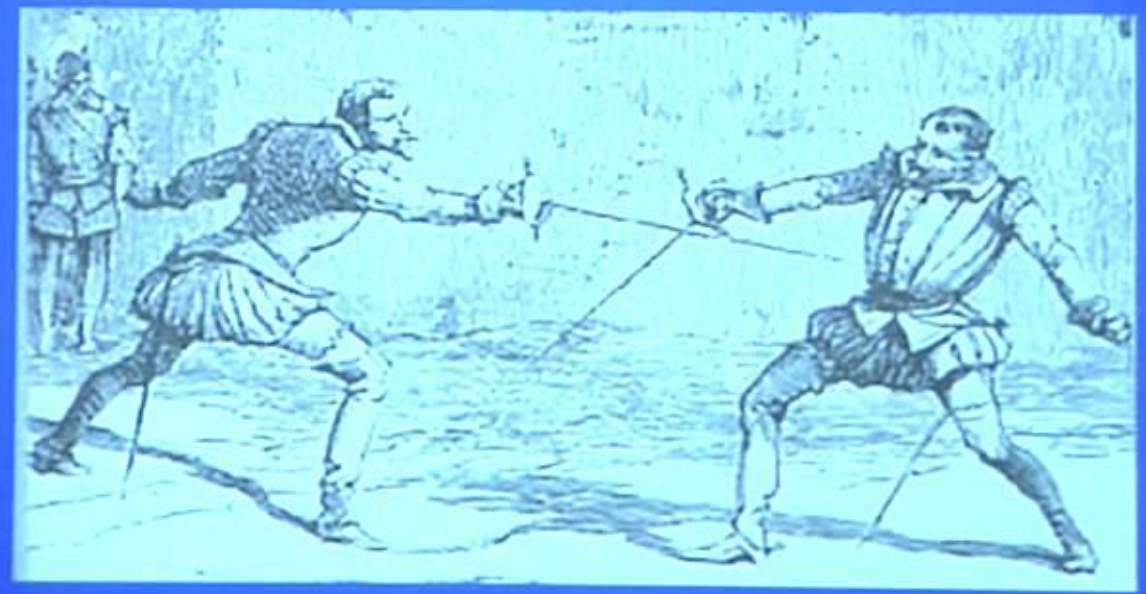
Chapter 6:

For the record…*S. mitis* – lunar survivor or post-flight interloper?



