



1
00:00:06,470 --> 00:00:04,130
hello and welcome to this SSE Community

2
00:00:08,030 --> 00:00:06,480
discussion hour my name is Annalisa

3
00:00:10,549 --> 00:00:08,040
ventola I'm the editor of edge science

4
00:00:13,070 --> 00:00:10,559
and I will be your host for this event I

5
00:00:15,650 --> 00:00:13,080
have with me Patrick wedge who is a

6
00:00:18,769 --> 00:00:15,660
writer editor publisher and television

7
00:00:20,810 --> 00:00:18,779
producer he spent two days two decades

8
00:00:22,730 --> 00:00:20,820
writing about science for magazines from

9
00:00:25,609 --> 00:00:22,740
Omni to discover to the New York Times

10
00:00:28,790 --> 00:00:25,619
it was a staff writer Newsweek produced

11
00:00:32,389 --> 00:00:28,800
television documentaries for WGBH and

12
00:00:34,970 --> 00:00:32,399
wnet was the editor of ssc's edge

13
00:00:38,150 --> 00:00:34,980

science for more than 12 years and as

14

00:00:40,430 --> 00:00:38,160

the author or co-author of nine books he

15

00:00:42,770 --> 00:00:40,440

is currently the editor and publisher of

16

00:00:45,229 --> 00:00:42,780

anomalous books Patrick it's a pleasure

17

00:00:46,790 --> 00:00:45,239

to have you with us today I invite you

18

00:00:49,310 --> 00:00:46,800

to begin your presentation and I will

19

00:00:52,729 --> 00:00:49,320

clear the stage

20

00:00:54,889 --> 00:00:52,739

thank you when it Lisa welcome everyone

21

00:00:57,229 --> 00:00:54,899

those of you who already know about the

22

00:00:59,569 --> 00:00:57,239

discovery of small comets probably have

23

00:01:01,069 --> 00:00:59,579

doubts about it as it's quite a

24

00:01:03,110 --> 00:01:01,079

controversial subject

25

00:01:05,450 --> 00:01:03,120

those of you who are not familiar with

26

00:01:07,609 --> 00:01:05,460

it are quite frankly in for a big

27

00:01:09,289 --> 00:01:07,619

surprise

28

00:01:11,690 --> 00:01:09,299

today I will tell you how the small

29

00:01:14,210 --> 00:01:11,700

comets were discovered and I will show

30

00:01:16,850 --> 00:01:14,220

you as much of the evidence I as I can

31

00:01:19,310 --> 00:01:16,860

squeeze into my presentation

32

00:01:21,710 --> 00:01:19,320

I will not discuss the details of the

33

00:01:23,450 --> 00:01:21,720

controversy that would take all day

34

00:01:24,770 --> 00:01:23,460

you'll have to read the book for that

35

00:01:26,990 --> 00:01:24,780

part of the story

36

00:01:30,050 --> 00:01:27,000

but I will tell you how I became

37

00:01:32,090 --> 00:01:30,060

involved in the story

38

00:01:34,249 --> 00:01:32,100

I'd like to begin by giving you a little

39

00:01:39,550 --> 00:01:34,259

bit of background about The Man Behind

40

00:01:44,090 --> 00:01:42,469

was a space physicist at the University

41

00:01:46,850 --> 00:01:44,100

of Iowa

42

00:01:49,370 --> 00:01:46,860

as an undergraduate there he assisted

43

00:01:51,649 --> 00:01:49,380

James Van Allen in the calibration of

44

00:01:53,630 --> 00:01:51,659

the first U.S lunars probes Pioneer

45

00:01:56,450 --> 00:01:53,640

three and four

46

00:01:58,249 --> 00:01:56,460

at the time of the discovery he was

47

00:02:01,130 --> 00:01:58,259

regarded as one of the most respected

48

00:02:02,630 --> 00:02:01,140

space physicists in the world he was

49

00:02:05,510 --> 00:02:02,640

responsible for more scientific

50

00:02:07,069 --> 00:02:05,520

instruments aboard spacecraft than any

51
00:02:08,270 --> 00:02:07,079
other scientist hadn't been an

52
00:02:15,110 --> 00:02:08,280
investigator

53
00:02:17,869 --> 00:02:15,120
aboard 42 spacecraft

54
00:02:21,410 --> 00:02:17,879
his scientific accomplishments were many

55
00:02:23,510 --> 00:02:21,420
he discovered the Theta Aurora made the

56
00:02:26,030 --> 00:02:23,520
first measurements of the plasma ring

57
00:02:28,190 --> 00:02:26,040
around Jupiter and Saturn he was the

58
00:02:30,170 --> 00:02:28,200
first to measure solar wind plasma

59
00:02:32,449 --> 00:02:30,180
funneling directly into the Earth's

60
00:02:35,089 --> 00:02:32,459
polar atmosphere and he discovered the

61
00:02:40,790 --> 00:02:35,099
belt of ions around

62
00:02:47,030 --> 00:02:44,089
now in August of 1981 a spacecraft

63
00:02:49,130 --> 00:02:47,040

called Dynamics Explorer 1 was launched

64

00:02:51,710 --> 00:02:49,140

it's basically an earth absorbing

65

00:02:53,210 --> 00:02:51,720

platform there were many scientists have

66

00:02:55,970 --> 00:02:53,220

who had instruments aboard the

67

00:02:58,430 --> 00:02:55,980

spacecraft and Frank was responsible for

68

00:03:01,070 --> 00:02:58,440

three of his instruments one of which

69

00:03:03,110 --> 00:03:01,080

was the ultraviolet camera which was

70

00:03:04,369 --> 00:03:03,120

built and operated by his colleague John

71

00:03:06,650 --> 00:03:04,379

Craven

72

00:03:08,630 --> 00:03:06,660

the ultraviolet camera which was

73

00:03:10,369 --> 00:03:08,640

designed to study the Earth's Aurora

74

00:03:12,290 --> 00:03:10,379

which is Frank's interest

75

00:03:14,089 --> 00:03:12,300

shows the Earth's deglo which is

76
00:03:16,910 --> 00:03:14,099
produced by the interaction of sunlight

77
00:03:19,309 --> 00:03:16,920
with the atomic oxygen present in the

78
00:03:21,710 --> 00:03:19,319
earth's upper atmosphere

79
00:03:24,890 --> 00:03:21,720
the images that came back from a UV

80
00:03:27,229 --> 00:03:24,900
camera were normal except they were

81
00:03:30,589 --> 00:03:27,239
speckled with some very puzzling dark

82
00:03:35,149 --> 00:03:32,690
now normally

83
00:03:37,130 --> 00:03:35,159
scientists will just ignore things that

84
00:03:41,149 --> 00:03:37,140
don't directly pertain to what they're

85
00:03:42,770 --> 00:03:41,159
interested are but Fred didn't like like

86
00:03:45,050 --> 00:03:42,780
to know about everything that was going

87
00:03:47,690 --> 00:03:45,060
on in his images and these dark spots

88
00:03:50,149 --> 00:03:47,700

really annoyed him

89

00:03:52,850 --> 00:03:50,159

so what is a scientist supposed to do

90

00:03:57,830 --> 00:03:52,860

when you can't understand something well

91

00:04:00,949 --> 00:03:57,840

you assign the job to a graduate student

92

00:04:03,530 --> 00:04:00,959

in this case John sayworth

93

00:04:05,509 --> 00:04:03,540

so he looked into whether it was do

94

00:04:09,309 --> 00:04:05,519

these dark spots were due to faulty

95

00:04:12,910 --> 00:04:09,319

instrumentation radio transmission noise

96

00:04:19,069 --> 00:04:12,920

failing sensors paint Flex on the camera

97

00:04:24,350 --> 00:04:21,830

so Frank concluded after a few years of

98

00:04:26,330 --> 00:04:24,360

putting John sigworth to work on this

99

00:04:28,969 --> 00:04:26,340

that there was something between the

100

00:04:31,370 --> 00:04:28,979

satellite itself and the region in the

101
00:04:33,830 --> 00:04:31,380
upper atmosphere being observed

102
00:04:36,770 --> 00:04:33,840
something was absorbing the ultraviolet

103
00:04:40,249 --> 00:04:36,780
light in that region and creating a kind

104
00:04:43,189 --> 00:04:40,259
of dark atmospheric hole in the uniform

105
00:04:45,590 --> 00:04:43,199
glow of the Earth

106
00:04:48,730 --> 00:04:45,600
Frank and seaworth found more than 30

107
00:04:52,249 --> 00:04:48,740
000 such spots in images during some

108
00:04:54,590 --> 00:04:52,259
2000 hours of observing time

109
00:04:57,170 --> 00:04:54,600
whatever the black spots represented

110
00:05:00,830 --> 00:04:57,180
they showed the pro-grade motion that is

111
00:05:03,490 --> 00:05:00,840
characteristic of meteorite material

112
00:05:06,830 --> 00:05:03,500
but these dark spots were enormous

113
00:05:09,469 --> 00:05:06,840

measuring about 30 miles in diameter and

114

00:05:10,370 --> 00:05:09,479

an altitude of 200 to 600 miles above

115

00:05:13,430 --> 00:05:10,380

the Earth

116

00:05:15,590 --> 00:05:13,440

these could not be rocks

117

00:05:18,110 --> 00:05:15,600

so what could it be

118

00:05:19,670 --> 00:05:18,120

well water just happens to absorb at the

119

00:05:20,749 --> 00:05:19,680

wavelengths they were observing with

120

00:05:23,390 --> 00:05:20,759

their camera

121

00:05:25,730 --> 00:05:23,400

but no amount of evaporation from the

122

00:05:27,650 --> 00:05:25,740

surface of the Earth could produce such

123

00:05:29,150 --> 00:05:27,660

large clouds of water vapor at that

