
for quantum effects so warm means it's

2477
01:21:27,030 --> 01:21:23,760
too hot

2478
01:21:29,590 --> 01:21:27,040
you have a

2479
01:21:31,189 --> 01:21:29,600
geometrical lattice with with mechanical

2480
01:21:32,870 --> 01:21:31,199
vibrational resonances

2481
01:21:34,310 --> 01:21:32,880
the heat's going to pump it so it's

2482
01:21:35,510 --> 01:21:34,320
going to have these oscillations that

2483
01:21:37,750 --> 01:21:35,520
are coherent

2484
01:21:38,950 --> 01:21:37,760
so you couple the quantum coherence the

2485
01:21:40,070 --> 01:21:38,960
mechanical parent

2486
01:21:43,030 --> 01:21:40,080
that's why you're saying it was like a

2487
01:21:45,669 --> 01:21:43,040
laser yes exactly

2488
01:21:47,350 --> 01:21:45,679

okay is computation happening at the

2489

01:21:49,030 --> 01:21:47,360

level of glial cells or is it just the

2490

01:21:51,590 --> 01:21:49,040

pyramidal neurons

2491

01:21:53,350 --> 01:21:51,600

good question uh glial cells have a lot

2492

01:21:56,149 --> 01:21:53,360

of microtubules all cells have even

2493

01:22:00,149 --> 01:21:56,159

plant cells have microtubules

2494

01:22:03,830 --> 01:22:00,159

the the pyramidal cells uh

2495

01:22:07,350 --> 01:22:03,840

so what's different about microtubules

2496

01:22:09,590 --> 01:22:07,360

in in neurons in general is that okay

2497

01:22:10,550 --> 01:22:09,600

let me back up you know take any cell at

2498

01:22:14,390 --> 01:22:10,560

all

2499

01:22:15,830 --> 01:22:14,400

and uh uh an amoeba or or any cell

2500

01:22:17,750 --> 01:22:15,840

you can the microtubules are going to

2501
01:22:19,750 --> 01:22:17,760
radiate out from the central part of the

2502
01:22:21,110 --> 01:22:19,760
cell like spokes of a wheel

2503
01:22:23,189 --> 01:22:21,120
they're going to be continuous because

2504
01:22:24,550 --> 01:22:23,199
you want their structural support

2505
01:22:25,990 --> 01:22:24,560
and they're gonna they have the same

2506
01:22:26,870 --> 01:22:26,000
polarity they have a plus end and a

2507
01:22:31,189 --> 01:22:26,880
minus set

2508
01:22:34,070 --> 01:22:31,199
so they're all unipolar and radial

2509
01:22:36,070 --> 01:22:34,080
uh yeah but that's for pyramidal right

2510
01:22:37,430 --> 01:22:36,080
yeah so pyramidal they're interrupted

2511
01:22:38,870 --> 01:22:37,440
and of mixed polarity so you have one

2512
01:22:42,310 --> 01:22:38,880
going here one going

2513
01:22:44,390 --> 01:22:42,320

going here and uh and um

2514

01:22:45,990 --> 01:22:44,400

if if you if you wanted them there for

2515

01:22:48,149 --> 01:22:46,000

structural support like the

2516

01:22:49,750 --> 01:22:48,159

skeleton of your body you wouldn't have

2517

01:22:53,030 --> 01:22:49,760

them broken and interrupted

2518

01:22:54,310 --> 01:22:53,040

okay and why would you have them mixed

2519

01:22:55,990 --> 01:22:54,320

polarity up and down

2520

01:22:58,470 --> 01:22:56,000

and that's been a big mystery and what

2521

01:23:00,950 --> 01:22:58,480

we what roger and i think is that

2522

01:23:02,629 --> 01:23:00,960

that if you have two microtubules in

2523

01:23:04,390 --> 01:23:02,639

mixed polarity next to each other and

2524

01:23:05,590 --> 01:23:04,400

they're in a common voltage

2525

01:23:07,430 --> 01:23:05,600

they're gonna have slightly different

2526

01:23:08,629 --> 01:23:07,440

frequency resonant frequencies and

2527

01:23:09,750 --> 01:23:08,639

that's going to give rise to beat

2528

01:23:11,270 --> 01:23:09,760

frequencies

2529

01:23:13,270 --> 01:23:11,280

so going back to what i said before

2530

01:23:15,189 --> 01:23:13,280

about you know eventually when i

2531

01:23:16,950 --> 01:23:15,199

and and what you said about repeating at

2532

01:23:19,430 --> 01:23:16,960

different frequency ranges

2533

01:23:21,669 --> 01:23:19,440

we want to get the cell similar patterns

2534

01:23:22,950 --> 01:23:21,679

from the terahertz gigahertz megahertz

2535

01:23:26,149 --> 01:23:22,960

kilohertz

2536

01:23:28,870 --> 01:23:26,159

and hertz which is eeg so the eeg

2537

01:23:29,430 --> 01:23:28,880

may be kind of a a snapshot at a very

2538

01:23:32,830 --> 01:23:29,440

slow

2539

01:23:35,350 --> 01:23:32,840

low frequency of what's happening at

2540

01:23:36,550 --> 01:23:35,360

kilohertz uh megahertz gigahertz and

2541

01:23:38,709 --> 01:23:36,560

terahertz

2542

01:23:40,709 --> 01:23:38,719

so it's all kind of more like music than

2543

01:23:42,070 --> 01:23:40,719

computation is another way of putting it

2544

01:23:44,149 --> 01:23:42,080

when you have resonances and

2545

01:23:45,750 --> 01:23:44,159

and harmonics and interference beats

2546

01:23:50,550 --> 01:23:45,760

like in music

2547

01:23:53,990 --> 01:23:51,830

this is just for the people who are

2548

01:23:55,750 --> 01:23:54,000

watching all over yeah so what are these

2549

01:23:58,790 --> 01:23:55,760

frequencies indicating

2550

01:24:00,310 --> 01:23:58,800

is it that same energy yeah yeah that

2551

01:24:02,310 --> 01:24:00,320

goes along with that

2552

01:24:04,149 --> 01:24:02,320

yeah yeah and then i try to put it in a

2553

01:24:08,550 --> 01:24:04,159

schematic to show what's happening at

2554

01:24:12,709 --> 01:24:11,669

does this mean that potentially quantum

2555

01:24:15,750 --> 01:24:12,719

computers can be

2556

01:24:17,910 --> 01:24:15,760

conscious they would have to collapse by

2557

01:24:19,030 --> 01:24:17,920

roger's mechanism and right now quantum

2558

01:24:21,669 --> 01:24:19,040

computers

2559

01:24:22,950 --> 01:24:21,679

are built at uh near near absolute zero

2560

01:24:26,229 --> 01:24:22,960

and um

2561

01:24:27,270 --> 01:24:26,239

uh they collapse because somebody makes

2562

01:24:29,669 --> 01:24:27,280

a measurement which

2563

01:24:31,189 --> 01:24:29,679

this is randomness so it's presently

2564

01:24:34,390 --> 01:24:31,199

constituted no

2565

01:24:36,229 --> 01:24:34,400

however uh uh my friend hart mcnevin who

2566

01:24:39,750 --> 01:24:36,239

is the head of uh

2567

01:24:42,070 --> 01:24:39,760

google google's quantum ai

2568

01:24:43,189 --> 01:24:42,080

uh roger and i visited there uh a year

2569

01:24:46,229 --> 01:24:43,199

or so ago

2570

01:24:49,430 --> 01:24:46,239

and uh we were talking about this

2571

01:24:50,149 --> 01:24:49,440

and uh they they had uh discovered some

2572

01:24:51,430 --> 01:24:50,159

anomalies

2573

01:24:54,390 --> 01:24:51,440

in their quantum computing when it

2574

01:24:57,110 --> 01:24:54,400

seemed to be uh collapsing prematurely

2575

01:24:58,709 --> 01:24:57,120

and uh i had and hartman told me that i

2576

01:24:59,910 --> 01:24:58,719

said well are you sure your client care

2577

01:25:01,270 --> 01:24:59,920

is not conscious

2578

01:25:03,910 --> 01:25:01,280

you know it's having the roger's

2579

01:25:05,110 --> 01:25:03,920

objective reduction and he said oh my

2580

01:25:07,750 --> 01:25:05,120

god i hope not

2581

01:25:08,470 --> 01:25:07,760

because that would have created a public

2582

01:25:11,750 --> 01:25:08,480

relations

2583

01:25:12,870 --> 01:25:11,760

issue so this one of his people gave a

2584

01:25:14,550 --> 01:25:12,880

seminar and

2585

01:25:16,149 --> 01:25:14,560

showed you know tons and tons of

2586

01:25:18,229 --> 01:25:16,159

equations that i didn't understand

2587

01:25:19,270 --> 01:25:18,239

and concluded that no it wasn't

2588

01:25:21,350 --> 01:25:19,280

objective reduction

2589

01:25:22,310 --> 01:25:21,360

and their quantum computer wasn't

2590

01:25:24,310 --> 01:25:22,320

conscious

2591

01:25:26,149 --> 01:25:24,320

i'm not sure i understood but they at

2592

01:25:28,310 --> 01:25:26,159

least they at least thought about it

2593

01:25:29,189 --> 01:25:28,320

however i think it is possible to have a

2594

01:25:31,590 --> 01:25:29,199

conscious

2595

01:25:33,830 --> 01:25:31,600

quantum computer if you built it out of

2596

01:25:34,229 --> 01:25:33,840

something like uh graphene or fullerenes

2597

01:25:37,510 --> 01:25:34,239

that's

2598

01:25:39,350 --> 01:25:37,520

at warm temperature

2599

01:25:41,030 --> 01:25:39,360

and pumped it to get to get coherence

2600

01:25:43,030 --> 01:25:41,040

which would be basically building

2601
01:25:44,390 --> 01:25:43,040
something like a microtubule in an

2602
01:25:48,149 --> 01:25:44,400
artificial sense

2603
01:25:50,310 --> 01:25:48,159
i i you know that's it's not something i

2604
01:25:51,750 --> 01:25:50,320
want to do because i i'm not

2605
01:25:53,750 --> 01:25:51,760
technological but

2606
01:25:55,830 --> 01:25:53,760
i think it that is possible that may be

2607
01:25:57,510 --> 01:25:55,840
the future of

2608
01:25:58,709 --> 01:25:57,520
consciousness in you know in vitro if

2609
01:26:00,709 --> 01:25:58,719
you want to have a conscious computer

2610
01:26:02,870 --> 01:26:00,719
that'd be the way to do it

2611
01:26:04,629 --> 01:26:02,880
in the brain i believe it's topological

2612
01:26:08,310 --> 01:26:04,639
qubits

2613
01:26:13,910 --> 01:26:08,320

the topological yes so in the in the uh

2614

01:26:17,350 --> 01:26:15,669

cutting off just one second do you mind

2615

01:26:19,030 --> 01:26:17,360

repeating that because as far as i don't

2616

01:26:20,629 --> 01:26:19,040

think google is pursuing topological

2617

01:26:22,629 --> 01:26:20,639

qubits but i know microsoft is

2618

01:26:23,750 --> 01:26:22,639

so if anyone has a chance of producing a

2619

01:26:25,750 --> 01:26:23,760

conscious computer would

2620

01:26:27,750 --> 01:26:25,760

it would be them but i'm not sure if

2621

01:26:29,030 --> 01:26:27,760

topological qubits are required or if

2622

01:26:31,270 --> 01:26:29,040

it's just because

2623

01:26:33,110 --> 01:26:31,280

of the brain needing some area

2624

01:26:33,590 --> 01:26:33,120

correcting and topological qubits seem

2625

01:26:37,510 --> 01:26:33,600

to be

2626

01:26:39,669 --> 01:26:37,520

careful here because roger

2627

01:26:40,790 --> 01:26:39,679

this is where another uh where roger and

2628

01:26:42,149 --> 01:26:40,800

i don't don't agree

2629

01:26:44,149 --> 01:26:42,159

and i'm not sure it's because i'm not

2630

01:26:46,709 --> 01:26:44,159

explaining uh

2631

01:26:47,830 --> 01:26:46,719

i think properly or he's smarter than me

2632

01:26:51,510 --> 01:26:47,840

and knows i'm wrong

2633

01:26:54,950 --> 01:26:51,520

before i even get there uh but

2634

01:26:58,229 --> 01:26:54,960

what happened was uh this goes back to

2635

01:27:00,629 --> 01:26:58,239

the late 90s roger invited me to the uh

2636

01:27:02,229 --> 01:27:00,639

to the royal society meeting on uh on

2637

01:27:03,669 --> 01:27:02,239

quantum information which was

2638

01:27:05,990 --> 01:27:03,679

right when all the entanglement stuff

2639

01:27:06,950 --> 01:27:06,000

was coming out really exciting time we

2640

01:27:08,709 --> 01:27:06,960

had all these uh

2641

01:27:10,470 --> 01:27:08,719

super smart young physicists talking

2642

01:27:12,470 --> 01:27:10,480

about entanglement over

2643

01:27:14,550 --> 01:27:12,480

hundreds of miles and this and that and

2644

01:27:15,990 --> 01:27:14,560

um you know i mean the aspect experiment

2645

01:27:16,950 --> 01:27:16,000

proving entanglement didn't happen until

2646

01:27:19,430 --> 01:27:16,960

86.