1
00:00:06,150 --> 00:00:03,030
the last session of the day today is

2
00:00:09,110 --> 00:00:06,160
entitled public perceptions priorities

3
00:00:11,990 --> 00:00:09,120
and solar system exploration

4
00:00:13,430 --> 00:00:12,000
my name is heidi hamill i am a planetary

5
00:00:15,190 --> 00:00:13,440
scientist

6
00:00:23,590 --> 00:00:15,200
i am

7
00:00:27,509 --> 00:00:23,600
this is the time for the women to take

8
00:00:31,109 --> 00:00:27,519
over the panels i hope you notice that

9
00:00:33,270 --> 00:00:31,119
so we are going to get into this here

10
00:00:35,030 --> 00:00:33,280
our first speaker today will be linda

11
00:00:37,670 --> 00:00:35,040
billings who is a fellow at george

12
00:00:39,110 --> 00:00:37,680
washington university school of media

13
00:00:41,350 --> 00:00:39,120

and public affairs right here in

14
00:00:44,229 --> 00:00:41,360
washington

15
00:00:46,790 --> 00:00:44,239
she does communications research she has

16
00:00:50,150 --> 00:00:46,800
her phd in mass communication from

17
00:00:53,270 --> 00:00:50,160
indiana university and quite a diverse

18
00:00:56,310 --> 00:00:53,280
field of research including science and

19
00:00:58,950 --> 00:00:56,320
risk communication social studies of

20
00:01:01,349 --> 00:00:58,960
science and the rhetoric of science and

21
00:01:03,670 --> 00:01:01,359
space we've certainly been hearing some

22
00:01:05,990 --> 00:01:03,680
rhetoric today

23
00:01:07,990 --> 00:01:06,000
she has a lot of experience in many

24
00:01:10,630 --> 00:01:08,000
different areas including lots of

25
00:01:13,990 --> 00:01:10,640
editorial work and today she will be

26
00:01:16,870 --> 00:01:14,000
talking to us about a very interesting

27
00:01:18,950 --> 00:01:16,880
scientific urban myth

28
00:01:20,710 --> 00:01:18,960
about the uh

29
00:01:23,109 --> 00:01:20,720
presence of uh

30
00:01:25,270 --> 00:01:23,119
materials in that have come back from

31
00:01:31,510 --> 00:01:25,280
the moon or not

32
00:01:31,520 --> 00:01:38,630
hey slides

33
00:01:43,830 --> 00:01:41,429
supplies to be cute up in the meantime

34
00:01:45,270 --> 00:01:43,840
for those of you watching on the web uh

35
00:01:48,230 --> 00:01:45,280
i want to say

36
00:01:50,550 --> 00:01:48,240
that this is a story that depends on a

37
00:01:52,469 --> 00:01:50,560
lot of details

38
00:01:55,030 --> 00:01:52,479

and i'm going to try to go back to my

39
00:01:56,709 --> 00:01:55,040
there we go

40
00:01:58,950 --> 00:01:56,719
yes thank you

41
00:02:00,550 --> 00:01:58,960
thank you jonathan

42
00:02:02,230 --> 00:02:00,560
and the details are not going to be in

43
00:02:04,069 --> 00:02:02,240
my talk because we don't have a lot of

44
00:02:06,230 --> 00:02:04,079
time but they are in my paper and i will

45
00:02:07,429 --> 00:02:06,240
email the paper to anybody who wants to

46
00:02:10,630 --> 00:02:07,439
read it

47
00:02:12,869 --> 00:02:10,640
billings linda1 gmail.com billingslinda1

48
00:02:14,390 --> 00:02:12,879
gmail.com and that goes for everybody in

49
00:02:15,350 --> 00:02:14,400
the audience as well

50
00:02:18,550 --> 00:02:15,360
so

51
00:02:21,190 --> 00:02:18,560
my story is about a survivor or not the

52
00:02:24,150 --> 00:02:21,200
story of s midas on the moon as midas is

53
00:02:26,309 --> 00:02:24,160
streptococcus midas bacteria that

54
00:02:28,150 --> 00:02:26,319
probably all of us have

55
00:02:30,630 --> 00:02:28,160
living in our mouths right now and i'll

56
00:02:32,630 --> 00:02:30,640
get to that in a minute

57
00:02:35,190 --> 00:02:32,640
the story of how nasa technicians found

58
00:02:37,110 --> 00:02:35,200
a viable streptococcus midas bacteria

59
00:02:39,030 --> 00:02:37,120
inside equipment retrieved from the moon

60
00:02:41,589 --> 00:02:39,040
and returned to earth

61
00:02:44,070 --> 00:02:41,599
by astronauts has been replicated widely

62
00:02:46,390 --> 00:02:44,080
and reported as fact for decades

63
00:02:48,470 --> 00:02:46,400

but it appears to be false

64
00:02:49,430 --> 00:02:48,480
and i'm going to try to explain my case

65
00:02:51,350 --> 00:02:49,440
today

66
00:02:53,830 --> 00:02:51,360
more than 30 years after the story was

67
00:02:55,190 --> 00:02:53,840
first told in 1970

68
00:02:57,830 --> 00:02:55,200
it may be difficult to prove it

69
00:03:00,149 --> 00:02:57,840
definitively true or definitively false

70
00:03:02,149 --> 00:03:00,159