124

00:05:32,390 --> 00:05:29,160

altitude

125

00:05:34,189 --> 00:05:32,400

the water had to come from out there

126

00:05:37,310 --> 00:05:34,199

Frank's conclusion

127

00:05:40,070 --> 00:05:37,320

these dark spots are What Remain when

128

00:05:42,950 --> 00:05:40,080

small comets house-sized chunks of water

129

00:05:46,310 --> 00:05:42,960

snow are vaporized above the Earth's

130

00:05:49,969 --> 00:05:46,320

atmosphere every minute

131

00:05:52,790 --> 00:05:49,979

so we're talking about millions of small

132

00:05:55,430 --> 00:05:52,800

comets incoming each year

133

00:05:57,890 --> 00:05:55,440

that was a problem if Frank had said

134

00:06:00,409 --> 00:05:57,900

there was one comment ten comment maybe

135

00:06:01,790 --> 00:06:00,419

a hundred comments coming in a year I

136

00:06:02,930 --> 00:06:01,800

don't think the hoopla would have been

137

00:06:05,270 --> 00:06:02,940

what it is

138

00:06:08,930 --> 00:06:05,280

but obviously the criticism came down

139

00:06:13,010 --> 00:06:10,610

now what's interesting is that the black

140

00:06:15,110 --> 00:06:13,020

spots would appear and disappear in a

141

00:06:17,210 --> 00:06:15,120

sequence of frames

142

00:06:19,810 --> 00:06:17,220

the odd the black spots seem to be

143

00:06:22,129 --> 00:06:19,820

objects in motion

144

00:06:24,529 --> 00:06:22,139

Frank's concluded that the gradual

145

00:06:27,890 --> 00:06:24,539

appearance and disappearance of a single

146

00:06:30,830 --> 00:06:27,900

atmospheric hole is caused by a small

147

00:06:34,029 --> 00:06:30,840

comet in a sequence of images taken 42

148

00:06:36,590 --> 00:06:34,039

seconds apart as you can see here

149

00:06:39,230 --> 00:06:36,600

these images reflect the transient

150

00:06:41,450 --> 00:06:39,240

nature of the water vapor clouds or the

151
00:06:45,610 --> 00:06:41,460
remains of small comets as they plunged

152
00:06:50,409 --> 00:06:48,050
Frank's Discovery was announced in

153
00:06:53,150 --> 00:06:50,419
geophysical research letters in April of

154
00:06:54,409 --> 00:06:53,160
1986. this is the cover of the journal

155
00:06:56,570 --> 00:06:54,419
where it appeared

156
00:06:59,689 --> 00:06:56,580
and you see at the top

157
00:07:03,710 --> 00:06:59,699
the ring which is the uh ultraviolet

158
00:07:06,409 --> 00:07:03,720
image of the northern oral oval

159
00:07:08,629 --> 00:07:06,419
now Alex dexler was the editor of the

160
00:07:11,150 --> 00:07:08,639
journal at that time and he allowed

161
00:07:14,510 --> 00:07:11,160
Frank to have two papers in this issue

162
00:07:16,070 --> 00:07:14,520
one was the data paper the other was the

163
00:07:18,710 --> 00:07:16,080

interpretation

164

00:07:21,469 --> 00:07:18,720

no one had any problems with the data

165

00:07:24,409 --> 00:07:21,479

paper the data paper was what it was but

166

00:07:27,170 --> 00:07:24,419

the interpretation caused The Firestorm

167

00:07:29,809 --> 00:07:27,180

desler ended up publishing 11 critical

168

00:07:32,029 --> 00:07:29,819

comments they covered a very broad range

169

00:07:34,430 --> 00:07:32,039

of subjects from geology to planetary

170

00:07:37,909 --> 00:07:34,440

atmosphere and from lunar science to

171

00:07:42,710 --> 00:07:37,919

astronomy Frank replied to each one it

172

00:07:46,790 --> 00:07:45,170

now if one satellite we're seeing these

173

00:07:48,830 --> 00:07:46,800

dark spots maybe there were other

174

00:07:51,050 --> 00:07:48,840

satellites as well well there just

175

00:07:53,689 --> 00:07:51,060

happened to be a Swedish satellite in

176

00:07:54,770 --> 00:07:53,699

the air at that time and he was allowed

177

00:07:57,529 --> 00:07:54,780

to

178

00:07:59,749 --> 00:07:57,539

examine some of their images and sure

179

00:08:06,070 --> 00:07:59,759

enough he spotted the dark spots in

180

00:08:11,570 --> 00:08:08,930

one of the people who was interested in

181

00:08:13,790 --> 00:08:11,580

Frank's area was Thomas Donahue who was

182

00:08:15,110 --> 00:08:13,800

a respected atmospheric scientist in the

183

00:08:17,450 --> 00:08:15,120

University of Michigan

184

00:08:20,210 --> 00:08:17,460

he looked at Frank's Facebook papers and

185

00:08:22,550 --> 00:08:20,220

said if Frank is right these comments

186

00:08:27,230 --> 00:08:22,560

would have brought enough water over the

187

00:08:31,010 --> 00:08:29,210

now this really surprised Frank because

188

00:08:33,110 --> 00:08:31,020

he had always assumed that the oceans

189

00:08:35,630 --> 00:08:33,120

had always been here and so did

190

00:08:38,329 --> 00:08:35,640

everybody else based on a very famous

191

00:08:40,430 --> 00:08:38,339

paper by William Ruby who was Pub that

192

00:08:42,889 --> 00:08:40,440

was published in 1951.

193

00:08:44,630 --> 00:08:42,899

everyone cites Ruby's paper as saying

194

00:08:45,590 --> 00:08:44,640

that the water must have been here at

195

00:08:47,870 --> 00:08:45,600

the beginning

196

00:08:50,509 --> 00:08:47,880

but if you look at Ruby's paper he did

197

00:08:52,430 --> 00:08:50,519

not say that he actually said that the

198

00:08:54,590 --> 00:08:52,440

water must have arrived on the surface

199

00:08:56,690 --> 00:08:54,600

of the Earth over time

200

00:08:58,490 --> 00:08:56,700

I don't think he meant to the present

201

00:09:01,370 --> 00:08:58,500

day however

202

00:09:03,949 --> 00:09:01,380

now one geologist was interested in all

203

00:09:06,470 --> 00:09:03,959

this a geologist at the University of

204

00:09:08,990 --> 00:09:06,480

Oklahoma Dave Deming later published the

205

00:09:10,910 --> 00:09:09,000

paper in the journal paleo supporting

206

00:09:13,370 --> 00:09:10,920

the idea that the oceans must have

207

00:09:17,110 --> 00:09:13,380

formed through a gradual accretion of

208

00:09:20,030 --> 00:09:17,120

volatiles over time to the present day

209

00:09:21,410 --> 00:09:20,040

this is where I came into the paper

210

00:09:24,650 --> 00:09:21,420

the New York Times at that time

211

00:09:26,690 --> 00:09:24,660

published a an article about Frank's

212

00:09:28,790 --> 00:09:26,700

Theory and the possibility they were

213

00:09:30,170 --> 00:09:28,800

responsible for the formation of the

214

00:09:32,630 --> 00:09:30,180

oceans on the earth

215

00:09:34,490 --> 00:09:32,640

I saw this and being a science

216

00:09:37,430 --> 00:09:34,500

journalist at the time I pitched the

217

00:09:38,810 --> 00:09:37,440

idea to an editor and you at Oceans

218

00:09:41,570 --> 00:09:38,820

magazine

219

00:09:43,310 --> 00:09:41,580

the editor gave me the go-ahead and I

220

00:09:45,410 --> 00:09:43,320

contacted

221

00:09:48,710 --> 00:09:45,420

uh Liu Frank

222

00:09:50,870 --> 00:09:48,720

interview them at length and my article

223

00:09:53,210 --> 00:09:50,880

ended up being published in Publishers

224

00:09:55,090 --> 00:09:53,220

magazine so that was my first

225

00:10:00,949 --> 00:09:55,100

uh

226

00:10:06,110 --> 00:10:03,769

now one of the things that's that's

227

00:10:07,930 --> 00:10:06,120

puzzled atmospheric scientists for a

228

00:10:10,490 --> 00:10:07,940

long time are not to listen's class

229

00:10:12,230 --> 00:10:10,500

they're not there's not enough rewarded

230

00:10:15,170 --> 00:10:12,240

thought to evaporate from the Earth's

231

00:10:17,090 --> 00:10:15,180

surface and reach altitudes of 55 miles

232

00:10:18,949 --> 00:10:17,100

to form these clouds

233

00:10:21,829 --> 00:10:18,959

but if the small comets are bringing

234

00:10:23,870 --> 00:10:21,839

water in and depositing a little of it

235

00:10:26,690 --> 00:10:23,880

in the upper atmosphere as it gets

236

00:10:28,250 --> 00:10:26,700

injected into the atmosphere and the

237

00:10:32,170 --> 00:10:28,260

Mystery of these clouds has a very

238

00:10:37,070 --> 00:10:34,250

something else that's a puzzled

239

00:10:40,970 --> 00:10:37,080

scientist for a long time are transient

240

00:10:43,790 --> 00:10:40,980

lunar phenomena these momentary glows

241

00:10:45,050 --> 00:10:43,800

that appears on the earth on the moon's

242

00:10:48,170 --> 00:10:45,060

surface

243

00:10:50,630 --> 00:10:48,180

and here is an image from a series of

244

00:10:52,490 --> 00:10:50,640

frames taken by some Greek astronomers

245

00:10:54,650 --> 00:10:52,500

in 1985.