2647

01:27:20,629 --> 01:27:19,440

so 10 10 or 12 years later you know a

2648

01:27:22,709 --> 01:27:20,639

lot of it happened and they were

2649

01:27:23,910 --> 01:27:22,719

talking about this technology and we had

2650

01:27:26,790 --> 01:27:23,920

a talk by uh

2651

01:27:27,590 --> 01:27:26,800

uh john preschool of caltech and he

2652

01:27:30,470 --> 01:27:27,600

showed a

2653

01:27:31,750 --> 01:27:30,480

a a lattice for a quantum computer which

2654

01:27:33,669 --> 01:27:31,760

was orthogonal

2655

01:27:35,189 --> 01:27:33,679

where he had the quantum computations

2656

01:27:37,669 --> 01:27:35,199

running in one direction

2657

01:27:40,149 --> 01:27:37,679

kind of up and down and he had the

2658

01:27:42,550 --> 01:27:40,159

quantum air correction running

2659

01:27:44,229 --> 01:27:42,560

sideways so they were intersecting and

2660

01:27:45,030 --> 01:27:44,239

the quantum merit correction would would

2661

01:27:47,430 --> 01:27:45,040

correct the

2662

01:27:49,030 --> 01:27:47,440

what was happening on on the vertical

2663

01:27:51,669 --> 01:27:49,040

and uh

2664

01:27:53,350 --> 01:27:51,679

i kind of woke up from from dozing

2665

01:27:56,790 --> 01:27:53,360

because i

2666

01:27:59,270 --> 01:27:56,800

they had lost me a hexagonal lattice

2667

01:28:01,350 --> 01:27:59,280

like thinking on microtubule

2668

01:28:02,709 --> 01:28:01,360

well sure why not where you have it

2669

01:28:03,910 --> 01:28:02,719

going this way so

2670

01:28:05,910 --> 01:28:03,920

on the coffee break i was talking with

2671

01:28:08,470 --> 01:28:05,920

roger about it and he said wouldn't it

2672

01:28:11,830 --> 01:28:08,480

be interesting if the fibonacci pathways

2673

01:28:14,870 --> 01:28:11,840

were some kind of topological qubit and

2674

01:28:15,350 --> 01:28:14,880

but for him topology means like you know

2675

01:28:21,030 --> 01:28:15,360

the

2676

01:28:23,590 --> 01:28:21,040

topology because of this and it has a

2677

01:28:26,229 --> 01:28:23,600

whole another meeting that that i wasn't

2678

01:28:27,030 --> 01:28:26,239

catching on to so uh i don't want to

2679

01:28:28,629 --> 01:28:27,040

talk about

2680

01:28:30,070 --> 01:28:28,639

so now i just call them helical

2681

01:28:32,310 --> 01:28:30,080

geometric pathways

2682

01:28:33,270 --> 01:28:32,320

but i think they could be topological in

2683

01:28:35,430 --> 01:28:33,280

a sense

2684

01:28:36,870 --> 01:28:35,440

and if you had them in a right because

2685

01:28:38,550 --> 01:28:36,880

in a microtubule if you have a

2686

01:28:40,470 --> 01:28:38,560

the helical pathway it's much more

2687

01:28:43,110 --> 01:28:40,480

stable from a quantum standpoint

2688

01:28:44,550 --> 01:28:43,120

because if for example one individual

2689

01:28:46,070 --> 01:28:44,560

tubulin gets out of whack it's going to

2690

01:28:47,030 --> 01:28:46,080

be pulled back into quantum coherence by

2691

01:28:48,629 --> 01:28:47,040

the others

2692

01:28:50,229 --> 01:28:48,639

so i think these helical geometric

2693

01:28:52,149 --> 01:28:50,239

pathways whether you call them

2694

01:28:54,470 --> 01:28:52,159

topological or not might be there might

2695

01:28:56,229 --> 01:28:54,480

be a way to go for quantum computing

2696

01:28:58,229 --> 01:28:56,239

in some kind of material it doesn't need

2697

01:28:59,750 --> 01:28:58,239

to be absolutely cold

2698

01:29:01,669 --> 01:28:59,760

is there something specific about the

2699

01:29:02,870 --> 01:29:01,679

lattice that's conducive to quantum

2700

01:29:05,430 --> 01:29:02,880

computing

2701
01:29:06,790 --> 01:29:05,440
or consciousness because i know that

2702
01:29:08,830 --> 01:29:06,800
penrose has done some work on the

2703
01:29:11,830 --> 01:29:08,840
tilings which are aperiodic which are

2704
01:29:13,590 --> 01:29:11,840
not tilings

2705
01:29:15,189 --> 01:29:13,600
well they're not periodic tilings i

2706
01:29:17,030 --> 01:29:15,199
don't know about the relationship

2707
01:29:18,470 --> 01:29:17,040
between periodic and aperiodic

2708
01:29:20,149 --> 01:29:18,480
i don't know if penrose was using those

2709
01:29:21,590 --> 01:29:20,159
tilings to demonstrate that well we can

2710
01:29:22,629 --> 01:29:21,600
do something that's non-computational

2711
01:29:23,910 --> 01:29:22,639
that was it or if it

2712
01:29:25,910 --> 01:29:23,920
has some other implication for

2713
01:29:27,910 --> 01:29:25,920

consciousness

2714

01:29:29,270 --> 01:29:27,920

good question i'm not sure actually i've

2715

01:29:31,350 --> 01:29:29,280

kind of asked him that myself

2716

01:29:33,030 --> 01:29:31,360

and and uh i get the feeling i'm not

2717

01:29:35,189 --> 01:29:33,040

even close to being able to

2718

01:29:36,950 --> 01:29:35,199

figure out what he's saying on that so i

2719

01:29:40,550 --> 01:29:36,960

can't really answer that

2720

01:29:42,550 --> 01:29:40,560

but the helical pathways i think

2721

01:29:45,270 --> 01:29:42,560

are very useful because they avoid

2722

01:29:47,189 --> 01:29:45,280

de-coherence and help us in other ways

2723

01:29:48,550 --> 01:29:47,199

why is it that iit says that

2724

01:29:49,990 --> 01:29:48,560

consciousness occurs at the back of the

2725

01:29:51,270 --> 01:29:50,000

brain but then the global neuronal

2726
01:29:53,990 --> 01:29:51,280
workspace theory says that

2727
01:29:54,790 --> 01:29:54,000
occurs at the front and where does your

2728
01:29:58,390 --> 01:29:54,800
theory

2729
01:30:02,229 --> 01:30:01,750
in pyramidal cells so the cortex has six

2730
01:30:04,229 --> 01:30:02,239
layers

2731
01:30:06,070 --> 01:30:04,239
the cortex covers well you know the

2732
01:30:09,189 --> 01:30:06,080
whole not the cerebellum but

2733
01:30:09,830 --> 01:30:09,199
everything else is on top and it's six

2734
01:30:13,590 --> 01:30:09,840
layers

2735
01:30:15,590 --> 01:30:13,600
and uh so when uh information comes in

2736
01:30:19,110 --> 01:30:15,600
it goes to layer

2737
01:30:19,990 --> 01:30:19,120
uh five well it winds up in layer five

2738
01:30:21,590 --> 01:30:20,000

it goes to four

2739

01:30:23,910 --> 01:30:21,600

and then from four goes one two three

2740

01:30:25,270 --> 01:30:23,920

and six and one two three and six

2741

01:30:26,950 --> 01:30:25,280

converge on layer five

2742

01:30:29,830 --> 01:30:26,960

and layer five is the pyramidal

2743

01:30:31,910 --> 01:30:29,840

pyramidal neurons they have these huge

2744

01:30:33,030 --> 01:30:31,920

cone-shaped cell bodies they call them

2745

01:30:34,870 --> 01:30:33,040

pyramids because

2746

01:30:36,390 --> 01:30:34,880

they look pure but actually they're

2747

01:30:38,470 --> 01:30:36,400

they're cone-shaped

2748

01:30:39,750 --> 01:30:38,480

and they're enormous compared to other

2749

01:30:42,790 --> 01:30:39,760

neurons

2750

01:30:45,430 --> 01:30:42,800

and they they have

2751

01:30:47,990 --> 01:30:45,440

the biggest array of mixed polarity

2752

01:30:50,790 --> 01:30:48,000

interrupted microtubules anywhere

2753

01:30:51,910 --> 01:30:50,800

and their basal or dendrites are

2754

01:30:54,950 --> 01:30:51,920

continuous and this

2755

01:30:56,870 --> 01:30:54,960

so they form one continuous sheet over

2756

01:31:00,149 --> 01:30:56,880

the whole cortex

2757

01:31:02,310 --> 01:31:00,159

and they are the and their outputs uh

2758

01:31:04,629 --> 01:31:02,320

illicit behavior and their apical

2759

01:31:07,030 --> 01:31:04,639

dendrites give rise to eeg

2760

01:31:08,070 --> 01:31:07,040

so i think consciousness can happen in

2761

01:31:11,590 --> 01:31:08,080

in

2762

01:31:13,110 --> 01:31:11,600

really if

2763

01:31:15,270 --> 01:31:13,120

but it may be proto-conscious if it

2764

01:31:18,310 --> 01:31:15,280

doesn't have information but the most

2765

01:31:19,830 --> 01:31:18,320

likely place in the brain would be among

2766

01:31:21,350 --> 01:31:19,840

the pyramidal neurons

2767

01:31:23,750 --> 01:31:21,360

of layer five throughout the whole

2768

01:31:25,430 --> 01:31:23,760

cortex with lateral connections

2769

01:31:27,110 --> 01:31:25,440

and i think consciousness can actually

2770

01:31:28,550 --> 01:31:27,120

move around within it

2771

01:31:30,709 --> 01:31:28,560

so if you're having an auditory

2772

01:31:32,709 --> 01:31:30,719

sensation it's an auditory cortex

2773

01:31:34,790 --> 01:31:32,719

visual it's in the visual cortex and

2774

01:31:37,830 --> 01:31:34,800

other other areas are related

2775

01:31:41,270 --> 01:31:37,840

prefrontal cortex i mean um

2776

01:31:41,830 --> 01:31:41,280

with with uh there the whole brain there

2777

01:31:43,189 --> 01:31:41,840

are three

2778

01:31:44,870 --> 01:31:43,199

you know it goes in three ways from

2779

01:31:46,390 --> 01:31:44,880

thalamus to primary cortex primary

2780

01:31:48,390 --> 01:31:46,400

cortex to the front of the brain

2781

01:31:50,149 --> 01:31:48,400

front of the brain elsewhere and it's

2782

01:31:51,270 --> 01:31:50,159

that third wave elsewhere

2783

01:31:52,790 --> 01:31:51,280

that seems to correlate with

2784

01:31:54,950 --> 01:31:52,800

consciousness because that's the only

2785

01:31:57,990 --> 01:31:54,960

way that's affected by anesthesia

2786

01:32:01,270 --> 01:31:58,000

now how about how that fits with gnw and

2787

01:32:03,830 --> 01:32:01,280

iit and uh

2788

01:32:05,910 --> 01:32:03,840

higher order theory and recursive

2789

01:32:08,550 --> 01:32:05,920

processing all the other theories

2790

01:32:09,590 --> 01:32:08,560

i'm not sure and i know that in the

2791

01:32:11,270 --> 01:32:09,600

templeton

2792

01:32:12,629 --> 01:32:11,280

program on accelerating research and

2793

01:32:15,189 --> 01:32:12,639

consciousness there's a

2794

01:32:16,149 --> 01:32:15,199

five million dollar study uh front of

2795

01:32:18,709 --> 01:32:16,159

the brain versus

2796

01:32:20,470 --> 01:32:18,719

back of the brain iit versus uh global

2797

01:32:22,390 --> 01:32:20,480

neuronal workspace

2798

01:32:24,149 --> 01:32:22,400

and i'm not sure what that's going to

2799

01:32:25,669 --> 01:32:24,159

prove actually because i think under

2800

01:32:27,270 --> 01:32:25,679

different circumstances consciousness

2801

01:32:28,629 --> 01:32:27,280

can be anywhere in the brain

2802

01:32:31,830 --> 01:32:28,639

but we'll find out we're part of that

2803

01:32:35,669 --> 01:32:31,840

program too but we're we're much more uh

2804

01:32:37,590 --> 01:32:35,679

uh focused on looking at effects of

2805

01:32:39,110 --> 01:32:37,600

anesthesia on quantum vibrations and

2806

01:32:41,510 --> 01:32:39,120

microtubules

2807

01:32:43,990 --> 01:32:41,520

and if we don't see that we're we'll

2808

01:32:45,189 --> 01:32:44,000

we'll be falsified so we're

2809

01:32:47,030 --> 01:32:45,199

we're putting their money where our

2810

01:32:50,070 --> 01:32:47,040

mouth is i'm not sure if this other

2811

01:32:52,550 --> 01:32:50,080

study will prove anything but we'll see

2812

01:32:53,189 --> 01:32:52,560

i actually i've talked and read a lot

2813

01:32:58,709 --> 01:32:53,199

about

2814

01:33:01,350 --> 01:32:58,719

i don't really understand it i know it's

2815

01:33:02,950 --> 01:33:01,360

it's some measure of integration

2816

01:33:04,550 --> 01:33:02,960

but they say that it can happen at any

2817

01:33:05,830 --> 01:33:04,560

level so i asked christoph and julia

2818

01:33:07,990 --> 01:33:05,840

well what happens if

2819

01:33:09,750 --> 01:33:08,000

if you measure microtubules in uh if you

2820

01:33:11,669 --> 01:33:09,760

measure phi in microtubules

2821

01:33:12,790 --> 01:33:11,679

they said yeah it could be extremely

2822

01:33:13,669 --> 01:33:12,800

high there so that's well how do you

2823

01:33:15,110 --> 01:33:13,679

measure it

2824

01:33:16,310 --> 01:33:15,120

and they would they they couldn't say

2825

01:33:17,750 --> 01:33:16,320

how you would measure it i said what if

2826
01:33:18,870 --> 01:33:17,760
we get these quantum vibrations and

2827
01:33:21,990 --> 01:33:18,880
microtubules

2828
01:33:23,590 --> 01:33:22,000
could you apply and see if that that is

2829
01:33:25,110 --> 01:33:23,600
phi and they they wouldn't answer that

2830
01:33:27,750 --> 01:33:25,120
either so

2831
01:33:29,350 --> 01:33:27,760
uh i don't know actually and i think all

2832
01:33:30,870 --> 01:33:29,360
those other theories can be

2833
01:33:32,470 --> 01:33:30,880
more or less correct they're all at the

2834
01:33:34,629 --> 01:33:32,480
level of neurons although

2835
01:33:36,149 --> 01:33:34,639
ihds that can happen at any level but

2836
01:33:37,910 --> 01:33:36,159
they really focus on neurons

2837
01:33:39,830 --> 01:33:37,920
they could all be happening and then but

2838
01:33:40,390 --> 01:33:39,840

still need or happening at a deeper

2839

01:33:44,390 --> 01:33:40,400

level

2840

01:33:46,709 --> 01:33:44,400

so they're all basically uh

2841

01:33:47,750 --> 01:33:46,719

are cognitive architectures that may or

2842

01:33:49,110 --> 01:33:47,760

may not have anything to do with

2843

01:33:50,870 --> 01:33:49,120

consciousness

2844

01:33:52,229 --> 01:33:50,880

of course i'm yeah i'm skeptical i'm the

2845

01:33:53,990 --> 01:33:52,239

enemy according to them

2846

01:33:55,510 --> 01:33:54,000

and uh but i think that you need to go

2847

01:33:58,550 --> 01:33:55,520

to a deeper level into the quantum

2848

01:34:00,149 --> 01:33:58,560

economic realm do you feel like anyone

2849

01:34:02,310 --> 01:34:00,159

else has a scientific theory that

2850

01:34:03,990 --> 01:34:02,320

confronts the hard problem or something

2851
01:34:05,430 --> 01:34:04,000
that's posed as rigorous even

2852
01:34:07,910 --> 01:34:05,440
something slightly rigorous that could