246

00:10:58,130 --> 00:10:54,660

these exposures taken eight seconds

247

00:11:00,949 --> 00:10:58,140

apart and the impact of a small comet on

248

00:11:05,410 --> 00:11:00,959

the moon would produce such a momentary

249

00:11:10,430 --> 00:11:07,610

now one of the people who was very

250

00:11:14,329 --> 00:11:10,440

interested in in Frank's Theory actually

251
00:11:16,670 --> 00:11:14,339
was very uh skeptical of it was someone

252
00:11:17,870 --> 00:11:16,680
named clayne Yates at the jet propulsion

253
00:11:20,269 --> 00:11:17,880
Laboratory

254
00:11:21,829 --> 00:11:20,279
at the time uh he was working on the

255
00:11:24,290 --> 00:11:21,839
Galileo project

256
00:11:26,090 --> 00:11:24,300
but the gallery layout project was

257
00:11:27,230 --> 00:11:26,100
delayed because of the Challenger

258
00:11:29,870 --> 00:11:27,240
disaster

259
00:11:32,569 --> 00:11:29,880
so he decided to see if he could search

260
00:11:35,030 --> 00:11:32,579
for the small comets using a telescope

261
00:11:39,110 --> 00:11:35,040
now they're not many telescopes that are

262
00:11:41,630 --> 00:11:39,120
usable for near-earth objects but one of

263
00:11:44,030 --> 00:11:41,640

them was a space watch telescope

264

00:11:45,949 --> 00:11:44,040

in Kick B

265

00:11:48,350 --> 00:11:45,959

and Arizona

266

00:11:50,930 --> 00:11:48,360

so he got together with Frank and they

267

00:11:53,269 --> 00:11:50,940

did they discussed exactly how the

268

00:11:55,970 --> 00:11:53,279

search should be run to find small

269

00:12:00,050 --> 00:11:57,769

now Yates managed to get the first

270

00:12:01,850 --> 00:12:00,060

Optical images the small comets the

271

00:12:04,370 --> 00:12:01,860

large streaks in the image of star

272

00:12:07,250 --> 00:12:04,380

Trails but a faint small Comet Trail

273

00:12:10,310 --> 00:12:07,260

appears as well it's the slanted line

274

00:12:12,310 --> 00:12:10,320

the faint slanted line and the outline

275

00:12:15,350 --> 00:12:12,320

box

276

00:12:17,690 --> 00:12:15,360

these small dark fast-moving objects

277

00:12:23,030 --> 00:12:17,700

have so far only appeared in images

278

00:12:29,389 --> 00:12:26,389

now these these small comets appeared in

279

00:12:31,610 --> 00:12:29,399

the number of plain Yates images from

280

00:12:35,150 --> 00:12:31,620

the search

281

00:12:37,310 --> 00:12:35,160

here in the top image you'll see that uh

282

00:12:40,190 --> 00:12:37,320

Frank has tried to identify everything

283

00:12:44,150 --> 00:12:40,200

in the image from Star Trails cosmic

284

00:12:47,810 --> 00:12:44,160

rays counting statistics CCD effects but

285

00:12:50,030 --> 00:12:47,820

once again in the box you'll see the

286

00:12:51,970 --> 00:12:50,040

characteristic slanted line of a small

287

00:12:55,190 --> 00:12:51,980

comet

288

00:13:00,110 --> 00:12:55,200

these exposures were taken by astronomer

289

00:13:02,449 --> 00:13:00,120

Tom carrolls in April of 1988.

290

00:13:05,210 --> 00:13:02,459

now the same comments seen the top image

291

00:13:08,629 --> 00:13:05,220

is seen in the in the Box in the

292

00:13:09,889 --> 00:13:08,639

following image which began 36 seconds

293

00:13:12,230 --> 00:13:09,899

later

294

00:13:14,389 --> 00:13:12,240

taking consecutive frames of the same

295

00:13:17,210 --> 00:13:14,399

object is the standard of proof and

296

00:13:19,069 --> 00:13:17,220

astronomy normally but after seeing the

297

00:13:21,290 --> 00:13:19,079

critics this after seeing this the

298

00:13:23,870 --> 00:13:21,300

critics wanted three consecutive images

299

00:13:27,650 --> 00:13:23,880

of the same object to accept that the

300

00:13:27,660 --> 00:13:31,030

foreign

301
00:13:36,050 --> 00:13:33,530
who is a professor of astronomy at

302
00:13:39,829 --> 00:13:36,060
Boston University was curious about all

303
00:13:43,310 --> 00:13:39,839
this and in 1988 he sent up a sounding

304
00:13:46,970 --> 00:13:43,320
rocket from Wallops Island in Virginia

305
00:13:50,150 --> 00:13:46,980
the payload of the rocket released 584

306
00:13:53,030 --> 00:13:50,160
pounds of water water vapor ice carbon

307
00:13:54,610 --> 00:13:53,040
dioxide and debris 185 miles up into the

308
00:13:57,769 --> 00:13:54,620
atmosphere

309
00:14:00,050 --> 00:13:57,779
almost 4 000 miles above the Dynamics

310
00:14:03,170 --> 00:14:00,060
Explorer satellite had been reprogrammed

311
00:14:04,970 --> 00:14:03,180
to take a series of one minute images of

312
00:14:07,610 --> 00:14:04,980
the narrow region surrounding the

313
00:14:10,550 --> 00:14:07,620

release of the Rockets payload and

314

00:14:13,310 --> 00:14:10,560

indeed Dynamic is 4 managed to spot the

315

00:14:16,910 --> 00:14:13,320

event showing that Frank's proposal was

316

00:14:19,009 --> 00:14:16,920

at the very least quite plausible

317

00:14:20,690 --> 00:14:19,019

somebody else who was interested in this

318

00:14:23,629 --> 00:14:20,700

was a meteorologist at Penn State

319

00:14:25,670 --> 00:14:23,639

University John oliveiro

320

00:14:27,829 --> 00:14:25,680

he wondered is there really a large

321

00:14:30,590 --> 00:14:27,839

amount of water in the upper atmosphere

322

00:14:34,610 --> 00:14:30,600

after repeatedly observing short-term

323

00:14:37,009 --> 00:14:34,620

perturbations in my microwave Spectra he

324

00:14:39,829 --> 00:14:37,019

concluded that those that these

325

00:14:41,990 --> 00:14:39,839

temporary increases in water vapor

326

00:14:44,629 --> 00:14:42,000

concentrations in the other atmosphere

327

00:14:47,870 --> 00:14:44,639

must have come from extraterrestrial

328

00:14:53,650 --> 00:14:49,670

foreign

329

00:14:57,290 --> 00:14:53,660

so after Lou Franks saw my paper in

330

00:14:59,090 --> 00:14:57,300

Ocean's magazine he contacted me and he

331

00:15:00,769 --> 00:14:59,100

asked me if I would be interested in

332

00:15:02,269 --> 00:15:00,779

writing a book with him about his

333

00:15:04,430 --> 00:15:02,279

discovery

334

00:15:07,430 --> 00:15:04,440

uh I thought I was very surprised by

335

00:15:11,269 --> 00:15:07,440

this because my article starts out

336

00:15:13,250 --> 00:15:11,279

rather skeptically about his finding but

337

00:15:15,350 --> 00:15:13,260

apparently he liked it enough that he

338

00:15:17,810 --> 00:15:15,360

offered this

339

00:15:22,790 --> 00:15:17,820

to me to write a book and the book

340

00:15:24,530 --> 00:15:22,800

appeared in 1990 and it gathered some uh

341

00:15:25,610 --> 00:15:24,540

it didn't make a big splash it made a

342

00:15:30,769 --> 00:15:25,620

little splash

343

00:15:30,779 --> 00:15:36,650

that's not the end of the story however

344

00:15:42,350 --> 00:15:40,129

while Frank was uh getting the uh data

345

00:15:44,689 --> 00:15:42,360

down from the Dynamics Explorer

346

00:15:47,509 --> 00:15:44,699

satellite he was also working on other

347

00:15:51,050 --> 00:15:47,519

instruments for a forthcoming

348

00:15:53,689 --> 00:15:51,060

spacecraft called polar

349

00:15:55,910 --> 00:15:53,699

and he decided to tweak a few things to

350

00:15:58,550 --> 00:15:55,920

make sure to be able to learn excuse me

351
00:16:01,689 --> 00:15:58,560
to learn more about what these black

352
00:16:04,550 --> 00:16:01,699
spots were and the small comets

353
00:16:07,550 --> 00:16:04,560
while the Dynamics Explorer showed the

354
00:16:09,710 --> 00:16:07,560
atmospheric holes in singles pixels

355
00:16:12,530 --> 00:16:09,720
this led critics to dismiss the

356
00:16:15,350 --> 00:16:12,540
phenomena as instrumental artifact

357
00:16:20,210 --> 00:16:15,360
but on the Polar space graph you see

358
00:16:25,069 --> 00:16:22,129
this was taken by the visible image

359
00:16:27,170 --> 00:16:25,079
system on NASA's polar spacecraft in

360
00:16:29,449 --> 00:16:27,180
1996.