2853
01:34:10,310 --> 01:34:07,920
be philosophical i think uh

2854
01:34:11,910 --> 01:34:10,320
i think our theory is head and shoulders

2855
01:34:13,350 --> 01:34:11,920
above any other theory in that regard in

2856
01:34:14,310 --> 01:34:13,360
terms of rigor or even approaching the

2857
01:34:16,629 --> 01:34:14,320
heart problem

2858
01:34:18,070 --> 01:34:16,639
i mean everybody else basically says

2859
01:34:19,510 --> 01:34:18,080
it's an emergent phenomenon at a

2860
01:34:22,790 --> 01:34:19,520
critical level of something

2861
01:34:24,709 --> 01:34:22,800
complexity some non-linear function that

2862
01:34:26,790 --> 01:34:24,719
has not yet been defined maybe it's five

2863
01:34:29,189 --> 01:34:26,800

but what is phi we don't really know

2864

01:34:30,870 --> 01:34:29,199

so i'm pretty i'm pretty uh dubious

2865

01:34:33,750 --> 01:34:30,880

about that i think uh

2866

01:34:34,470 --> 01:34:33,760

you know we're we're way farther out on

2867

01:34:36,470 --> 01:34:34,480

a limb

2868

01:34:37,510 --> 01:34:36,480

we're much easier to falsify than any

2869

01:34:39,030 --> 01:34:37,520

other theory

2870

01:34:40,310 --> 01:34:39,040

and that's both good and bad it's bad

2871

01:34:42,550 --> 01:34:40,320

because we could be falsified but it's

2872

01:34:44,070 --> 01:34:42,560

good that we have a specific theory

2873

01:34:45,910 --> 01:34:44,080

you know if it can't be falsified then

2874

01:34:47,830 --> 01:34:45,920

it's not a theory what are some ways of

2875

01:34:49,510 --> 01:34:47,840

falsifying it

2876

01:34:50,870 --> 01:34:49,520

well the what i just said we're we're in

2877

01:34:53,750 --> 01:34:50,880

this program now we're

2878

01:34:54,709 --> 01:34:53,760

starting experiments very soon uh so the

2879

01:34:58,870 --> 01:34:54,719

way they showed

2880

01:35:01,350 --> 01:34:58,880

quantum effects in photosynthesis

2881

01:35:03,109 --> 01:35:01,360

protein is take a this protein

2882

01:35:04,790 --> 01:35:03,119

and do what's called 2d electron

2883

01:35:07,270 --> 01:35:04,800

spectroscopy where you put

2884

01:35:08,229 --> 01:35:07,280

i think three laser beams in and get two

2885

01:35:11,590 --> 01:35:08,239

laser beams out

2886

01:35:13,910 --> 01:35:11,600

and if there's a or two emission two uh

2887

01:35:15,030 --> 01:35:13,920

emissions from it and if there's a

2888

01:35:17,990 --> 01:35:15,040

quantum superposition

2889

01:35:20,390 --> 01:35:18,000

in the protein then you get a sawtooth

2890

01:35:21,669 --> 01:35:20,400

interference a set of of interference

2891

01:35:23,270 --> 01:35:21,679

peaks coming out

2892

01:35:25,270 --> 01:35:23,280

and that is indicative that there's a

2893

01:35:27,189 --> 01:35:25,280

quantum superposition in the protein

2894

01:35:29,510 --> 01:35:27,199

so that was done with an fmo protein of

2895

01:35:31,109 --> 01:35:29,520

about 25 kilograms

2896

01:35:33,350 --> 01:35:31,119

and we'll be trying it at tubulin which

2897

01:35:36,950 --> 01:35:33,360

is 110 kilodollars 110

2898

01:35:42,149 --> 01:35:36,960

000. what's a kilodown kill adult

2899

01:35:44,790 --> 01:35:42,159

uh uh that's the united st

2900

01:35:45,910 --> 01:35:44,800

okay okay it's 110 the molecular the

2901

01:35:49,189 --> 01:35:45,920

molecular weight

2902

01:35:51,590 --> 01:35:49,199

is uh her atomic weight is 110 000. so

2903

01:35:53,109 --> 01:35:51,600

uh if you count up all the uh protons

2904

01:35:54,629 --> 01:35:53,119

and neutrons so it has i don't know how

2905

01:35:57,830 --> 01:35:54,639

many atoms out of that

2906

01:36:01,189 --> 01:35:57,840

but um uh

2907

01:36:02,550 --> 01:36:01,199

that's uh uh if the tubulin is four

2908

01:36:03,830 --> 01:36:02,560

times the size of the protein they

2909

01:36:04,870 --> 01:36:03,840

previously measured on is what i'm

2910

01:36:07,750 --> 01:36:04,880

trying to say

2911

01:36:09,590 --> 01:36:07,760

so it's it's a it's a step up and the

2912

01:36:10,550 --> 01:36:09,600

guy doing it is greg scholes who did

2913

01:36:12,229 --> 01:36:10,560

some of the original work in the

2914

01:36:12,870 --> 01:36:12,239

photosynthesis protein he's an expert in

2915

01:36:14,390 --> 01:36:12,880

this

2916

01:36:16,709 --> 01:36:14,400

so he thinks he can do it and there's

2917

01:36:18,709 --> 01:36:16,719

some tricks involved and if we see that

2918

01:36:20,070 --> 01:36:18,719

if we see that quantum interference at

2919

01:36:22,390 --> 01:36:20,080

room temperature

2920

01:36:23,990 --> 01:36:22,400

in a in a tubulin protein we'll then

2921

01:36:25,109 --> 01:36:24,000

attempt to anesthetize and see if it

2922

01:36:26,470 --> 01:36:25,119

goes away

2923

01:36:28,390 --> 01:36:26,480

proportional to the potency of the

2924

01:36:31,109 --> 01:36:28,400

anesthetic and we'd like to also give it

2925

01:36:32,709 --> 01:36:31,119

psychedelics and see if it increases ah

2926

01:36:33,030 --> 01:36:32,719

speaking of psychedelics you mentioned

2927

01:36:34,390 --> 01:36:33,040

that

2928

01:36:36,470 --> 01:36:34,400

well i'm not sure if it was you but

2929

01:36:39,109 --> 01:36:36,480

there's an indole group and they

2930

01:36:41,430 --> 01:36:39,119

interact with the benzene in some manner

2931

01:36:42,629 --> 01:36:41,440

uh an indole has a benzene and a

2932

01:36:45,030 --> 01:36:42,639

five-sided ring

2933

01:36:47,189 --> 01:36:45,040

combined it's a fuse it's fused so it's

2934

01:36:48,870 --> 01:36:47,199

found in tryptophan the amino acid

2935

01:36:51,109 --> 01:36:48,880

it's found in most of the psychedelics

2936

01:36:53,270 --> 01:36:51,119

you have this indoor ring

2937

01:36:55,189 --> 01:36:53,280

uh it's amazing actually the the the

2938

01:36:56,310 --> 01:36:55,199

neurotransmitters like serotonin and

2939

01:36:57,990 --> 01:36:56,320

dopamine

2940

01:36:59,430 --> 01:36:58,000

and the psychedelics all have these same

2941

01:37:02,149 --> 01:36:59,440

pi resonance groups that

2942

01:37:03,830 --> 01:37:02,159

that are conducive to quantum effects i

2943

01:37:05,350 --> 01:37:03,840

don't know if you've heard of this

2944

01:37:06,790 --> 01:37:05,360

thought i think you have because i think

2945

01:37:07,750 --> 01:37:06,800

i got it from you there's a thought

2946

01:37:09,189 --> 01:37:07,760

experiment by coke

2947

01:37:11,030 --> 01:37:09,199

called i don't know what to call it

2948

01:37:13,350 --> 01:37:11,040

other than binocular rivalry

2949

01:37:15,030 --> 01:37:13,360

and i'm not sure if it has implications

2950

01:37:16,390 --> 01:37:15,040

for your theory or implications for some

2951
01:37:17,189 --> 01:37:16,400
other theory but do you mind outlining

2952
01:37:19,430 --> 01:37:17,199
what that is

2953
01:37:20,709 --> 01:37:19,440
and then what your thoughts are on it

2954
01:37:23,750 --> 01:37:20,719
yeah well actually uh

2955
01:37:25,430 --> 01:37:23,760
it was done by nico slogathetis

2956
01:37:27,910 --> 01:37:25,440
where you present different images to

2957
01:37:30,870 --> 01:37:27,920
different to the two eyes

2958
01:37:32,550 --> 01:37:30,880
uh so one eye sings one scene one eyes

2959
01:37:34,550 --> 01:37:32,560
seeing the other thing

2960
01:37:35,669 --> 01:37:34,560
uh the other way to think of it is the

2961
01:37:37,430 --> 01:37:35,679
neck or cube

2962
01:37:39,189 --> 01:37:37,440
where you see in the foreground of the

2963
01:37:41,270 --> 01:37:39,199

background it shifts back and forth

2964

01:37:42,229 --> 01:37:41,280

or the the the vase and the face and

2965

01:37:44,310 --> 01:37:42,239

that sort of thing

2966

01:37:46,149 --> 01:37:44,320

there's two different perceptions but if

2967

01:37:48,149 --> 01:37:46,159

you if you put the two different things

2968

01:37:49,510 --> 01:37:48,159

you have a conscious perception of one

2969

01:37:51,510 --> 01:37:49,520

and then it switches to the other that

2970

01:37:54,790 --> 01:37:51,520

switches back and forth

2971

01:37:56,550 --> 01:37:54,800

and um uh i would say that you have a

2972

01:37:57,350 --> 01:37:56,560

superposition of both and it collapses

2973

01:37:59,270 --> 01:37:57,360

to one

2974

01:38:00,830 --> 01:37:59,280

and then it collapses to the other so i

2975

01:38:03,350 --> 01:38:00,840

have a you know that's that'd be our

2976

01:38:05,510 --> 01:38:03,360

explanation and my explanation for that

2977

01:38:07,270 --> 01:38:05,520

let's get to penrose and his explanation

2978

01:38:08,709 --> 01:38:07,280

as to how consciousness arises so

2979

01:38:10,470 --> 01:38:08,719

there's a superposition at a quantum

2980

01:38:12,470 --> 01:38:10,480

level and when it collapses

2981

01:38:14,629 --> 01:38:12,480

that is a small proto-consciousness

2982

01:38:15,189 --> 01:38:14,639

moment and somehow that consciousness

2983

01:38:17,830 --> 01:38:15,199

moment

2984

01:38:20,709 --> 01:38:17,840

is either influenced by or accesses

2985

01:38:23,590 --> 01:38:20,719

platonic forms

2986

01:38:25,030 --> 01:38:23,600

yes although yes uh well if it's

2987

01:38:26,629 --> 01:38:25,040

happening if it's proto-conscious

2988

01:38:28,709 --> 01:38:26,639

happening here there and everywhere

2989

01:38:30,149 --> 01:38:28,719

it's gonna have very little effect it's

2990

01:38:31,430 --> 01:38:30,159

gonna be

2991

01:38:33,350 --> 01:38:31,440

it's not going to be affected very much

2992

01:38:36,950 --> 01:38:33,360

by these platonic forms

2993

01:38:39,510 --> 01:38:36,960

which uh are kind of preferred states in

2994

01:38:40,870 --> 01:38:39,520

and uh in our in our paper roger came up

2995

01:38:41,910 --> 01:38:40,880

with the name of the equations that

2996

01:38:44,149 --> 01:38:41,920

actually govern this but i

2997

01:38:45,510 --> 01:38:44,159

i forget what they are at the moment um

2998

01:38:47,590 --> 01:38:45,520

but you need a you need a pretty

2999

01:38:49,430 --> 01:38:47,600

organized or orchestrated uh

3000

01:38:51,590 --> 01:38:49,440

superposition for that effect to be

3001
01:38:52,629 --> 01:38:51,600
significant yes that's the idea that

3002
01:38:54,229 --> 01:38:52,639
it's not random

3003
01:38:56,229 --> 01:38:54,239
like as it would be in measurement or

3004
01:38:56,950 --> 01:38:56,239
de-coherence but there's some influence

3005
01:38:59,990 --> 01:38:56,960
due to these

3006
01:39:02,950 --> 01:39:00,000
platonic testosterone preferred states

3007
01:39:04,390 --> 01:39:02,960
and therefore if you're mindful it'd be

3008
01:39:06,149 --> 01:39:04,400
like what we call intuition or

3009
01:39:09,590 --> 01:39:06,159
creativity or insight or

3010
01:39:12,390 --> 01:39:09,600
hunch or stroke of genius or

3011
01:39:14,310 --> 01:39:12,400
the way of the dao or divine guidance or

3012
01:39:16,550 --> 01:39:14,320
you know however you want to put it

3013
01:39:18,229 --> 01:39:16,560

speaking of stroke of genius the part of

3014

01:39:18,550 --> 01:39:18,239

your theory and penrose's theory that i

3015

01:39:20,870 --> 01:39:18,560

like

3016

01:39:21,669 --> 01:39:20,880

the most is not just the ingenuity of it

3017

01:39:23,189 --> 01:39:21,679

but the fa and

3018

01:39:25,030 --> 01:39:23,199

so for example you fold in multiple

3019

01:39:27,109 --> 01:39:25,040

mysteries like

3020

01:39:28,629 --> 01:39:27,119

how does one integrate quantum theory

3021

01:39:31,669 --> 01:39:28,639

with gravity and so on

3022

01:39:33,350 --> 01:39:31,679

but and by the way let me just

3023

01:39:34,229 --> 01:39:33,360

say we're criticized by i don't want to

3024

01:39:34,790 --> 01:39:34,239

interrupt your train of thought because

3025

01:39:35,990 --> 01:39:34,800

i want to hear

3026

01:39:37,910 --> 01:39:36,000

you you're going to ask me yeah it's a

3027

01:39:40,790 --> 01:39:37,920

compliment so

3028

01:39:41,109 --> 01:39:40,800

but but you know when you criticized uh

3029

01:39:44,070 --> 01:39:41,119

for

3030

01:39:45,430 --> 01:39:44,080

you know well people really chalmers has

3031

01:39:47,430 --> 01:39:45,440

ridiculed us and and

3032

01:39:49,109 --> 01:39:47,440

stephen pinker said well quantum theory

3033

01:39:51,030 --> 01:39:49,119

is one mystery consciousness

3034

01:39:52,629 --> 01:39:51,040

maybe they're the same mystery ha ha

3035

01:39:56,709 --> 01:39:52,639

well damn it maybe they are

3036

01:39:59,030 --> 01:39:56,719

and outcomes razor would suggest that

3037

01:40:00,470 --> 01:39:59,040

the minimization of mysteries is a good

3038

01:40:01,990 --> 01:40:00,480

thing i mean

3039

01:40:03,510 --> 01:40:02,000

dave chambers a good friend of mine

3040

01:40:04,870 --> 01:40:03,520

ridiculed us by saying oh they're just

3041

01:40:06,470 --> 01:40:04,880

invoking the mythical

3042

01:40:08,709 --> 01:40:06,480

minimization law of minimization of

3043

01:40:09,990 --> 01:40:08,719

mysteries but if you if you believe in

3044

01:40:12,629 --> 01:40:10,000

occam's razors

3045

01:40:14,229 --> 01:40:12,639

outcomes razor you know one explanation

3046

01:40:16,550 --> 01:40:14,239

for several mysteries is a good thing

3047

01:40:17,510 --> 01:40:16,560

and when i hear that i'm reminded of a

3048

01:40:18,950 --> 01:40:17,520

talk by tegmark

3049

01:40:20,709 --> 01:40:18,960

and you where you were both critiquing

3050

01:40:22,390 --> 01:40:20,719

one another and tegmark said hey

3051

01:40:23,510 --> 01:40:22,400

maybe consciousness is explained in the

3052

01:40:24,950 --> 01:40:23,520

same way that we thought there were

3053

01:40:26,629 --> 01:40:24,960

different laws for

3054

01:40:28,229 --> 01:40:26,639

billiard balls than the moon and it

3055

01:40:29,109 --> 01:40:28,239

turned out to be one law well you can

3056

01:40:30,870 --> 01:40:29,119

use that same

3057

01:40:32,310 --> 01:40:30,880

logic to suggest that quantum mechanics

3058

01:40:33,990 --> 01:40:32,320

has something to do with consciousness

3059

01:40:35,510 --> 01:40:34,000

in the same way

3060

01:40:37,590 --> 01:40:35,520

okay anyway what i like about your

3061

01:40:39,830 --> 01:40:37,600

theory yours and penrose is not just the

3062

01:40:41,189 --> 01:40:39,840

fact that it's creative and inventive

3063

01:40:43,030 --> 01:40:41,199

but

3064

01:40:44,390 --> 01:40:43,040

there's a gallantry there's an endurance

3065

01:40:45,510 --> 01:40:44,400

that you have to go against the

3066

01:40:48,830 --> 01:40:45,520

prevailing norms

3067

01:40:51,350 --> 01:40:48,840

and to take

3068

01:40:52,950 --> 01:40:51,360

criticism for years that you're a

3069

01:40:56,229 --> 01:40:52,960

crackpot and so on

3070

01:40:59,270 --> 01:40:56,239

and to me that

3071

01:41:01,430 --> 01:40:59,280

that's not easy that's

3072

01:41:02,709 --> 01:41:01,440

most people would consciously buckle or

3073

01:41:04,550 --> 01:41:02,719

unconsciously

3074

01:41:06,470 --> 01:41:04,560

so that is some i can't convey in words

3075

01:41:08,870 --> 01:41:06,480

how difficult that is

3076

01:41:10,470 --> 01:41:08,880

and that i actually find commendable

3077

01:41:13,270 --> 01:41:10,480

well thank you

3078

01:41:13,830 --> 01:41:13,280

thank you you know uh roger's just above

3079

01:41:16,950 --> 01:41:13,840

it all

3080

01:41:17,990 --> 01:41:16,960

and uh for my you know but although he's

3081

01:41:19,109 --> 01:41:18,000

sensitive and he doesn't like being

3082

01:41:20,709 --> 01:41:19,119

criticized but

3083

01:41:22,310 --> 01:41:20,719

but i think he's he's operating on a

3084

01:41:25,109 --> 01:41:22,320

higher level than

3085

01:41:26,790 --> 01:41:25,119

the rest of us so for him it's just well

3086

01:41:28,470 --> 01:41:26,800

they'll they'll figure it out eventually

3087

01:41:30,709 --> 01:41:28,480

my perspective about being criticized

3088

01:41:34,229 --> 01:41:30,719

and yeah it hurts um

3089

01:41:34,870 --> 01:41:34,239

but um you know i'm i i don't need

3090

01:41:38,149 --> 01:41:34,880

grants

3091

01:41:40,470 --> 01:41:38,159

fund my livelihood

3092

01:41:41,350 --> 01:41:40,480

so i don't need to follow somebody

3093

01:41:43,750 --> 01:41:41,360

else's idea

3094

01:41:44,709 --> 01:41:43,760

of what's important to put food on the

3095

01:41:46,310 --> 01:41:44,719

table

3096

01:41:48,470 --> 01:41:46,320

i you know i make my living as an

3097

01:41:50,390 --> 01:41:48,480

anesthesiologist i'm an academic so i i

3098

01:41:52,310 --> 01:41:50,400

do research and so forth

3099

01:41:54,229 --> 01:41:52,320

but my livelihood doesn't depend i

3100

01:41:56,550 --> 01:41:54,239

follow my nose i follow my intuition

3101

01:41:57,669 --> 01:41:56,560

it's it's more of a i hate to say it's a

3102

01:41:59,510 --> 01:41:57,679

hobby because that

3103

01:42:00,790 --> 01:41:59,520

sounds demeaning because it's very

3104

01:42:04,550 --> 01:42:00,800

important to me

3105

01:42:05,990 --> 01:42:04,560

um but why is it so important

3106

01:42:07,590 --> 01:42:06,000

it's the most interesting question in

3107

01:42:10,709 --> 01:42:07,600

the world i mean it's uh

3108

01:42:13,590 --> 01:42:10,719

it's it's it's what i do you know

3109

01:42:15,590 --> 01:42:13,600

if i were if my hobby were well i used

3110

01:42:17,430 --> 01:42:15,600

to ski a lot if it was skiing

3111

01:42:20,950 --> 01:42:17,440

it what i love that you just want to go

3112

01:42:23,430 --> 01:42:20,960

out and ski and it's what i enjoy doing

3113

01:42:25,430 --> 01:42:23,440

and you know it's fun and it's gotten me

3114

01:42:26,709 --> 01:42:25,440

to see the world i met people like roger

3115

01:42:29,109 --> 01:42:26,719

and you and

3116

01:42:31,109 --> 01:42:29,119

countless other people and been uh all

3117

01:42:34,229 --> 01:42:31,119

over the world you know before covid and

3118

01:42:35,590 --> 01:42:34,239

uh hopefully will again and uh you know

3119

01:42:36,790 --> 01:42:35,600

it keeps me going like you said i'm

3120

01:42:39,750 --> 01:42:36,800

pretty old but i'm still

3121

01:42:41,109 --> 01:42:39,760

highly motivated and and i never said

3122

01:42:43,109 --> 01:42:41,119

you're pretty old i said but i

3123

01:42:45,270 --> 01:42:43,119

well it's true i am pretty old but i'm

3124

01:42:47,990 --> 01:42:45,280

still uh i'm still doing anesthesia

3125

01:42:49,910 --> 01:42:48,000

although i'm cutting back on time and uh

3126

01:42:51,669 --> 01:42:49,920

but my research keeps me going you know

3127

01:42:53,510 --> 01:42:51,679

it's it's what i love to do among other

3128

01:42:54,870 --> 01:42:53,520

things

3129

01:42:56,629 --> 01:42:54,880

what does your theory have to say about

3130

01:42:58,310 --> 01:42:56,639

zero point consciousness or the view

3131

01:43:01,430 --> 01:42:58,320

from nowhere

3132

01:43:04,310 --> 01:43:01,440

oh yeah nothingness yeah

3133

01:43:05,830 --> 01:43:04,320

so if in medi if you meditate uh it's

3134

01:43:09,189 --> 01:43:05,840

just contentless conscious

3135

01:43:11,590 --> 01:43:09,199

whether it's contentless or not uh

3136

01:43:13,270 --> 01:43:11,600

is is debatable some people say well

3137

01:43:14,950 --> 01:43:13,280

nothingness is something

3138

01:43:16,470 --> 01:43:14,960

um but i think you could be highly

3139

01:43:18,950 --> 01:43:16,480

conscious of just uh

3140

01:43:20,629 --> 01:43:18,960

pure conscious consciousness with

3141

01:43:23,750 --> 01:43:20,639

feelings i think you know

3142

01:43:24,310 --> 01:43:23,760

our feelings content i i think you know

3143

01:43:26,390 --> 01:43:24,320

it depends

3144

01:43:27,830 --> 01:43:26,400

it's a semantic question so i think you

3145

01:43:29,910 --> 01:43:27,840

can be highly conscious without any

3146

01:43:32,070 --> 01:43:29,920

content and sometimes that's the best

3147

01:43:33,590 --> 01:43:32,080

the best types of the best type of

3148

01:43:34,629 --> 01:43:33,600

consciousness when you say it's the best

3149

01:43:36,229 --> 01:43:34,639

type do you mean that it comes with

3150

01:43:37,270 --> 01:43:36,239

euphoria or do you mean that somehow

3151

01:43:39,510 --> 01:43:37,280

it's aiding your

3152

01:43:41,109 --> 01:43:39,520

regular life when you come back to it

3153

01:43:42,550 --> 01:43:41,119

well it could be the latter but you know

3154

01:43:44,709 --> 01:43:42,560

at the time i'm just thinking it's just

3155

01:43:46,709 --> 01:43:44,719

peaceful and euphoric and

3156

01:43:49,189 --> 01:43:46,719

in pure existence and and very

3157

01:43:50,550 --> 01:43:49,199

gratifying you know

3158

01:43:53,030 --> 01:43:50,560

have you heard of wolfram's

3159

01:43:55,430 --> 01:43:53,040

computational theory

3160

01:43:57,350 --> 01:43:55,440

i know will from what which computation

3161

01:43:59,189 --> 01:43:57,360

no his physics theory that says that

3162

01:44:00,470 --> 01:43:59,199

perhaps at the bottom of our universe is

3163

01:44:02,709 --> 01:44:00,480

something like hypergraphs

3164

01:44:04,629 --> 01:44:02,719

and there's a rule that dictates the

3165

01:44:05,109 --> 01:44:04,639

update of the hypergraph and then that

3166

01:44:07,430 --> 01:44:05,119

can

3167

01:44:10,950 --> 01:44:07,440

lead to regularities that we interpret

3168

01:44:14,950 --> 01:44:12,870

it could be uh it sounds a little like

3169

01:44:16,950 --> 01:44:14,960

roger's idea but he wouldn't call it

3170

01:44:19,189 --> 01:44:16,960

computation i think you know the whole

3171

01:44:22,629 --> 01:44:19,199

idea of the brain is computers

3172

01:44:25,510 --> 01:44:22,639

the universe is a computer is maybe uh

3173

01:44:26,870 --> 01:44:25,520

its brain is more like an orchestra and

3174

01:44:28,310 --> 01:44:26,880

consciousness is more like music than a

3175

01:44:29,830 --> 01:44:28,320

computation

3176

01:44:31,669 --> 01:44:29,840

have you heard of bernardo castro's

3177

01:44:33,510 --> 01:44:31,679

theories of consciousness

3178

01:44:35,430 --> 01:44:33,520

a little bit yeah i know bernardo and

3179

01:44:36,950 --> 01:44:35,440

i've heard him speak and he's kind of an

3180

01:44:39,830 --> 01:44:36,960

idealist

3181

01:44:41,350 --> 01:44:39,840

and uh where consciousness is everything

3182

01:44:42,229 --> 01:44:41,360

and uh you know he has a rigorous

3183

01:44:45,350 --> 01:44:42,239

approach to it and i

3184

01:44:48,629 --> 01:44:45,360

and i respect that i just think that uh

3185

01:44:50,550 --> 01:44:48,639

you know matter is also real and

3186

01:44:52,870 --> 01:44:50,560

we kind of oscillate between a quantum

3187

01:44:55,189 --> 01:44:52,880

and a classical realm

3188

01:44:56,470 --> 01:44:55,199

at a high frequency so i don't think

3189

01:44:58,629 --> 01:44:56,480

it's quite right to say that

3190

01:45:00,470 --> 01:44:58,639

that consciousness is all there is i

3191

01:45:02,310 --> 01:45:00,480

think there's there's a real world out

3192

01:45:04,070 --> 01:45:02,320

there too a classical world what i was

3193

01:45:05,830 --> 01:45:04,080

wondering about your theory is how does

3194

01:45:08,550 --> 01:45:05,840

it solve the hard problem

3195

01:45:09,030 --> 01:45:08,560

when it seems like there's this material

3196

01:45:10,310 --> 01:45:09,040

base

3197

01:45:11,590 --> 01:45:10,320

and then there's a collapse and that

3198

01:45:13,510 --> 01:45:11,600

collapses consciousness but then i'm

3199

01:45:15,430 --> 01:45:13,520

wondering okay how is the collapse

3200

01:45:17,750 --> 01:45:15,440

consciousness because that's of a

3201

01:45:19,189 --> 01:45:17,760

different ontological category

3202

01:45:20,790 --> 01:45:19,199

so you're starting from material and

3203

01:45:22,629 --> 01:45:20,800

somehow you produce consciousness but it

3204

01:45:25,430 --> 01:45:22,639

still seems to me to lack an explanation

3205

01:45:26,629 --> 01:45:25,440

as to why consciousness arises

3206

01:45:28,550 --> 01:45:26,639

you have to you have to say that

3207

01:45:29,510 --> 01:45:28,560

experience is a fundamental component of

3208

01:45:30,790 --> 01:45:29,520

the universe

3209

01:45:33,030 --> 01:45:30,800

now a lot of people say that pan

3210

01:45:34,950 --> 01:45:33,040

cyclists pan cyclists say that

3211

01:45:36,390 --> 01:45:34,960

idealists say that ideally say that

3212

01:45:38,870 --> 01:45:36,400

that's all there is

3213

01:45:40,709 --> 01:45:38,880

uh pan psycho say would say i guess that

3214

01:45:43,189 --> 01:45:40,719

it's a property

3215

01:45:44,790 --> 01:45:43,199

of of matter that every atom has a

3216

01:45:47,830 --> 01:45:44,800

property or state

3217

01:45:50,870 --> 01:45:47,840

of of qualia of consciousness

3218

01:45:53,109 --> 01:45:50,880

and uh our approach is more

3219

01:45:55,669 --> 01:45:53,119

more of a process philosophy more along

3220

01:45:57,270 --> 01:45:55,679

the lines of alfred north whitehead

3221

01:45:59,189 --> 01:45:57,280

who said that consciousness is a

3222

01:46:00,950 --> 01:45:59,199

sequence of events

3223

01:46:02,390 --> 01:46:00,960

and doesn't even bring in matter you

3224

01:46:05,350 --> 01:46:02,400

know it's a sequence of events

3225

01:46:06,390 --> 01:46:05,360

of occasions of experience occurring in

3226

01:46:09,430 --> 01:46:06,400

a wider field

3227

01:46:13,189 --> 01:46:09,440

of of experience

3228

01:46:15,189 --> 01:46:13,199

and it was uh abner shimoni who

3229

01:46:16,629 --> 01:46:15,199

made the observation that whitehead's

3230

01:46:18,709 --> 01:46:16,639

occasions of experience are very much

3231

01:46:21,270 --> 01:46:18,719

like quantum state reductions

3232

01:46:21,750 --> 01:46:21,280

and whitehead was was aware of quantum

3233

01:46:23,990 --> 01:46:21,760

and didn't

3234

01:46:26,070 --> 01:46:24,000

and talked about a little bit but but

3235

01:46:28,229 --> 01:46:26,080

the idea is that consciousness is not

3236

01:46:29,510 --> 01:46:28,239

a property of matter but it's a it's an

3237

01:46:33,669 --> 01:46:29,520

event like a

3238

01:46:35,750 --> 01:46:33,679

photon is an event or um things are

3239

01:46:37,350 --> 01:46:35,760

events occurrences that that happen

3240

01:46:40,709 --> 01:46:37,360

rather than being states of matter

3241

01:46:42,709 --> 01:46:40,719

and what that does is the event cr

3242

01:46:44,310 --> 01:46:42,719

creates a particular state of matter so

3243

01:46:45,990 --> 01:46:44,320

if you have a superposition of

3244

01:46:47,350 --> 01:46:46,000

multiple possibilities and it collapses

3245

01:46:49,669 --> 01:46:47,360

to this

3246

01:46:51,109 --> 01:46:49,679

that's the state that's created and the

3247

01:46:54,149 --> 01:46:51,119

transition from going from

3248

01:46:55,030 --> 01:46:54,159

both to one emits i don't know if emit

3249

01:46:58,950 --> 01:46:55,040

is the proper

3250

01:46:59,910 --> 01:46:58,960

verb uh causes creates or is equivalent

3251
01:47:01,669 --> 01:46:59,920
to

3252
01:47:03,830 --> 01:47:01,679
a moment of conscious experience with

3253
01:47:06,830 --> 01:47:03,840
qualia you could say it's a quail it's

3254
01:47:09,270 --> 01:47:06,840
it's a quantum of

3255
01:47:12,070 --> 01:47:09,280
interesting what does your theory have

3256
01:47:13,669 --> 01:47:12,080
to say about free will

3257
01:47:15,590 --> 01:47:13,679
um well first of all you need the

3258
01:47:19,189 --> 01:47:15,600
backward time effect to be able to act

3259
01:47:21,189 --> 01:47:19,199
in real time uh it uh it doesn't address

3260
01:47:21,990 --> 01:47:21,199
determinism because even if you do act