361
00:16:31,370 --> 00:16:29,459
these black spots are in the image are

362
00:16:34,370 --> 00:16:31,380
caused by water vapor clouds from small

363
00:16:36,829 --> 00:16:34,380

comets disintegrating anywhere from 600

364

00:16:39,470 --> 00:16:36,839
to 1200 miles above the Earth

365

00:16:41,990 --> 00:16:39,480
the water vapor clouds momentarily and

366

00:16:44,990 --> 00:16:42,000
locally absorb the Earth's day glow as

367

00:16:48,110 --> 00:16:45,000
viewed from The Polar spacecraft

368

00:16:50,870 --> 00:16:48,120
when these uh when the news broke about

369

00:16:53,090 --> 00:16:50,880
this finding uh people called it a

370

00:16:57,590 --> 00:16:53,100
Vindication of Frank's provocative

371

00:16:59,389 --> 00:16:57,600
Theory and in 1997 this made the front

372

00:17:05,390 --> 00:16:59,399
pages of the New York Times The

373

00:17:05,400 --> 00:17:08,110
now

374

00:17:13,909 --> 00:17:10,730
Frank's images above polar managed to

375

00:17:16,549 --> 00:17:13,919
produce a lot of other images of that

376

00:17:18,890 --> 00:17:16,559

supported Frank's conclusion uh this

377

00:17:21,289 --> 00:17:18,900

image of the sun lit Earth

378

00:17:24,169 --> 00:17:21,299

seen in the far ultraviolet

379

00:17:26,750 --> 00:17:24,179

was taken by an image by camera Awards

380

00:17:28,850 --> 00:17:26,760

polar and the image has a malted

381

00:17:30,770 --> 00:17:28,860

appearance because of intensities in

382

00:17:33,049 --> 00:17:30,780

this spectral window or factors of a

383

00:17:35,090 --> 00:17:33,059

million dimmer than those for Visible

384

00:17:37,250 --> 00:17:35,100

wavelengths

385

00:17:39,110 --> 00:17:37,260

this is the a record of the final

386

00:17:42,470 --> 00:17:39,120

moments of the disintegration of a small

387

00:17:46,430 --> 00:17:44,330

now one thing that was very interesting

388

00:17:47,450 --> 00:17:46,440

about polar is that when Polar was first

389

00:17:49,490 --> 00:17:47,460

sent up

390

00:17:51,650 --> 00:17:49,500

there was a misalignment of the center

391

00:17:53,270 --> 00:17:51,660

of gravity and spin axis of the

392

00:17:56,830 --> 00:17:53,280

spacecraft

393

00:18:00,230 --> 00:17:56,840

this unintended swaying Motion in the

394

00:18:03,230 --> 00:18:00,240

spacecraft's platform which they were

395

00:18:05,690 --> 00:18:03,240

later able to compensate for cause

396

00:18:07,490 --> 00:18:05,700

things that seen in the line of sight of

397

00:18:10,370 --> 00:18:07,500

Poland to appear

398

00:18:12,590 --> 00:18:10,380

double or Cat's eyes

399

00:18:16,370 --> 00:18:12,600

here are two frames the one on the left

400

00:18:17,409 --> 00:18:16,380

is a star showing up doubled because of

401
00:18:21,049 --> 00:18:17,419
the problem

402
00:18:24,049 --> 00:18:21,059
and here is an atmospheric hold showing

403
00:18:28,370 --> 00:18:24,059
up doubled again because of this

404
00:18:31,610 --> 00:18:28,380
misalignment in the Imager

405
00:18:33,710 --> 00:18:31,620
so once again this lens created to the

406
00:18:39,770 --> 00:18:33,720
fact that this is a genuine

407
00:18:46,250 --> 00:18:44,270
more images the raw images on the right

408
00:18:49,130 --> 00:18:46,260
for small comets bursting at high

409
00:18:51,770 --> 00:18:49,140
altitudes Trails of bright glows from

410
00:18:53,810 --> 00:18:51,780
Atomic oxygen were observed by the polar

411
00:18:56,090 --> 00:18:53,820
spacecraft high resolution Earth camera

412
00:18:58,310 --> 00:18:56,100
for ultraviolet wavelengths

413
00:19:00,169 --> 00:18:58,320

these trails are distinguished from

414

00:19:02,990 --> 00:19:00,179

artifacts due to penetration of

415

00:19:05,570 --> 00:19:03,000

energetic charged particles into the

416

00:19:08,510 --> 00:19:05,580

camera sensors by a sequence of

417

00:19:11,270 --> 00:19:08,520

electronic shutter closings during the

418

00:19:14,390 --> 00:19:11,280

exposure period of the image

419

00:19:17,150 --> 00:19:14,400

thus a real oxygen Trail is identified

420

00:19:19,610 --> 00:19:17,160

by alternative alternate brightenings

421

00:19:22,130 --> 00:19:19,620

and dimmings along the trails you can

422

00:19:24,409 --> 00:19:22,140

see how it's cut up along the trail an

423

00:19:31,630 --> 00:19:24,419

energetic particle will not have the

424

00:19:38,390 --> 00:19:34,730

here is a long oxygen trail from the

425

00:19:42,110 --> 00:19:38,400

disruption of a small comet passing by

426
00:19:47,210 --> 00:19:44,630
now unlike the large comets which are

427
00:19:49,789 --> 00:19:47,220
detected by their comma commas small

428
00:19:50,870 --> 00:19:49,799
comets can only be detected by reflected

429
00:19:53,450 --> 00:19:50,880
sunlight

430
00:19:55,909 --> 00:19:53,460
and because they are so faint they need

431
00:19:59,150 --> 00:19:55,919
to pass much closer to the Earth than

432
00:20:02,750 --> 00:19:59,160
the large comets in order to be seen

433
00:20:04,789 --> 00:20:02,760
but if they do exist some astronomers

434
00:20:07,370 --> 00:20:04,799
have realized there would certainly be

435
00:20:10,190 --> 00:20:07,380
many of them as very likely they would

436
00:20:16,730 --> 00:20:10,200
be indistinguishable from the meteors we

437
00:20:21,890 --> 00:20:19,669
now here are subframes from two cameras

438
00:20:25,190 --> 00:20:21,900

aboard this polar spacecraft one is

439

00:20:28,010 --> 00:20:25,200

divisible and one is uvi

440

00:20:30,890 --> 00:20:28,020

that showed this day glow intensities at

441

00:20:35,510 --> 00:20:30,900

the same location in the earth's upper

442

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

atmosphere both before during and after

443

00:20:39,830 --> 00:20:37,679

the occurrence of an atmospheric hole

444

00:20:42,409 --> 00:20:39,840

produced by the deposition of water

445

00:20:45,049 --> 00:20:42,419

vapor from a small comet

446

00:20:47,270 --> 00:20:45,059

Whatever Whenever a large atmospheric

447

00:20:50,029 --> 00:20:47,280

hole was detected in one camera's frame

448

00:20:51,470 --> 00:20:50,039

it was detected in the other camera's

449

00:20:54,230 --> 00:20:51,480

frame

450

00:20:56,630 --> 00:20:54,240

this series of observations provide a

451
00:21:00,770 --> 00:20:56,640
conclusive identification of atmospheric

452
00:21:05,510 --> 00:21:00,780
holes as a genuine geophysical phenomena

453
00:21:11,210 --> 00:21:08,090
here is a diagram basically of what

454
00:21:13,370 --> 00:21:11,220
happens you have an incoming small Comet

455
00:21:15,890 --> 00:21:13,380
about 40 feet in diameter containing

456
00:21:18,409 --> 00:21:15,900
about 100 tons of water vapor moving

457
00:21:20,810 --> 00:21:18,419
about 10 miles per second

458
00:21:22,370 --> 00:21:20,820
the comment breaks up about 800 miles

459
00:21:25,610 --> 00:21:22,380
above the Earth

460
00:21:27,590 --> 00:21:25,620
the comet vaporizes about 330 miles

461
00:21:29,930 --> 00:21:27,600
above the Earth

462
00:21:31,850 --> 00:21:29,940
producing a cloud of water vapor about

463
00:21:34,549 --> 00:21:31,860

30 miles in diameter

464

00:21:37,190 --> 00:21:34,559

and the dispersal as the the water vapor

465

00:21:40,070 --> 00:21:37,200

gets injected into the atmosphere it's

466

00:21:42,350 --> 00:21:40,080

it's dispersed by the upper atmospheric

467

00:21:45,590 --> 00:21:42,360

winds and finally the water vapor

468

00:21:47,630 --> 00:21:45,600

condenses into the Earth's oceans

469

00:21:50,090 --> 00:21:47,640

now the small comets are thought to be

470

00:21:51,610 --> 00:21:50,100

responsible for a tiny fraction of the

471

00:21:54,230 --> 00:21:51,620

annual rainfall

472

00:21:56,149 --> 00:21:54,240

depositing only about one ten

473

00:22:01,490 --> 00:21:56,159

thousandths of an inch of water on this

474

00:22:06,890 --> 00:22:04,610

's another image from polar's low

475

00:22:10,070 --> 00:22:06,900

resolution visible camera recording the

476

00:22:11,810 --> 00:22:10,080

emissions from the oh molecules when the

477

00:22:15,049 --> 00:22:11,820

small comets plunged toward the other

478

00:22:17,810 --> 00:22:15,059

upper atmosphere and disrupted by and

479

00:22:20,870 --> 00:22:17,820

vaporized by sunlight

480

00:22:23,630 --> 00:22:20,880

this is a multiple exposure three

481

00:22:25,909 --> 00:22:23,640

consecutive snap suction one image of

482

00:22:28,750 --> 00:22:25,919

the of you of the event taking six

483

00:22:33,950 --> 00:22:30,850

a view of the Earth has been

484

00:22:35,930 --> 00:22:33,960

superimposed on the images on the image

485

00:22:38,630 --> 00:22:35,940

as there are no detectable emissions

486

00:22:40,430 --> 00:22:38,640

from the Earth's nighttime atmosphere at

487

00:22:45,110 --> 00:22:40,440

the wavelengths where these oxygen

488

00:22:49,190 --> 00:22:47,690

and you probably can't see the charts on

489

00:22:50,930 --> 00:22:49,200

the left hand side but I'll describe

490

00:22:52,370 --> 00:22:50,940

what the it what they are

491

00:22:55,010 --> 00:22:52,380

the top

492

00:22:58,610 --> 00:22:55,020

are the result are the results from

493

00:23:01,610 --> 00:22:58,620

Polar from November 1997 through late

494

00:23:04,330 --> 00:23:01,620

January at 1998.

495

00:23:06,470 --> 00:23:04,340

this is the frequency of of of

496

00:23:08,750 --> 00:23:06,480

atmospheric holes

497

00:23:11,930 --> 00:23:08,760

the middle chart is from Dynamics

498

00:23:14,570 --> 00:23:11,940

Explorer which was taken 16 years later

499

00:23:17,210 --> 00:23:14,580

once again showing the same seasonal

500

00:23:18,950 --> 00:23:17,220

variation in November High the January

501
00:23:20,810 --> 00:23:18,960
low

502
00:23:23,510 --> 00:23:20,820
the bottom chart which is really

503
00:23:26,409 --> 00:23:23,520
interesting this was taken 42 years

504
00:23:30,649 --> 00:23:26,419
earlier and it shows the non-shower

505
00:23:32,950 --> 00:23:30,659
forward scatter meteor rates observed in

506
00:23:35,810 --> 00:23:32,960
Ottawa Canada

507
00:23:38,270 --> 00:23:35,820
it's no mystery why the atmospheric

508
00:23:39,950 --> 00:23:38,280
whole rate should correlate so well with

509
00:23:43,610 --> 00:23:39,960
the meteorite measured by forward

510
00:23:46,370 --> 00:23:43,620
scatter radar after all small comets are

511
00:23:48,649 --> 00:23:46,380
just a part of the neurotic Dusk and

512
00:23:50,810 --> 00:23:48,659
debris that orbits the Sun and falls

513
00:23:52,010 --> 00:23:50,820

into the Earth's atmosphere on a daily

514

00:23:55,610 --> 00:23:52,020

basis

515

00:23:58,250 --> 00:23:55,620

Fortis forward scatter radar is ideally

516

00:23:59,330 --> 00:23:58,260

suited to reflect the infall of small

517

00:24:02,270 --> 00:23:59,340

comets

518

00:24:04,370 --> 00:24:02,280

the the shaded areas are the shower

519

00:24:08,649 --> 00:24:04,380

times

520

00:24:15,770 --> 00:24:11,529

okay where did the story stand today

521

00:24:18,770 --> 00:24:15,780

well in April of 2003 it was French

522

00:24:20,090 --> 00:24:18,780

suffered a stroke that effectively ended

523

00:24:23,270 --> 00:24:20,100

his career

524

00:24:26,090 --> 00:24:23,280

he died in May of 2014.