3261
01:47:23,030 --> 01:47:22,000
in real time you still

3262
01:47:24,310 --> 01:47:23,040
have the problem well maybe it was

3263
01:47:25,510 --> 01:47:24,320

always going to be that way because of

3264

01:47:27,430 --> 01:47:25,520

everything else that

3265

01:47:28,950 --> 01:47:27,440

that's already happened but when you

3266

01:47:30,550 --> 01:47:28,960

bring in the backward time effects i

3267

01:47:32,870 --> 01:47:30,560

think that gives you the possibility

3268

01:47:34,070 --> 01:47:32,880

of free will but you're still you're

3269

01:47:38,070 --> 01:47:34,080

still governed by

3270

01:47:39,910 --> 01:47:38,080

you know the deterministic schrodin

3271

01:47:43,030 --> 01:47:39,920

equation up to that point

3272

01:47:44,790 --> 01:47:43,040

and uh and uh you know maybe even the

3273

01:47:46,470 --> 01:47:44,800

platonic values so

3274

01:47:48,629 --> 01:47:46,480

you know the best they could say is that

3275

01:47:50,470 --> 01:47:48,639

the free will is the experience

3276

01:47:51,990 --> 01:47:50,480

of your volition being influenced by

3277

01:47:53,590 --> 01:47:52,000

platonic values

3278

01:47:55,350 --> 01:47:53,600

and actually i have a paper about that

3279

01:47:57,270 --> 01:47:55,360

called how quantum brain biology can

3280

01:47:59,030 --> 01:47:57,280

rescue conscious free will

3281

01:48:00,550 --> 01:47:59,040

but it deals with the backward time

3282

01:48:00,950 --> 01:48:00,560

effect rather than the other the other

3283

01:48:03,990 --> 01:48:00,960

issues

3284

01:48:07,910 --> 01:48:04,000

but is published already

3285

01:48:10,390 --> 01:48:07,920

in 2012 uh uh how quantum brain biology

3286

01:48:12,229 --> 01:48:10,400

can rescue conscious free will

3287

01:48:13,990 --> 01:48:12,239

and i think it's got more views than any

3288

01:48:16,149 --> 01:48:14,000

other paper i've written

3289

01:48:18,310 --> 01:48:16,159

it's in one of the frontiers journals

3290

01:48:20,390 --> 01:48:18,320

something like 50 000 views

3291

01:48:21,830 --> 01:48:20,400

i'll link it in the description okay now

3292

01:48:24,390 --> 01:48:21,840

this question i'm not sure if it's

3293

01:48:25,750 --> 01:48:24,400

better directed at penrose or to you and

3294

01:48:27,590 --> 01:48:25,760

i'm not sure who's the obverse

3295

01:48:28,870 --> 01:48:27,600

of the two but i'll for the sake of

3296

01:48:29,430 --> 01:48:28,880

flattering you'll pretend it i'll say

3297

01:48:32,629 --> 01:48:29,440

it's you

3298

01:48:34,709 --> 01:48:32,639

for this conversation there's a strong

3299

01:48:37,350 --> 01:48:34,719

anthropic principle and a weak one

3300

01:48:41,350 --> 01:48:37,360

now as far as i know actually i don't

3301

01:48:44,709 --> 01:48:43,510

well you can explain it i can't find it

3302

01:48:46,149 --> 01:48:44,719

right now

3303

01:48:47,510 --> 01:48:46,159

one has the causal arrow going in the

3304

01:48:49,669 --> 01:48:47,520

other direction yeah well basically the

3305

01:48:53,750 --> 01:48:49,679

anthropic principle is that uh

3306

01:48:55,669 --> 01:48:53,760

uh the if you look at the 20 or so

3307

01:48:57,590 --> 01:48:55,679

values of the parameters that govern the

3308

01:49:00,870 --> 01:48:57,600

universe the charge of this and the

3309

01:49:01,430 --> 01:49:00,880

the sep and uh uh all the things that

3310

01:49:02,870 --> 01:49:01,440

govern

3311

01:49:05,189 --> 01:49:02,880

at the microscope right right right

3312

01:49:08,149 --> 01:49:05,199

level okay if they weren't

3313

01:49:09,350 --> 01:49:08,159

exactly if all 22 i think weren't

3314

01:49:11,910 --> 01:49:09,360

exactly what they were

3315

01:49:13,589 --> 01:49:11,920

what they are we wouldn't have a

3316

01:49:15,510 --> 01:49:13,599

universe with with stars

3317

01:49:17,270 --> 01:49:15,520

light life and consciousness so they

3318

01:49:20,470 --> 01:49:17,280

have to be exactly

3319

01:49:23,589 --> 01:49:20,480

exactly how they are for us to be here

3320

01:49:26,629 --> 01:49:23,599

and one view is that it you know

3321

01:49:28,790 --> 01:49:26,639

uh god did it you know that there's a

3322

01:49:30,950 --> 01:49:28,800

prime mover and he created he or she

3323

01:49:32,629 --> 01:49:30,960

created the universe the way it is

3324

01:49:34,149 --> 01:49:32,639

and that i think that's the strong

3325

01:49:37,589 --> 01:49:34,159

anti-anatomic principle

3326

01:49:40,870 --> 01:49:37,599

i'm not sure uh the other view is that

3327

01:49:43,030 --> 01:49:40,880

um is that

3328

01:49:44,790 --> 01:49:43,040

it brings in multiple worlds and that

3329

01:49:48,550 --> 01:49:44,800

there's an infinite number of

3330

01:49:49,510 --> 01:49:48,560

worlds and that we happen to live in the

3331

01:49:52,310 --> 01:49:49,520

one world

3332

01:49:53,589 --> 01:49:52,320

the one and only world that has all the

3333

01:49:55,109 --> 01:49:53,599

parameters right that can have

3334

01:49:57,990 --> 01:49:55,119

consciousness

3335

01:49:59,350 --> 01:49:58,000

so that um uh all the other worlds they

3336

01:50:01,910 --> 01:49:59,360

don't have cut so

3337

01:50:03,910 --> 01:50:01,920

it it solves the problem of you know the

3338

01:50:05,430 --> 01:50:03,920

that we won the cosmic lottery by having

3339

01:50:07,750 --> 01:50:05,440

all these numbers being exactly

3340

01:50:08,790 --> 01:50:07,760

the way they are by saying well that's

3341

01:50:12,629 --> 01:50:08,800

that's only because

3342

01:50:14,790 --> 01:50:12,639

it's it's a uh it's a selector's bias

3343

01:50:15,990 --> 01:50:14,800

that you know we're asking the questions

3344

01:50:17,910 --> 01:50:16,000

because we're in the one and only

3345

01:50:21,350 --> 01:50:17,920

universe that has

3346

01:50:23,350 --> 01:50:21,360

the pro that has consciousness um

3347

01:50:24,870 --> 01:50:23,360

but then you have all these other worlds

3348

01:50:27,750 --> 01:50:24,880

what's the you know what's the point

3349

01:50:28,550 --> 01:50:27,760

um so i don't like that and then uh

3350

01:50:31,270 --> 01:50:28,560

chalmers

3351

01:50:32,550 --> 01:50:31,280

and uh kelvin mcqueen tried to to say

3352

01:50:34,870 --> 01:50:32,560

they have kind of a

3353

01:50:36,070 --> 01:50:34,880

copenhagen view of consciousness causes

3354

01:50:37,510 --> 01:50:36,080

collapse

3355

01:50:40,070 --> 01:50:37,520

and they were saying well consciousness

3356

01:50:41,350 --> 01:50:40,080

coming from another uh multiple worlds

3357

01:50:43,270 --> 01:50:41,360

i think they were saying that and i said

3358

01:50:45,430 --> 01:50:43,280

well that's the case to be coming from

3359

01:50:46,790 --> 01:50:45,440

a world with inferior inferior

3360

01:50:50,310 --> 01:50:46,800

consciousness because of

3361

01:50:53,350 --> 01:50:50,320

the end so they they drop that so

3362

01:50:56,550 --> 01:50:53,360

the explanation i like is

3363

01:50:57,910 --> 01:50:56,560

uh we actually talked about this in our

3364

01:50:59,589 --> 01:50:57,920

in our recent papers

3365

01:51:02,550 --> 01:50:59,599

you know roger has his whole own theory

3366

01:51:04,709 --> 01:51:02,560

about cyclical conformal cosmology

3367

01:51:06,709 --> 01:51:04,719

that the big bang was preceded by

3368

01:51:08,950 --> 01:51:06,719

another eon and that was preceded by

3369

01:51:11,350 --> 01:51:08,960

another eon and so forth

3370

01:51:12,070 --> 01:51:11,360

and uh i saw i said well why do you

3371

01:51:14,870 --> 01:51:12,080

think there was

3372

01:51:15,830 --> 01:51:14,880

uh consciousness in the previous eon he

3373

01:51:17,109 --> 01:51:15,840

said well sure

3374

01:51:18,870 --> 01:51:17,119

sure it could have been should have been

3375

01:51:21,510 --> 01:51:18,880

why not and uh

3376

01:51:22,629 --> 01:51:21,520

i then thought about a a book by uh lee

3377

01:51:25,830 --> 01:51:22,639

smolin

3378

01:51:29,589 --> 01:51:25,840

about called life of the cosmos and uh

3379

01:51:33,109 --> 01:51:29,599

he was talking about uh in a black hole

3380

01:51:35,350 --> 01:51:33,119

okay evolutionary model pardon me

3381

01:51:36,709 --> 01:51:35,360

an evolutionary model yeah that that

3382

01:51:39,430 --> 01:51:36,719

what comes down on the other side

3383

01:51:40,229 --> 01:51:39,440

is an improved version of what what went

3384

01:51:42,149 --> 01:51:40,239

in

3385

01:51:43,430 --> 01:51:42,159

so i said could that apply to your you

3386

01:51:46,870 --> 01:51:43,440

know big bangs and

3387

01:51:48,310 --> 01:51:46,880

in eons so that that uh every transition

3388

01:51:51,430 --> 01:51:48,320

from e on the e on

3389

01:51:53,350 --> 01:51:51,440

the parameters mutate or evolve

3390

01:51:54,709 --> 01:51:53,360

and so what comes out on the other side

3391

01:51:57,270 --> 01:51:54,719

is a slightly improved

3392

01:51:58,709 --> 01:51:57,280

or maybe dramatically improved version

3393

01:51:59,910 --> 01:51:58,719

of the parameters to support

3394

01:52:02,709 --> 01:51:59,920

consciousness

3395

01:52:04,709 --> 01:52:02,719

and that you know the universe is

3396

01:52:06,229 --> 01:52:04,719

evolving e on the eon to optimize

3397

01:52:08,470 --> 01:52:06,239

consciousness

3398

01:52:09,430 --> 01:52:08,480

so i was a little surprised he didn't

3399

01:52:11,350 --> 01:52:09,440

just say no

3400

01:52:13,189 --> 01:52:11,360

and said yeah it could be so we put that

3401

01:52:15,589 --> 01:52:13,199

in the that's in one of our recent

3402

01:52:17,990 --> 01:52:15,599

papers suggesting that

3403

01:52:19,350 --> 01:52:18,000

that consciousness is actually steering

3404

01:52:22,629 --> 01:52:19,360

the universe

3405

01:52:24,229 --> 01:52:22,639

um by these transition points uh big

3406

01:52:25,990 --> 01:52:24,239

bang transition points

3407

01:52:29,750 --> 01:52:26,000

and then e on the e on consciousness

3408

01:52:32,870 --> 01:52:31,350

instead of universes giving rise to one

3409

01:52:34,229 --> 01:52:32,880

where there are great conditions for

3410

01:52:36,550 --> 01:52:34,239

intelligence self-consciousness

3411

01:52:37,589 --> 01:52:36,560

that is the multiverse theory the weak

3412

01:52:39,109 --> 01:52:37,599

anthropic principle

3413

01:52:40,390 --> 01:52:39,119

you have consciousness is driving the

3414

01:52:42,390 --> 01:52:40,400

progression of the universe

3415

01:52:43,030 --> 01:52:42,400

evolutionarily as in penrose's cyclical

3416

01:52:44,629 --> 01:52:43,040

model

3417

01:52:46,629 --> 01:52:44,639

okay so then this to me implies that

3418

01:52:49,030 --> 01:52:46,639

there are better laws or more

3419

01:52:50,550 --> 01:52:49,040

adaptive physical constants so do you or

3420

01:52:52,709 --> 01:52:50,560

penrose make any predictions

3421

01:52:53,830 --> 01:52:52,719

as to what would be considered better

3422

01:52:55,189 --> 01:52:53,840

for consciousness

3423

01:52:57,430 --> 01:52:55,199

in terms of further tweaking these

3424

01:52:59,669 --> 01:52:57,440

fundamental constants

3425

01:53:00,790 --> 01:52:59,679

i can't tell you exactly you know what

3426

01:53:01,910 --> 01:53:00,800

would be what would improve

3427

01:53:05,270 --> 01:53:01,920

consciousness

3428

01:53:06,709 --> 01:53:05,280

uh but with all these 22 parameters

3429

01:53:09,750 --> 01:53:06,719

you know there must be some combination

3430

01:53:11,510 --> 01:53:09,760

that might optimize it in the sense that

3431

01:53:13,030 --> 01:53:11,520

how i don't know how but you know maybe

3432

01:53:15,109 --> 01:53:13,040

the platonic values are

3433

01:53:16,229 --> 01:53:15,119

evolving maybe the experience is getting

3434

01:53:19,270 --> 01:53:16,239

more fun

3435

01:53:20,390 --> 01:53:19,280

or feels better i don't know but

3436

01:53:21,669 --> 01:53:20,400

how would you you know if you want to

3437

01:53:23,270 --> 01:53:21,679

improve consciously well you know what

3438

01:53:24,550 --> 01:53:23,280

would be a way to improve it

3439

01:53:25,990 --> 01:53:24,560

outside of getting rid of people want to

3440

01:53:27,189 --> 01:53:26,000

kill other people and that sort of thing

3441

01:53:29,830 --> 01:53:27,199

but

3442

01:53:31,270 --> 01:53:29,840

you know just how would it get better

3443

01:53:33,589 --> 01:53:31,280

i'm not sure but i think

3444

01:53:35,189 --> 01:53:33,599

i think it's one possibility what else i

3445

01:53:35,510 --> 01:53:35,199

mean what what else would be the point

3446

01:53:40,790 --> 01:53:35,520

of

3447

01:53:42,790 --> 01:53:40,800

in other words i don't see consciousness

3448

01:53:43,510 --> 01:53:42,800

as kind of a of an afterthought i think

3449

01:53:46,790 --> 01:53:43,520

of it as more

3450

01:53:49,750 --> 01:53:48,229

at one point you mentioned that you can

3451

01:53:50,870 --> 01:53:49,760

vibrate literally vibrate the

3452

01:53:52,550 --> 01:53:50,880

microtubules to

3453

01:53:54,790 --> 01:53:52,560

treat cognitive disorders and that you

3454

01:53:56,629 --> 01:53:54,800

did this to yourself at some point

3455

01:53:59,589 --> 01:53:56,639

okay what were the results of that and

3456

01:54:01,510 --> 01:53:59,599

can this be done at home

3457

01:54:03,430 --> 01:54:01,520

i got to be careful here for and not

3458

01:54:06,310 --> 01:54:03,440

practice medicine over the internet but

3459

01:54:07,669 --> 01:54:06,320

but uh when uh when honor bond came out

3460

01:54:08,950 --> 01:54:07,679

with this idea that

3461

01:54:11,270 --> 01:54:08,960

or discovered that there were these

3462

01:54:15,030 --> 01:54:11,280

vibrations in microtubules

3463

01:54:16,470 --> 01:54:15,040

uh including in megahertz then um

3464

01:54:18,229 --> 01:54:16,480

[Music]