525

00:24:29,029 --> 00:24:26,100

at that time I called Bob Hoffman who

526

00:24:32,450 --> 00:24:29,039

was the NASA project scientist on Polar

527

00:24:36,590 --> 00:24:32,460

and I asked them have the small pop have

528

00:24:40,190 --> 00:24:36,600

the small comments effectively been

529

00:24:43,370 --> 00:24:40,200

proven wrong and he said no no one has

530

00:24:45,649 --> 00:24:43,380

come up with an interpretation that

531

00:24:48,289 --> 00:24:45,659

would take into your account all of

532

00:24:51,770 --> 00:24:48,299

Frank's data

533

00:24:53,270 --> 00:24:51,780

Frank's partner in small Comet crime is

534

00:24:55,250 --> 00:24:53,280

John siegward

535

00:24:58,310 --> 00:24:55,260

he had gone on to become a senior

536

00:25:01,610 --> 00:24:58,320

scientist at Nasa Goddard he died in

537

00:25:04,990 --> 00:25:01,620

December of 2010 of an erotic aneurysm

538

00:25:08,330 --> 00:25:05,000

at his home at the age of 49.

539

00:25:10,909 --> 00:25:08,340

then in January of 2021 John Craven a

540

00:25:13,310 --> 00:25:10,919

research scientist who built the imager

541

00:25:15,409 --> 00:25:13,320

for dynamic Explorer and was the third

542

00:25:21,230 --> 00:25:15,419

author of the original small Comet

543

00:25:24,010 --> 00:25:21,240

papers he passed away in Alaska of ALS

544

00:25:26,930 --> 00:25:24,020

foreign

545

00:25:29,750 --> 00:25:26,940

Advocate the general consensus was that

546

00:25:33,830 --> 00:25:29,760

the Comets small comets were dead that

547

00:25:37,010 --> 00:25:33,840

they had been proven to be non-existent

548

00:25:40,070 --> 00:25:37,020

so then in March of 2021 I received an

549

00:25:42,649 --> 00:25:40,080

email from Bill Abbott

550

00:25:45,110 --> 00:25:42,659

he had read the biggest clash and urged

551
00:25:46,909 --> 00:25:45,120
me to get the book reprinted he said the

552
00:25:49,370 --> 00:25:46,919
small Comet Discovery should not be

553
00:25:51,590 --> 00:25:49,380
forgotten

554
00:25:54,049 --> 00:25:51,600
now he was unaware that in the early

555
00:25:56,930 --> 00:25:54,059
2000s Frank and I had written an

556
00:25:59,510 --> 00:25:56,940
additional 40 000 word follow-up about

557
00:26:01,669 --> 00:25:59,520
the polar results and the continuing

558
00:26:04,070 --> 00:26:01,679
controversy after the big splash had

559
00:26:06,470 --> 00:26:04,080
been published this material had never

560
00:26:08,750 --> 00:26:06,480
seen the light at day we had tried to

561
00:26:10,490 --> 00:26:08,760
convince the original publisher to issue

562
00:26:13,010 --> 00:26:10,500
a new

563
00:26:14,990 --> 00:26:13,020

edition of The Big Splash but they

564

00:26:17,570 --> 00:26:15,000

declined

565

00:26:20,390 --> 00:26:17,580

so basically that manuscript the 40 000

566

00:26:25,010 --> 00:26:20,400

word additional manuscript sat in a box

567

00:26:27,289 --> 00:26:25,020

in my garage along with the uh

568

00:26:29,930 --> 00:26:27,299

supporting materials

569

00:26:31,250 --> 00:26:29,940

so I thought that uh Bill Abbott was

570

00:26:33,470 --> 00:26:31,260

right

571

00:26:35,510 --> 00:26:33,480

the big his Discovery should not be

572

00:26:37,010 --> 00:26:35,520

forgotten so I obtained a reversion of

573

00:26:39,950 --> 00:26:37,020

Rights the Big Splash from the original

574

00:26:41,750 --> 00:26:39,960

publisher I contacted Lou Frank's

575

00:26:43,850 --> 00:26:41,760

daughters who are the beneficiaries of

576

00:26:45,710 --> 00:26:43,860

his estate and they allowed me to

577

00:26:47,149 --> 00:26:45,720

publish a book which is now called

578

00:26:49,610 --> 00:26:47,159

Cosmic Rain

579

00:26:51,169 --> 00:26:49,620

title that Frank originally wanted for

580

00:26:54,110 --> 00:26:51,179

the book

581

00:26:57,890 --> 00:26:54,120

I have become the de facto historian of

582

00:27:02,710 --> 00:27:00,590

I will end the presentation with the

583

00:27:06,230 --> 00:27:02,720

same idea that I ended my original

584

00:27:08,510 --> 00:27:06,240

Ocean's article the history of science

585

00:27:10,130 --> 00:27:08,520

is full of wild ideas some of the which

586

00:27:12,049 --> 00:27:10,140

turned out to be right

587

00:27:14,630 --> 00:27:12,059

the continents are moving and at one

588

00:27:16,909 --> 00:27:14,640

time formed a single landmass

589

00:27:18,950 --> 00:27:16,919

life arose from a few Elemental

590

00:27:20,029 --> 00:27:18,960

molecules in the earth's primordial

591

00:27:22,549 --> 00:27:20,039

abroad

592

00:27:24,529 --> 00:27:22,559

humans are descendants from the first

593

00:27:26,930 --> 00:27:24,539

primitive life forms

594

00:27:29,750 --> 00:27:26,940

in the light of those ideas correct

595

00:27:32,630 --> 00:27:29,760

small comets Discovery appears rather

596

00:27:38,570 --> 00:27:36,470

so that's my presentation you can obtain

597

00:27:42,649 --> 00:27:38,580

the book it's a large format for all

598

00:27:44,630 --> 00:27:42,659

color book from Amazon you can see more

599

00:27:48,350 --> 00:27:44,640

information about the book on my website

600

00:27:51,529 --> 00:27:48,360

at anonymousbooks.com you can see all of

601
00:27:53,810 --> 00:27:51,539
Frank's papers over 15 papers at the

602
00:27:56,289 --> 00:27:53,820
small comets website at the University

603
00:28:00,730 --> 00:27:56,299
of Iowa

604
00:28:03,529 --> 00:28:00,740
Universe at smallcommons dot physics Dot

605
00:28:05,890 --> 00:28:03,539
uiowa.edu and if you have any questions

606
00:28:09,590 --> 00:28:05,900
about the book after this presentation

607
00:28:13,490 --> 00:28:09,600
you can email me at cosmicrainbook at

608
00:28:13,500 --> 00:28:18,649
thank you everybody

609
00:28:22,370 --> 00:28:20,390
okay

610
00:28:25,070 --> 00:28:22,380
um wow that was incredible presentation

611
00:28:28,789 --> 00:28:25,080
Patrick I mean what a surprise

612
00:28:31,669 --> 00:28:28,799
um first I want to invite those uh of us

613
00:28:34,430 --> 00:28:31,679

in the audience here at um

614

00:28:38,510 --> 00:28:34,440

air meat to to please put your questions

615

00:28:40,190 --> 00:28:38,520

if you have them in the Q a section

616

00:28:42,409 --> 00:28:40,200

um also there is an option to raise your

617

00:28:45,049 --> 00:28:42,419

hand and to come on stage and ask your

618

00:28:46,549 --> 00:28:45,059

question directly of Patrick if you use

619

00:28:48,230 --> 00:28:46,559

that feature do keep in mind that the

620

00:28:49,909 --> 00:28:48,240

session is being recorded and live

621

00:28:51,950 --> 00:28:49,919

streamed

622

00:28:54,769 --> 00:28:51,960

um and so as we wait for the audience to

623

00:28:56,390 --> 00:28:54,779

formulate their questions I I'm still

624

00:29:00,049 --> 00:28:56,400

trying to formulate mine because this is

625

00:29:02,750 --> 00:29:00,059

a really kind of stunning

626

00:29:06,950 --> 00:29:02,760

uh thesis so

627

00:29:09,529 --> 00:29:06,960

what is the current current status of

628

00:29:13,190 --> 00:29:09,539

this Theory

629

00:29:15,769 --> 00:29:13,200

is it still completely ignored or it's

630

00:29:18,350 --> 00:29:15,779

basically you know once uh Frank and

631

00:29:22,130 --> 00:29:18,360

John's figworth passed away

632

00:29:24,950 --> 00:29:22,140

no one has actually followed up on this

633

00:29:27,169 --> 00:29:24,960

and it's basically been ignored and when

634

00:29:30,230 --> 00:29:27,179

I tried to get this book reviewed when I

635

00:29:32,690 --> 00:29:30,240

published it at the end of last year

636

00:29:35,330 --> 00:29:32,700

the the book review editor for a

637

00:29:37,850 --> 00:29:35,340

magazine said oh the small comments have

638

00:29:41,510 --> 00:29:37,860

been dismissed it's not true

639

00:29:44,149 --> 00:29:41,520

well they haven't that's the problem

640

00:29:45,830 --> 00:29:44,159

I mean you said in your talk that

641

00:29:48,289 --> 00:29:45,840

um Frank spent like a full year

642

00:29:51,590 --> 00:29:48,299

responding to criticisms

643

00:29:54,950 --> 00:29:51,600

of of his research would you I mean were

644

00:29:57,889 --> 00:29:54,960

his explanation successful

645

00:30:02,810 --> 00:30:00,649

it was Heavy put it this way it covered

646

00:30:06,529 --> 00:30:02,820

so many fields of science

647

00:30:09,470 --> 00:30:06,539

and it covered it in such detail

648

00:30:11,029 --> 00:30:09,480

that he had to familiarize himself with

649

00:30:15,110 --> 00:30:11,039

all sorts of things

650

00:30:17,450 --> 00:30:15,120

and he he

651
00:30:20,810 --> 00:30:17,460
actually thought he answered the critics

652
00:30:25,610 --> 00:30:21,909
yeah

653