3465

01:54:19,830 --> 01:54:18,239

you know so he had terahertz gigahertz

3466

01:54:21,510 --> 01:54:19,840

megahertz kilohertz

3467

01:54:23,350 --> 01:54:21,520

so i said i wonder if there's a way to

3468

01:54:26,149 --> 01:54:23,360

treat the microtubule so

3469

01:54:27,430 --> 01:54:26,159

terahertz is is infrared and people

3470

01:54:28,870 --> 01:54:27,440

actually do try that but

3471

01:54:31,189 --> 01:54:28,880

it's kind of hard to get photons into

3472

01:54:32,470 --> 01:54:31,199

the brain gigahertz is

3473

01:54:33,910 --> 01:54:32,480

microwaves i wasn't interested in

3474

01:54:35,030 --> 01:54:33,920

putting microwaves in my brain although

3475

01:54:37,589 --> 01:54:35,040

that's that

3476

01:54:39,510 --> 01:54:37,599

apparently that uh that weapon that the

3477

01:54:41,990 --> 01:54:39,520

russians or the i forgot who used it

3478

01:54:43,910 --> 01:54:42,000

on our embassy people these loud pops

3479

01:54:47,270 --> 01:54:43,920

and apparently that was microwave

3480

01:54:49,510 --> 01:54:47,280

and so i wasn't interested in doing that

3481

01:54:50,950 --> 01:54:49,520

megahertz is in electromagnetics as

3482

01:54:52,709 --> 01:54:50,960

radio waves

3483

01:54:54,229 --> 01:54:52,719

wasn't interested in doing that but

3484

01:54:57,030 --> 01:54:54,239

megahertz in mechanical

3485

01:54:58,870 --> 01:54:57,040

is ultrasound and we use ultrasound and

3486

01:55:00,709 --> 01:54:58,880

anesthesia all the time

3487

01:55:01,910 --> 01:55:00,719

and so when i read this i looked over

3488

01:55:02,709 --> 01:55:01,920

and there's an ultrasound machine

3489

01:55:04,390 --> 01:55:02,719

sitting there

3490

01:55:05,990 --> 01:55:04,400

and i said i wonder if anybody's put

3491

01:55:08,070 --> 01:55:06,000

ultrasound into the brain

3492

01:55:09,990 --> 01:55:08,080

and ultrasound's been around forever and

3493

01:55:10,870 --> 01:55:10,000

it's mechanical vibrations megahertz

3494

01:55:12,709 --> 01:55:10,880

bounces off

3495

01:55:14,310 --> 01:55:12,719

echoes off surfaces so you get an image

3496

01:55:17,350 --> 01:55:14,320

inside the body you can see the

3497

01:55:17,990 --> 01:55:17,360

babies in the uterus and so forth and so

3498

01:55:24,550 --> 01:55:18,000

i

3499

01:55:26,149 --> 01:55:24,560

effects

3500

01:55:27,589 --> 01:55:26,159

and uh you know they could move their

3501

01:55:28,709 --> 01:55:27,599

paw you could get it you can make them

3502

01:55:31,430 --> 01:55:28,719

move their paw by

3503

01:55:32,870 --> 01:55:31,440

hitting the paw paw region and

3504

01:55:35,910 --> 01:55:32,880

physiological effects

3505

01:55:37,990 --> 01:55:35,920

and uh i wondered uh what would be the

3506

01:55:42,070 --> 01:55:38,000

effect on mental states

3507

01:55:44,229 --> 01:55:42,080

and uh um it ultrasound is approved for

3508

01:55:45,589 --> 01:55:44,239

have been approved for imaging the brain

3509

01:55:46,790 --> 01:55:45,599

so people in me getting ultrasound of

3510

01:55:48,950 --> 01:55:46,800

the brain but it wasn't very good

3511

01:55:50,229 --> 01:55:48,960

compared to you know mri and ct for

3512

01:55:51,350 --> 01:55:50,239

imaging the brain so it wasn't really

3513

01:55:53,430 --> 01:55:51,360

useful

3514

01:55:54,709 --> 01:55:53,440

so i said to my anesthesia colleagues

3515

01:55:56,070 --> 01:55:54,719

you know we have we have chronic pain

3516

01:55:56,950 --> 01:55:56,080

patients who are depressed in addition

3517

01:55:58,070 --> 01:55:56,960

to taking p

3518

01:55:59,990 --> 01:55:58,080

taking care of people in the operating

3519

01:56:01,589 --> 01:56:00,000

room for surgery we

3520

01:56:04,070 --> 01:56:01,599

see chronic pain patients do nerve

3521

01:56:05,510 --> 01:56:04,080

blocks and sort of thing and i'd i'd

3522

01:56:06,790 --> 01:56:05,520

done our i worked in our pain clinic a

3523

01:56:08,310 --> 01:56:06,800

while and i said you know they're all

3524

01:56:09,430 --> 01:56:08,320

depressed maybe we should put ultrasound

3525

01:56:11,669 --> 01:56:09,440

into their brain

3526

01:56:13,430 --> 01:56:11,679

and see if they feel better all over the

3527

01:56:15,189 --> 01:56:13,440

brain or in a specific region well i

3528

01:56:16,709 --> 01:56:15,199

didn't i didn't get that far

3529

01:56:18,790 --> 01:56:16,719

and that you know i hadn't really

3530

01:56:19,189 --> 01:56:18,800

thought about it and uh and my friend

3531

01:56:22,390 --> 01:56:19,199

said

3532

01:56:23,189 --> 01:56:22,400

okay you go first you know we don't try

3533

01:56:25,030 --> 01:56:23,199

to anybody

3534

01:56:27,109 --> 01:56:25,040

unless we try it on ourselves well you

3535

01:56:30,229 --> 01:56:27,119

have an easy head for it

3536

01:56:32,310 --> 01:56:30,239

yeah that's true i do and uh

3537

01:56:33,750 --> 01:56:32,320

but it was also my idea in fact that's

3538

01:56:34,950 --> 01:56:33,760

what he said that's what my friend said

3539

01:56:37,910 --> 01:56:34,960

he said you got a shaved head

3540

01:56:39,189 --> 01:56:37,920

your idea you go first and so it's the

3541

01:56:41,030 --> 01:56:39,199

end of the day we're sitting around

3542

01:56:42,310 --> 01:56:41,040

the table and i said okay what the heck

3543

01:56:42,629 --> 01:56:42,320

i thought about it and i really well

3544

01:56:44,310 --> 01:56:42,639

it's

3545

01:56:46,550 --> 01:56:44,320

approved for ultrasound brain imaging it

3546

01:56:48,070 --> 01:56:46,560

can't be that bad

3547

01:56:49,589 --> 01:56:48,080

how many seconds sorry it's interrupt

3548

01:56:51,030 --> 01:56:49,599

how many seconds does it take for the

3549

01:56:54,629 --> 01:56:51,040

imaging

3550

01:56:56,390 --> 01:56:54,639

immediately

3551

01:56:58,070 --> 01:56:56,400

okay so they don't leave prolonged

3552

01:56:58,629 --> 01:56:58,080

ultrasound on your brain at least not in

3553

01:57:01,830 --> 01:56:58,639

humans

3554

01:57:03,510 --> 01:57:01,840

that they've tested well i i

3555

01:57:05,750 --> 01:57:03,520

i'm not sure anybody used it for brain

3556

01:57:08,870 --> 01:57:05,760

imaging very much it was approved but

3557

01:57:10,550 --> 01:57:08,880

then ctm or i came came by came around

3558

01:57:12,229 --> 01:57:10,560

so i don't know if it was

3559

01:57:13,430 --> 01:57:12,239

there wasn't any guidelines i you know i

3560

01:57:14,229 --> 01:57:13,440

knew what they used in animals and that

3561

01:57:16,070 --> 01:57:14,239

sort of thing

3562

01:57:17,589 --> 01:57:16,080

anyway so they called my bluff my

3563

01:57:19,510 --> 01:57:17,599

friends call my bluff

3564

01:57:20,790 --> 01:57:19,520

and uh sit around the table and i picked

3565

01:57:23,109 --> 01:57:20,800

it up with my right hand

3566

01:57:24,629 --> 01:57:23,119

and uh you put this goo on it because

3567

01:57:26,550 --> 01:57:24,639

it's got to have gel

3568

01:57:28,390 --> 01:57:26,560

and being right-handed and knowing that

3569

01:57:29,750 --> 01:57:28,400

the temporal bone is the thinnest i put

3570

01:57:32,870 --> 01:57:29,760

it right here

3571

01:57:34,229 --> 01:57:32,880

turned on the machine saw would sort of

3572

01:57:37,030 --> 01:57:34,239

look like my brain on the

3573

01:57:38,229 --> 01:57:37,040

on the screen kept it there for about 15

3574

01:57:40,070 --> 01:57:38,239

seconds

3575

01:57:42,070 --> 01:57:40,080

put it down i didn't feel a thing i said

3576

01:57:43,830 --> 01:57:42,080

oh well that's disappointing

3577

01:57:45,510 --> 01:57:43,840

but about a minute later i did start to

3578

01:57:47,589 --> 01:57:45,520

feel anything to feel something and i

3579

01:57:50,390 --> 01:57:47,599

felt kind of a buzz i was like

3580

01:57:52,629 --> 01:57:50,400

really energized and invigorated and

3581

01:57:54,070 --> 01:57:52,639

felt really good for about an hour

3582

01:57:56,149 --> 01:57:54,080

and so i said you know what we should

3583

01:57:58,790 --> 01:57:56,159

try this so we did the first uh

3584

01:58:00,390 --> 01:57:58,800

study in 19 in 2012 it was actually

3585

01:58:01,430 --> 01:58:00,400

published in 2013 of chronic pain

3586

01:58:03,189 --> 01:58:01,440

patients

3587

01:58:05,109 --> 01:58:03,199

in the journal brain stimulation and

3588

01:58:06,550 --> 01:58:05,119

showed improved mood and reduced pain

3589

01:58:09,669 --> 01:58:06,560

and chronic pain patients

3590

01:58:12,229 --> 01:58:09,679

with 15 seconds of ultrasound to uh

3591

01:58:13,350 --> 01:58:12,239

contralateral to the pain in pain

3592

01:58:14,950 --> 01:58:13,360

chronic pain patients

3593

01:58:16,229 --> 01:58:14,960

in a double blind crossover study you

3594

01:58:17,510 --> 01:58:16,239

don't feel it so it's easy to do a

3595

01:58:19,350 --> 01:58:17,520

double blind study

3596

01:58:20,870 --> 01:58:19,360

now since then a number of other people

3597

01:58:22,310 --> 01:58:20,880

did it and we we did a study about a

3598

01:58:25,109 --> 01:58:22,320

year ago

3599

01:58:26,229 --> 01:58:25,119

uh with much better studies showed

3600

01:58:28,470 --> 01:58:26,239

improved mood and

3601
01:58:29,270 --> 01:58:28,480
changing mri connectivity so it actually

3602
01:58:34,629 --> 01:58:29,280
does

3603
01:58:37,510 --> 01:58:34,639
the brain

3604
01:58:38,390 --> 01:58:37,520
did you ever try it again i've tried it

3605
01:58:41,830 --> 01:58:38,400
a couple times

3606
01:58:43,430 --> 01:58:41,840
uh but nothing again not that you didn't

3607
01:58:46,870 --> 01:58:43,440
get that one hour of buzz

3608
01:58:49,030 --> 01:58:46,880
yeah i did but i didn't yeah but

3609
01:58:50,790 --> 01:58:49,040
have you tried it for creativity what's

3610
01:58:51,669 --> 01:58:50,800
that have you tried it to increase

3611
01:58:54,070 --> 01:58:51,679
creativity or

3612
01:58:55,270 --> 01:58:54,080
productivity i i don't i don't i don't

3613
01:58:57,109 --> 01:58:55,280

want to mess with it it's something

3614

01:58:59,109 --> 01:58:57,119

at work you know i i don't have one at

3615

01:59:01,270 --> 01:58:59,119

home it's not

3616

01:59:03,270 --> 01:59:01,280

something i'm really into to trying but

3617

01:59:05,270 --> 01:59:03,280

i think if i had alzheimer's or

3618

01:59:07,830 --> 01:59:05,280

or something like that i damn well try

3619

01:59:08,790 --> 01:59:07,840