00:30:28,370 --> 00:30:25,620
so I mean the implications of this is

654
00:30:34,730 --> 00:30:31,549
um so what this suggests is that perhaps

655
00:30:38,210 --> 00:30:34,740
water did not form itself on Earth but

656
00:30:41,389 --> 00:30:38,220
it has you know was deposited

657
00:30:43,850 --> 00:30:41,399
from elsewhere right well the original

658
00:30:46,070 --> 00:30:43,860
theory is that the the Earth was

659
00:30:50,210 --> 00:30:46,080
deposited on the Earth

660
00:30:53,029 --> 00:30:50,220
at the beginning through asteroids

661
00:30:54,950 --> 00:30:53,039
and basically all the Earth has always

662
00:30:56,930 --> 00:30:54,960
been here more or less

663
00:31:00,230 --> 00:30:56,940

and will always be here

664

00:31:02,029 --> 00:31:00,240

and Frank says Nope it was gradual

665

00:31:04,190 --> 00:31:02,039

accumulation and it continues to this

666

00:31:08,389 --> 00:31:04,200

day which of course

667

00:31:10,430 --> 00:31:08,399

has implications for climate

668

00:31:13,909 --> 00:31:10,440

okay uh one of the things that Frank

669

00:31:17,930 --> 00:31:13,919

tried to do is try to convince people

670

00:31:23,090 --> 00:31:17,940

who had uh uh created some climate

671

00:31:25,190 --> 00:31:23,100

models to inject this uh factor into

672

00:31:27,649 --> 00:31:25,200

their climate models to see how it would

673

00:31:30,529 --> 00:31:27,659

affect it and the person who had

674

00:31:34,490 --> 00:31:30,539

promised to do so kept promising kept

675

00:31:38,149 --> 00:31:34,500

promising and never did unfortunately

676

00:31:39,769 --> 00:31:38,159

yeah I mean first of all if the

677

00:31:41,510 --> 00:31:39,779

suggestion that this is enough comments

678

00:31:42,529 --> 00:31:41,520

to to fill our oceans that's a huge

679

00:31:44,330 --> 00:31:42,539

amount of water

680

00:31:46,909 --> 00:31:44,340

and then also the suggestion is that

681

00:31:49,730 --> 00:31:46,919

we're being bombarded by these small

682

00:31:52,010 --> 00:31:49,740

comments constantly and I think you said

683

00:31:54,230 --> 00:31:52,020

in your presentation like we're looking

684

00:31:56,690 --> 00:31:54,240

at a sea level change of about one tenth

685

00:31:59,570 --> 00:31:56,700

of an inch per year right 110

686

00:32:02,269 --> 00:31:59,580

thousandths of an inch per year yes okay

687

00:32:04,430 --> 00:32:02,279

um but still like if this excess water

688

00:32:06,769 --> 00:32:04,440

keeps accumulating

689

00:32:09,769 --> 00:32:06,779

um we're looking at possibly a much more

690

00:32:12,529 --> 00:32:09,779

watery planet in the very distant future

691

00:32:16,610 --> 00:32:12,539

well some of it evaporates into the into

692

00:32:18,230 --> 00:32:16,620

space some of it gets uh goes uh

693

00:32:21,350 --> 00:32:18,240

subducted into the ground

694

00:32:23,210 --> 00:32:21,360

there is water underground

695

00:32:24,889 --> 00:32:23,220

okay

696

00:32:25,630 --> 00:32:24,899

um do you

697

00:32:28,669 --> 00:32:25,640

um

698

00:32:31,490 --> 00:32:28,679

let me just say Frank ended his book by

699

00:32:33,669 --> 00:32:31,500

saying uh it will be a while before

700

00:32:35,389 --> 00:32:33,679

there's a beach in Iowa

701
00:32:38,810 --> 00:32:35,399

okay

702
00:32:40,190 --> 00:32:38,820

you got to that's what I was thinking so

703
00:32:42,289 --> 00:32:40,200

um we do have a couple of questions here

704
00:32:45,350 --> 00:32:42,299

I'm going to start with a question from

705
00:32:46,130 --> 00:32:45,360

the SEC president Margaret Moga

706
00:32:48,470 --> 00:32:46,140

um

707
00:32:50,570 --> 00:32:48,480

so she asked so most of the meteors and

708
00:32:51,789 --> 00:32:50,580

Fireballs are actually small comments

709
00:32:56,210 --> 00:32:51,799

question mark

710
00:32:58,789 --> 00:32:56,220

no no uh meteors and Fireballs are

711
00:33:01,850 --> 00:32:58,799

caused by Rocky objects

712
00:33:07,610 --> 00:33:01,860

small comments are very are like big

713
00:33:09,409 --> 00:33:07,620

fluffy snowballs with a thin uh uh

714

00:33:12,230 --> 00:33:09,419

carbon crust

715

00:33:14,630 --> 00:33:12,240

so these incoming

716

00:33:15,769 --> 00:33:14,640

small comets are not visible to the

717

00:33:21,769 --> 00:33:15,779

naked eye

718

00:33:27,769 --> 00:33:25,070

um this was in our chat

719

00:33:29,570 --> 00:33:27,779

um can you actually see that it says if

720

00:33:31,370 --> 00:33:29,580

small comments bring in water what are

721

00:33:33,889 --> 00:33:31,380

the implications for global warming and

722

00:33:35,330 --> 00:33:33,899

drying of large Parts in the planet if

723

00:33:37,490 --> 00:33:35,340

any implications

724

00:33:40,310 --> 00:33:37,500

well that's that's a good question not

725

00:33:42,889 --> 00:33:40,320

one I'm able to answer I'm not a

726

00:33:44,690 --> 00:33:42,899

specialist in this video I'm sure I I

727

00:33:46,190 --> 00:33:44,700

wish Frank was still alive to be able to

728

00:33:47,930 --> 00:33:46,200

answer these questions

729

00:33:50,269 --> 00:33:47,940

indeed

730

00:33:51,769 --> 00:33:50,279

um and then we have a question too from

731

00:33:53,990 --> 00:33:51,779

our

732

00:33:56,149 --> 00:33:54,000

support staff actually here at the soc

733

00:33:59,090 --> 00:33:56,159

he says congrats on your presentation

734

00:34:00,889 --> 00:33:59,100

with the advancement of astronomy and

735

00:34:02,930 --> 00:34:00,899

the launch of the web telescope can you

736

00:34:04,669 --> 00:34:02,940

envision any research follow-up that

737

00:34:06,889 --> 00:34:04,679

might emerge in the upcoming years to

738

00:34:10,609 --> 00:34:06,899

provide more data or some additional

739

00:34:12,409 --> 00:34:10,619

hypotheses or conclusions okay well uh

740

00:34:16,149 --> 00:34:12,419

one thing that's important to realize is

741

00:34:20,750 --> 00:34:16,159

that most telescopes are not geared

742

00:34:22,430 --> 00:34:20,760

to observing near-earth events there are

743

00:34:25,129 --> 00:34:22,440

actually very few telescopes that can do

744

00:34:27,349 --> 00:34:25,139

that most of them are focused way out in

745

00:34:29,930 --> 00:34:27,359

space now I don't think the web

746

00:34:31,970 --> 00:34:29,940

telescope is able to do that there was

747

00:34:34,550 --> 00:34:31,980

some discussion while Frank was alive of

748

00:34:38,050 --> 00:34:34,560

actually using the Hubble telescope but

749

00:34:42,770 --> 00:34:38,060

it would it would have required making

750

00:34:44,389 --> 00:34:42,780

uh changes to the the calibration and

751
00:34:46,849 --> 00:34:44,399
the focusing and everything else in the

752
00:34:48,290 --> 00:34:46,859
web tell us of the Hubble telescope and

753
00:34:50,450 --> 00:34:48,300
he did not want to be responsible for

754
00:34:54,829 --> 00:34:50,460
messing anything up

755
00:34:57,950 --> 00:34:54,839
so that said there are now other

756
00:35:01,130 --> 00:34:57,960
uh telescopes tracking near-earth

757
00:35:02,589 --> 00:35:01,140
objects and it's possible to use these

758
00:35:06,050 --> 00:35:02,599
other telescopes

759
00:35:08,630 --> 00:35:06,060
to have a dedicated small Comet search

760
00:35:12,349 --> 00:35:08,640
however it's

761
00:35:17,210 --> 00:35:12,359
it's it's it's uh it requires a very

762
00:35:19,670 --> 00:35:17,220
specific search to do so basically you

763
00:35:22,370 --> 00:35:19,680

need to use the telescopes as a in a

764

00:35:25,550 --> 00:35:22,380

skeet shooting mood mode so that you're

765

00:35:29,569 --> 00:35:25,560

actually tracking the small Comet as it

766

00:35:31,849 --> 00:35:29,579

moves you can't have just a a fixed spot

767

00:35:35,390 --> 00:35:31,859

something else that Frank wanted to do

768

00:35:38,810 --> 00:35:35,400

while he was alive he wanted to uh equip

769

00:35:40,069 --> 00:35:38,820

the shuttle uh astronauts with a special

770

00:35:41,930 --> 00:35:40,079

camera

771

00:35:45,410 --> 00:35:41,940

he thought that if they use the special

772

00:35:47,450 --> 00:35:45,420

camera they could actually see these

773

00:35:49,609 --> 00:35:47,460

small Comics coming in

774

00:35:51,310 --> 00:35:49,619

and he was going to he was working with

775

00:35:54,650 --> 00:35:51,320

someone

776

00:35:58,310 --> 00:35:54,660

who to provide the astronauts with this

777

00:35:59,990 --> 00:35:58,320

special camera but it never materialized

778

00:36:04,010 --> 00:36:00,000

because once again I think this the

779

00:36:09,109 --> 00:36:04,020

Challenger uh disaster changed the the

780

00:36:11,270 --> 00:36:09,119

uh the uh the sequence of of programs

781

00:36:13,069 --> 00:36:11,280