it okay let me get off on a hypothetical

3620

01:59:10,310 --> 01:59:08,800

plunge here

3621

01:59:12,550 --> 01:59:10,320

some people suggest that the universe as

3622

01:59:14,629 --> 01:59:12,560

a whole is conscious now i assume you

3623

01:59:15,750 --> 01:59:14,639

suggest that to some minor degree

3624

01:59:17,270 --> 01:59:15,760

proto-consciousness more like a

3625

01:59:18,870 --> 01:59:17,280

cacophony than a symphony because you

3626

01:59:20,950 --> 01:59:18,880

need to cohere it in some manner

3627

01:59:22,790 --> 01:59:20,960

okay but then consciousness is

3628

01:59:25,910 --> 01:59:22,800

associated with

3629

01:59:28,070 --> 01:59:25,920

40 hertz 10 hertz it could be at any

3630

01:59:31,030 --> 01:59:28,080

frequency

3631

01:59:33,030 --> 01:59:31,040

okay where i was going with this was you

3632

01:59:36,709 --> 01:59:33,040

can look at the universe as a whole

3633

01:59:39,109 --> 01:59:36,719

through astrological data

3634

01:59:39,750 --> 01:59:39,119

and in cosmological data and i'm

3635

01:59:42,149 --> 01:59:39,760

wondering

3636

01:59:43,430 --> 01:59:42,159

is there a way of seeing if the universe

3637

01:59:44,870 --> 01:59:43,440

is vibrating

3638

01:59:47,510 --> 01:59:44,880

and then let's imagine it's not

3639

01:59:49,270 --> 01:59:47,520

vibrating at some level

3640

01:59:51,189 --> 01:59:49,280

then does that mean that as far as we

3641

01:59:54,390 --> 01:59:51,199

can tell we are the most

3642

01:59:55,669 --> 01:59:54,400

conscious parts of the universe well it

3643

01:59:56,870 --> 01:59:55,679

may be vibrating questions whether it's

3644

01:59:59,350 --> 01:59:56,880

vibrating coherently

3645

02:00:00,070 --> 01:59:59,360

you know or is everything connected and

3646

02:00:01,109 --> 02:00:00,080

uh

3647

02:00:02,790 --> 02:00:01,119

some people would say yes and

3648

02:00:03,990 --> 02:00:02,800

everything's entangled you know going

3649

02:00:05,189 --> 02:00:04,000

back to the big bang everything's

3650

02:00:07,030 --> 02:00:05,199

entangled

3651
02:00:09,270 --> 02:00:07,040
you're kind of asking me whether you

3652
02:00:12,390 --> 02:00:09,280
know whether there's god out there

3653
02:00:13,830 --> 02:00:12,400
in terms of this and i think there might

3654
02:00:15,270 --> 02:00:13,840
be but i'm not gonna

3655
02:00:16,790 --> 02:00:15,280
you know i don't want to say yes or no

3656
02:00:17,510 --> 02:00:16,800
for sure i think there's something like

3657
02:00:20,950 --> 02:00:17,520
god

3658
02:00:22,629 --> 02:00:20,960
and uh and it could it it has to do with

3659
02:00:24,790 --> 02:00:22,639
uh you know platonic values and

3660
02:00:26,550 --> 02:00:24,800
consciousness out there but

3661
02:00:29,270 --> 02:00:26,560
i'd rather leave it vague because

3662
02:00:31,030 --> 02:00:29,280
otherwise it becomes religion

3663
02:00:32,870 --> 02:00:31,040

okay well then what i was wondering is

3664

02:00:34,310 --> 02:00:32,880

let's imagine that we are the most

3665

02:00:36,310 --> 02:00:34,320

conscious parts of the universe now i

3666

02:00:37,189 --> 02:00:36,320

know that's extreme hubris then does

3667

02:00:38,830 --> 02:00:37,199

that mean that

3668

02:00:40,870 --> 02:00:38,840

we have a chance at directing the

3669

02:00:42,390 --> 02:00:40,880

evolution toward

3670

02:00:44,149 --> 02:00:42,400

the universe being more conscious in the

3671

02:00:45,750 --> 02:00:44,159

next cycle

3672

02:00:47,350 --> 02:00:45,760

if consciousness is somehow directing

3673

02:00:48,470 --> 02:00:47,360

the evolution of these cycles and we

3674

02:00:51,030 --> 02:00:48,480

happen to be the most

3675

02:00:51,830 --> 02:00:51,040

conscious in this universe then do we

3676

02:00:54,790 --> 02:00:51,840

have some hand

3677

02:00:56,310 --> 02:00:54,800

at that this is a huge speculative jump

3678

02:00:58,390 --> 02:00:56,320

yeah yeah i know i know i mean

3679

02:01:00,390 --> 02:00:58,400

i did speculate that uh roger and i did

3680

02:01:01,990 --> 02:01:00,400

speculate that you know these crossovers

3681

02:01:03,750 --> 02:01:02,000

of e on the eon

3682

02:01:05,510 --> 02:01:03,760

but just to get there you know you have

3683

02:01:05,990 --> 02:01:05,520

to have this key death of the universe

3684

02:01:13,830 --> 02:01:06,000

and

3685

02:01:15,270 --> 02:01:13,840

somehow you know in the in the plank

3686

02:01:17,189 --> 02:01:15,280

scale and the fine scale structure of

3687

02:01:19,589 --> 02:01:17,199

the universe whatever that is

3688

02:01:20,950 --> 02:01:19,599

so i don't know that's that's a tough

3689

02:01:23,669 --> 02:01:20,960

one

3690

02:01:25,270 --> 02:01:23,679

what do you agree with deepak chopra on

3691

02:01:26,709 --> 02:01:25,280

and what do you disagree with him on

3692

02:01:28,550 --> 02:01:26,719

i was watching the interview between you

3693

02:01:30,149 --> 02:01:28,560

and him and i said this on the

3694

02:01:32,629 --> 02:01:30,159

a most recent interview i did with

3695

02:01:35,270 --> 02:01:32,639

bernardo castro that

3696

02:01:37,189 --> 02:01:35,280

i'm i don't disagree necessarily with

3697

02:01:37,910 --> 02:01:37,199

deepak it's not like i agree or disagree

3698

02:01:39,430 --> 02:01:37,920

because i just

3699

02:01:42,310 --> 02:01:39,440

reserve judgment i don't know the idea

3700

02:01:44,709 --> 02:01:42,320

is enough but i see him as

3701

02:01:46,550 --> 02:01:44,719

looking for scientific credibility from

3702

02:01:48,950 --> 02:01:46,560

people so when you say something that

3703

02:01:49,750 --> 02:01:48,960

is in line with what he thinks he'll ask

3704

02:01:52,149 --> 02:01:49,760

you to

3705

02:01:54,070 --> 02:01:52,159

expound and then say well what do you

3706

02:01:55,030 --> 02:01:54,080

say to people who disagree and say that

3707

02:02:21,910 --> 02:01:55,040

i

3708

02:02:23,510 --> 02:02:21,920

uh

3709

02:02:24,950 --> 02:02:23,520

he can be criticized along the lines of

3710

02:02:26,550 --> 02:02:24,960

what you what you said but

3711

02:02:29,510 --> 02:02:26,560

his heart's in a good place and he means

3712

02:02:32,149 --> 02:02:29,520

well and uh let's just leave it at that

3713

02:02:32,550 --> 02:02:32,159

he's a friend of mine when people say

3714

02:02:35,430 --> 02:02:32,560

that

3715

02:02:37,830 --> 02:02:35,440

we're all one and not in just some

3716

02:02:42,390 --> 02:02:37,840

abstract sense but in that we share

3717

02:02:45,910 --> 02:02:42,400

some entity what do you make of that

3718

02:02:47,830 --> 02:02:45,920

like consciousness is fundamental uh i

3719

02:02:49,510 --> 02:02:47,840

think we can be one i think i think you

3720

02:02:52,149 --> 02:02:49,520

know people can be entangled

3721

02:02:54,229 --> 02:02:52,159

i don't uh you know i think esp and that

3722

02:02:56,790 --> 02:02:54,239

sort of thing parapsychology can't

3723

02:02:57,910 --> 02:02:56,800

can occur by quantum non-locality but

3724

02:02:59,430 --> 02:02:57,920

does that mean we are

3725

02:03:01,910 --> 02:02:59,440

all entangled at any one time not

3726

02:03:02,470 --> 02:03:01,920

necessarily i think potentially we can

3727

02:03:04,950 --> 02:03:02,480

be but

3728

02:03:06,470 --> 02:03:04,960

uh again i don't want to go too far in

3729

02:03:08,709 --> 02:03:06,480

that direction i've already

3730

02:03:10,950 --> 02:03:08,719

i've gone on quite a limb in a lot of

3731

02:03:12,390 --> 02:03:10,960

areas

3732

02:03:14,470 --> 02:03:12,400

okay i'll take some questions from the

3733

02:03:16,310 --> 02:03:14,480

audience so let's take a look here

3734

02:03:21,270 --> 02:03:16,320

is the depressed person more or less

3735

02:03:24,950 --> 02:03:22,550

well you could say they're less

3736

02:03:26,950 --> 02:03:24,960

conscious but they would require the

3737

02:03:30,870 --> 02:03:26,960

same amount of anesthesia probably

3738

02:03:33,109 --> 02:03:30,880

so i'd say they're probably uh

3739

02:03:34,470 --> 02:03:33,119

the same but just on a negative poll you

3740

02:03:39,109 --> 02:03:34,480

know you can have

3741

02:03:42,709 --> 02:03:40,950

but but on the other hand i do have a

3742

02:03:45,350 --> 02:03:42,719

graph in one of my papers where

3743

02:03:46,550 --> 02:03:45,360

we plot the number of tubulins and you

3744

02:03:51,270 --> 02:03:46,560

know uh

3745

02:03:54,149 --> 02:03:53,030

so the intensity of the conscious

3746

02:03:55,350 --> 02:03:54,159

experience would be related to the

3747

02:03:57,589 --> 02:03:55,360

frequency

3748

02:03:59,589 --> 02:03:57,599

of the uh of the number of orca wire

3749

02:04:00,629 --> 02:03:59,599

events you can have so a plant cell

3750

02:04:02,709 --> 02:04:00,639

might have

3751

02:04:04,550 --> 02:04:02,719

you know a few per minute and we can we

3752

02:04:07,990 --> 02:04:04,560

might have you know uh

3753

02:04:09,990 --> 02:04:08,000

trillions per second so yes

3754

02:04:11,669 --> 02:04:10,000

there are levels of consciousness but

3755

02:04:11,990 --> 02:04:11,679

within humans it's it's kind of hard to

3756

02:04:13,669 --> 02:04:12,000

say

3757

02:04:15,430 --> 02:04:13,679

this being depressed doesn't really

3758

02:04:18,069 --> 02:04:15,440

necessarily make you less conscious

3759

02:04:19,510 --> 02:04:18,079

you certainly feel less conscious but

3760

02:04:22,390 --> 02:04:19,520

maybe that's the same thing

3761

02:04:24,069 --> 02:04:22,400

but would stewart be interested in

3762

02:04:26,470 --> 02:04:24,079

seeing raw neural signals

3763

02:04:27,350 --> 02:04:26,480

in awake primates that show timing

3764

02:04:28,870 --> 02:04:27,360

supporting

3765

02:04:30,790 --> 02:04:28,880

his time predictions for network

3766

02:04:32,950 --> 02:04:30,800

properties and i just read that

3767

02:04:35,510 --> 02:04:32,960

verbatim i don't quite understand what's

3768

02:04:37,910 --> 02:04:35,520

going on so perhaps you do

3769

02:04:39,669 --> 02:04:37,920

there was support what okay would

3770

02:04:40,629 --> 02:04:39,679

stewart be interested in seeing raw

3771

02:04:43,589 --> 02:04:40,639

neural signals

3772

02:04:45,830 --> 02:04:43,599

in awake primates that show timings

3773

02:04:48,629 --> 02:04:45,840

supporting his timing predictions

3774

02:04:50,390 --> 02:04:48,639

for network properties if you mean

3775

02:04:52,149 --> 02:04:50,400

something that shows a response before

3776

02:04:53,589 --> 02:04:52,159

the stimulus the backward time effect

3777

02:04:54,870 --> 02:04:53,599

yes

3778

02:04:57,030 --> 02:04:54,880

and i suspect they're all over

3779

02:04:58,629 --> 02:04:57,040

neuroscience and they get buried

3780

02:05:00,550 --> 02:04:58,639

because people don't want to deal with

3781

02:05:01,669 --> 02:05:00,560

them we had a talk to one of our

3782

02:05:03,510 --> 02:05:01,679

conferences and

3783

02:05:05,109 --> 02:05:03,520

somebody was showing uh implanted

3784

02:05:07,430 --> 02:05:05,119

electrodes in patients

3785

02:05:08,790 --> 02:05:07,440

and with response to different different

3786

02:05:10,870 --> 02:05:08,800

uh faces

3787

02:05:13,189 --> 02:05:10,880

you know the halle berry neuron would

3788

02:05:16,390 --> 02:05:13,199

fire the bill clinton neuron with fire

3789

02:05:17,750 --> 02:05:16,400

and it seemed that the uh the uh the

3790

02:05:19,109 --> 02:05:17,760

firing which he was showing on the

3791

02:05:20,550 --> 02:05:19,119

screen were happening slightly before

3792

02:05:22,950 --> 02:05:20,560

the picture appeared

3793

02:05:23,669 --> 02:05:22,960

and i said are they synchronized and he

3794

02:05:25,750 --> 02:05:23,679

said yes

3795

02:05:26,950 --> 02:05:25,760

i said so you mean the neuron responds

3796

02:05:29,270 --> 02:05:26,960

just before the

3797

02:05:30,709 --> 02:05:29,280

before the picture actually appears he

3798

02:05:32,149 --> 02:05:30,719

goes yes

3799

02:05:34,229 --> 02:05:32,159

and he said well i said well how do you

3800

02:05:36,629 --> 02:05:34,239

explain that he goes i can't

3801
02:05:37,750 --> 02:05:36,639
and uh i said you think they're backward

3802
02:05:40,229 --> 02:05:37,760
time effects

3803
02:05:41,510 --> 02:05:40,239
he said i don't know he wouldn't go he

3804
02:05:42,709 --> 02:05:41,520
wouldn't go there this was christoph

3805
02:05:44,709 --> 02:05:42,719
koch student

3806
02:05:46,830 --> 02:05:44,719
at the time and i invited him to the

3807
02:05:49,030 --> 02:05:46,840
next year's conference to talk about

3808
02:05:50,390 --> 02:05:49,040
that and he showed up and he talked

3809
02:05:51,830 --> 02:05:50,400
about something different i said why

3810
02:05:52,229 --> 02:05:51,840
don't you talk about the backward time

3811
02:05:53,750 --> 02:05:52,239
effect

3812
02:05:56,870 --> 02:05:53,760
he said kristoff said it would ruin my

3813
02:05:58,950 --> 02:05:56,880

career really

3814

02:06:00,830 --> 02:05:58,960

that would ruin his career what's uh has

3815

02:06:03,030 --> 02:06:00,840

this been published

3816

02:06:04,229 --> 02:06:03,040

no but there's been a lot of stuff

3817

02:06:05,750 --> 02:06:04,239

published on backward time you know

3818

02:06:08,069 --> 02:06:05,760

daryl bem had

3819

02:06:09,750 --> 02:06:08,079

uh you know eight to eight experiment

3820

02:06:10,950 --> 02:06:09,760

and nine experiments eight of nine

3821

02:06:13,030 --> 02:06:10,960

eight out of nine of which showed back

3822

02:06:14,390 --> 02:06:13,040

with time effects

3823

02:06:16,550 --> 02:06:14,400

okay do you mind repeating that person's

3824

02:06:20,149 --> 02:06:16,560

name this way i can darryl

3825

02:06:22,550 --> 02:06:20,159

eem a psychologist oh

3826

02:06:23,350 --> 02:06:22,560

back in 2012 something like that in a

3827

02:06:26,550 --> 02:06:23,360

mainstream

3828

02:06:27,589 --> 02:06:26,560

psychology journal did uh nine

3829

02:06:31,350 --> 02:06:27,599

experiments

3830

02:06:34,310 --> 02:06:31,360

showing uh uh and eight of them showed

3831

02:06:34,629 --> 02:06:34,320

essentially backward time effects see

3832

02:06:36,470 --> 02:06:34,639

i'm

3833

02:06:37,830 --> 02:06:36,480

super super interested in talking to

3834

02:06:39,510 --> 02:06:37,840

people who

3835

02:06:41,109 --> 02:06:39,520

have done studies that demonstrate

3836

02:06:43,350 --> 02:06:41,119

something that seems like esp

3837

02:06:44,709 --> 02:06:43,360

or near death experiences or paranormal

3838

02:06:47,270 --> 02:06:44,719

psi events because

3839

02:06:47,830 --> 02:06:47,280

unlike most of the physicists i don't

3840

02:06:51,109 --> 02:06:47,840

see it as

3841

02:06:52,149 --> 02:06:51,119

perhaps there's this is indicating new

3842

02:06:53,750 --> 02:06:52,159

physics

3843

02:06:55,189 --> 02:06:53,760

or the way that consciousness interacts

3844

02:06:57,350 --> 02:06:55,199

with physics which to me is

3845

02:06:58,629 --> 02:06:57,360

part of an explanatory framework right

3846

02:06:59,990 --> 02:06:58,639

and roger's working on this

3847

02:07:02,470 --> 02:07:00,000

retroactivity

3848

02:07:04,390 --> 02:07:02,480

now which could explain this but he's

3849

02:07:06,069 --> 02:07:04,400

doing it as a way to get rid of the uh

3850

02:07:07,109 --> 02:07:06,079

well for a different reason because of

3851
02:07:09,669 --> 02:07:07,119
the uh

3852
02:07:11,669 --> 02:07:09,679
to his objective reduction in the tails

3853
02:07:13,589 --> 02:07:11,679
problem and quantum collapse and i

3854
02:07:15,030 --> 02:07:13,599
i don't know that much about but uh

3855
02:07:16,149 --> 02:07:15,040
hopefully we'll hear more about that in

3856
02:07:19,109 --> 02:07:16,159
our next paper because

3857
02:07:20,870 --> 02:07:19,119
he said he's working on it andreas cole

3858
02:07:22,709 --> 02:07:20,880
says i'm so excited for this

3859
02:07:23,990 --> 02:07:22,719
could you ask him what he thinks about

3860
02:07:26,550 --> 02:07:24,000
open individualism

3861
02:07:28,950 --> 02:07:26,560
and what theory of self he personally

3862
02:07:31,510 --> 02:07:28,960
subscribes to

3863
02:07:34,629 --> 02:07:31,520

and then what does orkoar say about that

3864

02:07:37,669 --> 02:07:34,639

said theory of self

3865

02:07:38,950 --> 02:07:37,679

um i'm not sure what different theories

3866

02:07:40,950 --> 02:07:38,960

of self are

3867

02:07:42,709 --> 02:07:40,960

i have this debate with with betsy my

3868

02:07:44,790 --> 02:07:42,719

wife all the time because

3869

02:07:46,709 --> 02:07:44,800

uh she and many people think you need

3870

02:07:49,030 --> 02:07:46,719

self to have consciousness and i

3871

02:07:51,270 --> 02:07:49,040

don't think you need a self to have

3872

02:07:54,470 --> 02:07:51,280

consciousness i think you can just have

3873

02:07:56,069 --> 02:07:54,480

uh experiences that over time

3874

02:07:57,589 --> 02:07:56,079

build up memories and the memories

3875

02:08:01,350 --> 02:07:57,599

itself so

3876

02:08:04,550 --> 02:08:01,360

uh i'm not committed you know and then

3877

02:08:06,870 --> 02:08:04,560

julian james you know had this idea that

3878

02:08:08,149 --> 02:08:06,880

hundreds of thousands of years ago there

3879

02:08:10,229 --> 02:08:08,159

was no one

3880

02:08:12,229 --> 02:08:10,239

you there's no one curt in your head

3881

02:08:15,510 --> 02:08:12,239

there's no one steward in my head

3882

02:08:17,990 --> 02:08:15,520

it was just a bunch of voices and uh

3883

02:08:18,550 --> 02:08:18,000

and you know the gods or the gremlins or

3884

02:08:21,589 --> 02:08:18,560

whoever

3885

02:08:22,790 --> 02:08:21,599

and then over over time it consolidated

3886

02:08:25,270 --> 02:08:22,800

into itself

3887

02:08:26,709 --> 02:08:25,280

so i don't think you need a self to to

3888

02:08:27,910 --> 02:08:26,719

be conscious i think

3889

02:08:29,990 --> 02:08:27,920

and of course if you know the whole

3890

02:08:33,350 --> 02:08:30,000

point of meditation is to lose

3891

02:08:35,669 --> 02:08:33,360

self so uh i i

3892

02:08:37,350 --> 02:08:35,679

i don't worry about that too much and i

3893

02:08:38,870 --> 02:08:37,360

think if you have a seat

3894

02:08:41,189 --> 02:08:38,880

sequence uh you know over the course of

3895

02:08:41,910 --> 02:08:41,199

a lifetime of conscious moments and

3896

02:08:43,350 --> 02:08:41,920

memory

3897

02:08:44,870 --> 02:08:43,360

you're going to have a self built up but

3898

02:08:46,069 --> 02:08:44,880

that doesn't mean it's the self having

3899

02:08:48,310 --> 02:08:46,079

the consciousness

3900

02:08:49,510 --> 02:08:48,320

consciousness could just be it's you

3901

02:08:52,069 --> 02:08:49,520

know occurring by its

3902

02:08:52,550 --> 02:08:52,079

by itself have you researched much about

3903

02:08:54,149 --> 02:08:52,560

jung

3904

02:08:56,310 --> 02:08:54,159

because what you described sound like

3905

02:08:56,950 --> 02:08:56,320

what jung described as the individuation

3906

02:08:58,470 --> 02:08:56,960

process

3907

02:09:01,510 --> 02:08:58,480

and that is that there are different

3908

02:09:04,550 --> 02:09:01,520

personalities disparate maybe disjoint

3909

02:09:07,589 --> 02:09:04,560

that are competing and conflicting

3910

02:09:08,550 --> 02:09:07,599

it could be yeah i i'm not a i know a

3911

02:09:12,149 --> 02:09:08,560

little bit about young

3912

02:09:14,390 --> 02:09:12,159

and uh uh betsy studies young and my

3913

02:09:15,350 --> 02:09:14,400

my good friend harold ottman spocker is

3914

02:09:19,030 --> 02:09:15,360

big on young

3915

02:09:21,910 --> 02:09:19,040

um but uh

3916

02:09:24,390 --> 02:09:21,920

i don't really know that much about it

3917

02:09:26,390 --> 02:09:24,400

okay and lastly dan arms says

3918

02:09:27,910 --> 02:09:26,400

does he think there may be any basis to

3919

02:09:31,589 --> 02:09:27,920

the hypothesis

3920

02:09:34,709 --> 02:09:31,599

that the sun has consciousness the sun

3921

02:09:36,550 --> 02:09:34,719

yeah uh the only thing i want to say

3922

02:09:40,550 --> 02:09:36,560

about that is that uh

3923

02:09:43,910 --> 02:09:40,560

roger once said that neutron stars

3924

02:09:47,109 --> 02:09:43,920

uh have giant bose-einstein condensates

3925

02:09:50,550 --> 02:09:47,119

so they could have moments of collapse

3926

02:09:52,069 --> 02:09:50,560

and a neutron star might be having

3927

02:09:57,669 --> 02:09:52,079

conscious moments but

3928

02:10:02,069 --> 02:10:00,709

stuart thank you so much man hey you're

3929

02:10:03,910 --> 02:10:02,079

welcome

3930

02:10:05,750 --> 02:10:03,920

good talking to you good luck to you yes

3931

02:10:07,109 --> 02:10:05,760

great questions thanks for your audience