that were available for subsequent

782

00:36:16,069 --> 00:36:13,079

flights and it never made it on a

783

00:36:17,930 --> 00:36:16,079

subsequent shuttle flight

784

00:36:20,390 --> 00:36:17,940

questions

785

00:36:23,270 --> 00:36:20,400

I was um also thinking along the lines

786

00:36:25,370 --> 00:36:23,280

of the um current Galileo project where

787

00:36:27,770 --> 00:36:25,380

they're actually looking at the

788

00:36:30,410 --> 00:36:27,780

near-earth atmosphere for well

789

00:36:32,150 --> 00:36:30,420

extraterrestrial signatures

790

00:36:33,770 --> 00:36:32,160

um but I wonder if you know it would be

791

00:36:35,630 --> 00:36:33,780

possible for maybe there to be some

792

00:36:37,609 --> 00:36:35,640

accidental discovery of these small

793

00:36:39,950 --> 00:36:37,619

comets as they pay a little closer

794

00:36:42,890 --> 00:36:39,960

attention to their assassinosphere well

795

00:36:46,010 --> 00:36:42,900

I think the Galileo projects with the

796

00:36:48,650 --> 00:36:46,020

astronomer from at Harvard actually were

797

00:36:50,569 --> 00:36:48,660

interested in right uh he was more

798

00:36:53,569 --> 00:36:50,579

interested in objects inside the

799

00:36:55,210 --> 00:36:53,579

atmosphere okay rather than outside the

800

00:36:57,829 --> 00:36:55,220

atmosphere we're talking you know

801
00:37:00,050 --> 00:36:57,839
hundreds of miles to a thousand miles or

802
00:37:01,910 --> 00:37:00,060
so above the Earth

803
00:37:03,470 --> 00:37:01,920
we have a raised hand from one of our

804
00:37:13,930 --> 00:37:03,480
SSC members so I'm going to invite Mark

805
00:37:20,089 --> 00:37:17,690
hi uh thanks so much for taking taking

806
00:37:24,710 --> 00:37:20,099
my question and I wanted to thank you

807
00:37:29,109 --> 00:37:27,410
so I'm gonna admit first of all I'm not

808
00:37:31,430 --> 00:37:29,119
a scientist

809
00:37:34,130 --> 00:37:31,440
and I'm not a journalist and all those

810
00:37:36,349 --> 00:37:34,140
things but I'm more of a common I'm an

811
00:37:39,109 --> 00:37:36,359
I.T person but I I kind of represent the

812
00:37:41,210 --> 00:37:39,119
common person on the street so uh with

813
00:37:43,490 --> 00:37:41,220

that being said I apologize to my

814

00:37:47,150 --> 00:37:43,500

question seems Elementary but not a

815

00:37:50,870 --> 00:37:47,160

problem my my my basic understanding was

816

00:37:53,750 --> 00:37:50,880

that the Earth's water was seeded

817

00:37:56,210 --> 00:37:53,760

buy comments to begin with so this just

818

00:37:58,849 --> 00:37:56,220

to me it would seem as though this was

819

00:38:00,710 --> 00:37:58,859

just an advancing understanding of that

820

00:38:03,890 --> 00:38:00,720

almost like you're like instead of

821

00:38:06,470 --> 00:38:03,900

saying like when people said oh well

822

00:38:09,230 --> 00:38:06,480

Darwin thought Evolution was one big

823

00:38:11,870 --> 00:38:09,240

thing well we've now come to refine and

824

00:38:14,810 --> 00:38:11,880

Nuance that understanding this is merely

825

00:38:17,150 --> 00:38:14,820

a nuancing of the whole idea of there

826

00:38:19,609 --> 00:38:17,160

were comets way back when they seated it

827

00:38:22,010 --> 00:38:19,619

once and that was it no no no of course

828

00:38:24,829 --> 00:38:22,020

it doesn't work like that this is just

829

00:38:27,290 --> 00:38:24,839

merely a refining of that whole idea

830

00:38:29,390 --> 00:38:27,300

which it would seem silly people would

831

00:38:33,230 --> 00:38:29,400

fight against that considering science

832

00:38:36,050 --> 00:38:33,240

is always refining its understandings of

833

00:38:37,310 --> 00:38:36,060

things and so that's I'm if it's like

834

00:38:40,190 --> 00:38:37,320

well of course Mark you're not getting

835

00:38:41,750 --> 00:38:40,200

it because of X yeah common people

836

00:38:43,550 --> 00:38:41,760

probably won't get some of that so

837

00:38:45,410 --> 00:38:43,560

that's why I'm asking the question so I

838

00:38:46,910 --> 00:38:45,420

can refine my understanding when I try

839

00:38:49,130 --> 00:38:46,920

to explain this back to somebody else

840

00:38:51,050 --> 00:38:49,140

but that thank you and I'll take my

841

00:38:53,810 --> 00:38:51,060

question yeah well I think you're you're

842

00:38:55,310 --> 00:38:53,820

absolutely right it is a refinement the

843

00:38:57,530 --> 00:38:55,320

only problem is

844

00:38:59,930 --> 00:38:57,540

that it brings the refinement to the

845

00:39:02,329 --> 00:38:59,940

present day and people don't like the

846

00:39:05,329 --> 00:39:02,339

idea that the Earth is currently bomb

847

00:39:07,550 --> 00:39:05,339

being bombarded by small comets that's

848

00:39:09,890 --> 00:39:07,560

disturbing and they rather have it

849

00:39:11,450 --> 00:39:09,900

happen way in the past I'm fine we're

850

00:39:13,430 --> 00:39:11,460

fine with that

851

00:39:15,829 --> 00:39:13,440

the thing is we we tend to think that

852

00:39:18,950 --> 00:39:15,839

the Earth is isolated from from the rest

853

00:39:22,630 --> 00:39:18,960

of the universe it's not it's constantly

854

00:39:26,089 --> 00:39:22,640

being bombarded by rocks by dust by

855

00:39:28,310 --> 00:39:26,099

volatiles by small comets constantly

856

00:39:31,430 --> 00:39:28,320

coming into the Earth

857

00:39:33,470 --> 00:39:31,440

so it's really not that surprising and

858

00:39:37,910 --> 00:39:33,480

when I showed you those three graphs of

859

00:39:40,550 --> 00:39:37,920

of uh the frequency of of of these

860

00:39:43,130 --> 00:39:40,560

atmospheric holes as well as the forward

861

00:39:44,450 --> 00:39:43,140

scatter meteorate they were all about

862

00:39:46,730 --> 00:39:44,460

the same

863

00:39:49,430 --> 00:39:46,740

so it shows that this is all the

864

00:39:58,609 --> 00:39:49,440

incoming material it's just all sorts of

865

00:39:58,619 --> 00:40:00,710

um

866

00:40:00,720 --> 00:40:03,730

foreign

867

00:40:08,690 --> 00:40:06,310

looks like I

868

00:40:09,950 --> 00:40:08,700

lost my connection for a moment can you

869

00:40:13,550 --> 00:40:09,960

guys hear me okay

870

00:40:14,750 --> 00:40:13,560

I can okay good that was scary I

871

00:40:16,130 --> 00:40:14,760

hopefully won't have too much more of

872

00:40:17,870 --> 00:40:16,140

that we have a lot of questions here and

873

00:40:19,970 --> 00:40:17,880

I want to ask the audience to help me

874

00:40:21,770 --> 00:40:19,980

out by visiting the Q a and upvoting

875

00:40:24,530 --> 00:40:21,780

your favorite questions

876

00:40:26,990 --> 00:40:24,540

um so I uh I have another raised hand

877

00:40:28,970 --> 00:40:27,000

but I think I want to ask one of one of

878

00:40:29,750 --> 00:40:28,980

these questions

879

00:40:32,829 --> 00:40:29,760

um

880

00:40:36,770 --> 00:40:35,150

standby Carl we will get to your

881

00:40:37,490 --> 00:40:36,780

question

882

00:40:39,470 --> 00:40:37,500

um

883

00:40:42,109 --> 00:40:39,480

start with this question it says from

884

00:40:43,910 --> 00:40:42,119

herb Mertz uh with so many

885

00:40:45,349 --> 00:40:43,920

objects incoming wouldn't the

886

00:40:47,089 --> 00:40:45,359

International Space Station need to be

887

00:40:50,089 --> 00:40:47,099

watching for them and even if they were

888

00:40:51,950 --> 00:40:50,099

not a threat wouldn't they seem see them

889

00:40:54,290 --> 00:40:51,960

nearby

890

00:40:57,230 --> 00:40:54,300

okay first of all I think the space

891

00:40:59,450 --> 00:40:57,240

station is an altitude where it would

892

00:41:01,670 --> 00:40:59,460

not be a threat these Scott small

893

00:41:04,490 --> 00:41:01,680

comments would not be a threat

894

00:41:07,310 --> 00:41:04,500

now there's an interesting episode

895

00:41:09,530 --> 00:41:07,320

from a book about the mayor spacecraft

896

00:41:11,510 --> 00:41:09,540

the Russian mere spacecraft

897

00:41:13,790 --> 00:41:11,520

uh

898

00:41:16,310 --> 00:41:13,800

that at one point they just they they

899

00:41:19,430 --> 00:41:16,320

heard a couple of thumps and they saw

900

00:41:21,650 --> 00:41:19,440

all these like flakes all around their

901
00:41:23,990 --> 00:41:21,660
capsule and they were wondering what

902
00:41:26,270 --> 00:41:24,000
what just happened

903
00:41:29,690 --> 00:41:26,280
and Frank believes that this they could

904
00:41:31,849 --> 00:41:29,700
have been you know seen the the breakup

905
00:41:34,130 --> 00:41:31,859
of us of a small comments a

906
00:41:37,069 --> 00:41:34,140
disintegration of a small Comet around

907
00:41:38,890 --> 00:41:37,079
the spacecraft that turns into basically

908
00:41:47,810 --> 00:41:38,900
uh you know

909
00:41:53,450 --> 00:41:51,050
Roger Nelson asks is the one

910
00:41:56,030 --> 00:41:53,460
ten thousandth of an inch of a measure

911
00:41:58,310 --> 00:41:56,040
of the depth of a layer over the whole

912
00:41:59,870 --> 00:41:58,320
earth if it were so wouldn't we have all

913
00:42:02,630 --> 00:41:59,880

drowned long ago

914

00:42:03,650 --> 00:42:02,640

uh well no that's how that's basically

915

00:42:07,970 --> 00:42:03,660

how

916

00:42:12,470 --> 00:42:07,980

uh uh the Michigan atmospheric scientist

917

00:42:14,750 --> 00:42:12,480

calculated if you've got one one

918

00:42:15,829 --> 00:42:14,760

thousandths or one one thousandth of an

919

00:42:19,490 --> 00:42:15,839

inch

920

00:42:21,589 --> 00:42:19,500

a year over the age of the Earth he said

921

00:42:23,810 --> 00:42:21,599

well basically that's the amount of

922

00:42:27,470 --> 00:42:23,820

water we have in the earth's oceans

923

00:42:31,370 --> 00:42:29,089

I'm going to pass the mic now to Carl

924

00:42:33,050 --> 00:42:31,380

who is um I believe he is the

925

00:42:36,710 --> 00:42:33,060

representative of the associate members

926
00:42:36,720 --> 00:42:40,430
to him and see if he's

927
00:42:44,030 --> 00:42:42,589
good

928
00:42:46,730 --> 00:42:44,040
I'm here

929
00:42:48,170 --> 00:42:46,740
hello Carl hi Patrick let me see if I

930
00:42:50,450 --> 00:42:48,180
can turn my camera on I guess it's not

931
00:42:54,230 --> 00:42:50,460
important but oh there it is

932
00:42:56,870 --> 00:42:54,240
uh yeah um okay so just a quick question

933
00:42:59,210 --> 00:42:56,880
um I've I've read that there's always

934
00:43:01,849 --> 00:42:59,220
been talk about is or has there been

935
00:43:04,069 --> 00:43:01,859
water on Mars would that could that also

936
00:43:06,290 --> 00:43:04,079
have accounted for that as well

937
00:43:09,410 --> 00:43:06,300
okay what's interesting is that in the

938
00:43:11,030 --> 00:43:09,420

80s uh it was thought that the solar

939

00:43:13,490 --> 00:43:11,040

system there was very little water in

940

00:43:15,589 --> 00:43:13,500

the solar system people suspected well

941

00:43:17,210 --> 00:43:15,599

maybe there's water on Mars they

942

00:43:19,130 --> 00:43:17,220

couldn't quite figure out where it was

943

00:43:20,750 --> 00:43:19,140

but they thought there might be water on

944

00:43:24,410 --> 00:43:20,760

Mars somewhere

945

00:43:27,490 --> 00:43:24,420

but since then in the past

946

00:43:30,470 --> 00:43:27,500

you know 35 years

947

00:43:32,569 --> 00:43:30,480

one Discovery after another has come up

948

00:43:35,270 --> 00:43:32,579

oh there's water on the moon there's

949

00:43:38,329 --> 00:43:35,280

water on Mars there's this you know the

950

00:43:40,670 --> 00:43:38,339

moons of uh Saturn Jupiter have full of

951
00:43:42,890 --> 00:43:40,680
water I mean it's like

952
00:43:45,470 --> 00:43:42,900
through the solar system it's drenched

953
00:43:48,890 --> 00:43:45,480
in water at this point

954
00:43:50,390 --> 00:43:48,900
I mean if if you read the book all the

955
00:43:52,069 --> 00:43:50,400
some of these discoveries are mentioned

956
00:43:55,849 --> 00:43:52,079
in the book and there have been many

957
00:43:59,630 --> 00:43:55,859
discoveries since uh 2001 where

958
00:44:03,170 --> 00:43:59,640
basically the book ends but if if you

959
00:44:05,510 --> 00:44:03,180
look for water on various uh moons on

960
00:44:07,970 --> 00:44:05,520
various planets there's constant

961
00:44:10,370 --> 00:44:07,980
constant discoveries and it makes sense

962
00:44:12,589 --> 00:44:10,380
if the if the Earth is being bombarded

963
00:44:15,829 --> 00:44:12,599

by these small comets so is the rest of

964

00:44:18,230 --> 00:44:15,839

the solar system the question is how far

965

00:44:20,870 --> 00:44:18,240

in does it get how far in do they get

966

00:44:23,930 --> 00:44:20,880

before they're vaporized by the sun do

967

00:44:27,290 --> 00:44:23,940

they reach Mercury actually water has

968

00:44:29,210 --> 00:44:27,300

been discovered on Mercury volatiles

969

00:44:32,450 --> 00:44:29,220

so there's nothing unique about earth

970

00:44:35,510 --> 00:44:32,460

and water within this in in the theory

971

00:44:37,910 --> 00:44:35,520

no so it's Universal seems to be

972

00:44:38,890 --> 00:44:37,920

Universal we like to think we're unique

973

00:44:41,390 --> 00:44:38,900

yeah

974

00:44:51,290 --> 00:44:41,400

right okay

975

00:44:56,089 --> 00:44:53,750

thank you Carl for your question

976

00:44:58,609 --> 00:44:56,099

um we have one final

977

00:45:01,910 --> 00:44:58,619

question in the Q a I think it's a good

978

00:45:05,390 --> 00:45:03,710

um it says thank you Patrick for your

979

00:45:07,430 --> 00:45:05,400

presentation

980

00:45:09,650 --> 00:45:07,440

why do you think there was such Fierce

981

00:45:12,170 --> 00:45:09,660

resistance to this hypothesis especially

982

00:45:15,170 --> 00:45:12,180

since as you say in comparison to some

983

00:45:17,210 --> 00:45:15,180

others this one was relatively tame

984

00:45:19,370 --> 00:45:17,220

were certain implications too hard to

985

00:45:25,190 --> 00:45:21,589

well it's not so much the implications

986

00:45:28,069 --> 00:45:25,200

it's the very notion of being bombarded

987

00:45:31,370 --> 00:45:28,079

by a million maybe tens of millions of

988

00:45:34,309 --> 00:45:31,380

small comments every year I mean

989

00:45:36,770 --> 00:45:34,319

the astronomers responded to Frank at

990

00:45:39,050 --> 00:45:36,780

the beginning by saying hey if these

991

00:45:42,050 --> 00:45:39,060

things were real we would know about it

992

00:45:45,050 --> 00:45:42,060

first we would have known about it

993

00:45:49,370 --> 00:45:45,060

as a matter of fact I presented this

994

00:45:52,069 --> 00:45:49,380

small comic talk to the SSE

995

00:45:55,430 --> 00:45:52,079

in 1990 I believe

996

00:45:58,069 --> 00:45:55,440

when the uh when the SSC was held in

997

00:46:01,849 --> 00:45:58,079

Charlottesville Virginia

998

00:46:04,790 --> 00:46:01,859

and I started presenting basically the

999

00:46:07,250 --> 00:46:04,800

Dynamics Explorer results not the polar

1000

00:46:09,650 --> 00:46:07,260

which had not occurred at that time

1001
00:46:13,130 --> 00:46:09,660
and an astronomer in the audience

1002
00:46:16,309 --> 00:46:13,140
stood up and said

1003
00:46:19,910 --> 00:46:16,319
as I was presented presenting

1004
00:46:21,829 --> 00:46:19,920
of course the SSC being what it is the

1005
00:46:24,589 --> 00:46:21,839
audience said hey that's not the way we

1006
00:46:25,730 --> 00:46:24,599
treat our presenters

1007
00:46:29,210 --> 00:46:25,740
foreign

1008
00:46:35,150 --> 00:46:29,220
so basically uh it's just it's hard for

1009
00:46:38,390 --> 00:46:37,430
and that no one has discovered it before

1010
00:46:44,750 --> 00:46:38,400
now

1011
00:46:47,510 --> 00:46:44,760
such resistance to the idea

1012
00:46:49,910 --> 00:46:47,520
and I understand it Frank understood it

1013
00:46:51,410 --> 00:46:49,920

fully well also

1014

00:46:55,250 --> 00:46:51,420

but he said

1015

00:46:58,190 --> 00:46:55,260

listen I'm not going to ignore the data

1016

00:47:00,230 --> 00:46:58,200

the data tells me these things are

1017

00:47:02,270 --> 00:47:00,240

depositing water vapor into the

1018

00:47:04,370 --> 00:47:02,280

atmosphere and that's just the way it is

1019

00:47:09,109 --> 00:47:04,380

whether I believe it or not makes no

1020

00:47:13,130 --> 00:47:10,550

we'll put

1021

00:47:16,370 --> 00:47:13,140

well this is definitely an enlightening

1022

00:47:18,730 --> 00:47:16,380

conversation and um I I'm actually I'm

1023

00:47:21,410 --> 00:47:18,740

interested in your book now so

1024

00:47:23,690 --> 00:47:21,420

I might just take a look at it I

1025

00:47:24,349 --> 00:47:23,700

encourage everybody else to do the same

1026

00:47:26,150 --> 00:47:24,359

um

1027

00:47:27,230 --> 00:47:26,160

anyhow I think that's going to be it for

1028

00:47:29,390 --> 00:47:27,240

this hour

1029

00:47:32,390 --> 00:47:29,400

um we do following this we have a social

1030

00:47:34,430 --> 00:47:32,400

Lounge uh and I encourage people to

1031

00:47:38,030 --> 00:47:34,440

visit the social Lounge to just discuss

1032

00:47:39,890 --> 00:47:38,040

your insights from this conversation uh

1033

00:47:42,109 --> 00:47:39,900

and you know just to catch up with your

1034

00:47:44,630 --> 00:47:42,119

fellow SOC members so I hope you'll take

1035

00:47:47,150 --> 00:47:44,640

advantage of that opportunity uh and uh