however the evidence now points to false

71
00:03:05,110 --> 00:03:02,159
in large part thanks to the unearthing

72
00:03:06,710 --> 00:03:05,120
of old visual records i'll make the case

73
00:03:08,390 --> 00:03:06,720
that the claim that esmitas traveled

74
00:03:10,390 --> 00:03:08,400
from earth to the moon returned to earth

75
00:03:13,589 --> 00:03:10,400
and came back to life in a lab does not

76
00:03:16,149 --> 00:03:13,599
qualify as scientific truth

77
00:03:17,910 --> 00:03:16,159
this story has relevance to astrobiology

78
00:03:19,990 --> 00:03:17,920
planetary protection planetary

79
00:03:24,390 --> 00:03:20,000
exploration and of course the history

80
00:03:28,789 --> 00:03:26,550
as most people know all too well

81
00:03:30,869 --> 00:03:28,799
bacteria are hardy little buggers

82
00:03:32,710 --> 00:03:30,879
the existence of extremophilic microbial

83
00:03:35,190 --> 00:03:32,720
life an exotic concept just a few

84
00:03:36,869 --> 00:03:35,200
decades ago is now common knowledge

85
00:03:38,789 --> 00:03:36,879
we know that some microbes can form

86
00:03:40,470 --> 00:03:38,799
spores dormant non-reproductive

87
00:03:42,070 --> 00:03:40,480
structures that enable them to survive

88
00:03:44,390 --> 00:03:42,080

harsh conditions

89
00:03:46,309 --> 00:03:44,400
thanks in part to 50 years of exobiology

90
00:03:48,229 --> 00:03:46,319
and astrobiology research we know that

91
00:03:49,670 --> 00:03:48,239
microbes can thrive in virtually every

92
00:03:51,509 --> 00:03:49,680
sort of earth environment known to

93
00:03:53,110 --> 00:03:51,519
science and that some can survive

94
00:03:55,670 --> 00:03:53,120
radical changes in environmental

95
00:04:01,670 --> 00:03:55,680
conditions for years centuries or some

96
00:04:05,990 --> 00:04:03,990
meanwhile planetary exploration has

97
00:04:07,670 --> 00:04:06,000
revealed that mars and the jovian moons

98
00:04:09,110 --> 00:04:07,680
europa ganymede and callisto may have

99
00:04:11,110 --> 00:04:09,120
liquid water environments that could

100
00:04:12,789 --> 00:04:11,120
support life as we know it maybe

101
00:04:14,789 --> 00:04:12,799
enceladus too we've heard about this

102
00:04:16,949 --> 00:04:14,799
from previous speakers for missions to

103
00:04:18,710 --> 00:04:16,959
these targets planetary protection the

104
00:04:21,030 --> 00:04:18,720
practice of protecting solar system

105
00:04:22,790 --> 00:04:21,040
bodies from contamination by earth life

106
00:04:24,390 --> 00:04:22,800
and protecting earth from possible life

107
00:04:26,310 --> 00:04:24,400
forms that may be returned from other

108
00:04:28,390 --> 00:04:26,320
solar system bodies has become a

109
00:04:30,230 --> 00:04:28,400
complicated enterprise and john

110
00:04:31,590 --> 00:04:30,240
sarkisian asked a question at the end of

111
00:04:33,270 --> 00:04:31,600
the last session

112
00:04:34,950 --> 00:04:33,280
that related to planetary protection and

113
00:04:36,790 --> 00:04:34,960

nasa's current planetary protection

114
00:04:38,950 --> 00:04:36,800
officer cassie conley is here to answer

115
00:04:41,670 --> 00:04:38,960
any questions about that

116
00:04:44,310 --> 00:04:41,680
so let's get on with our story

117
00:04:45,909 --> 00:04:44,320
here are some and dare i say it facts

118
00:04:48,469 --> 00:04:45,919
about us midas

119
00:04:49,990 --> 00:04:48,479
this bacterium is part of the auraflora

120
00:04:51,909 --> 00:04:50,000
of mammals

121
00:04:54,310 --> 00:04:51,919
and there it is i'll introduce you to it

122
00:04:56,230 --> 00:04:54,320
it does not form spores it lives

123
00:04:58,469 --> 00:04:56,240
optimally at temperatures between 30 and

124
00:05:00,710 --> 00:04:58,479
35 degrees celsius which is

125
00:05:02,790 --> 00:05:00,720
approximately 85 to 95 degrees

126
00:05:04,469 --> 00:05:02,800
fahrenheit and it's commonly found in

127
00:05:06,070 --> 00:05:04,479
the human mouth

128
00:05:09,590 --> 00:05:06,080
so think about this

129
00:05:11,029 --> 00:05:09,600
did s midas could esmitas travel from

130
00:05:13,350 --> 00:05:11,039
earth to the moon survive more than two

131
00:05:15,029 --> 00:05:13,360
years of exposure there only to revive

132
00:05:16,870 --> 00:05:15,039
once brought back to earth

133
00:05:18,790 --> 00:05:16,880
and why were scientists and engineers

134
00:05:21,029 --> 00:05:18,800
even thinking about such possibilities

135
00:05:22,710 --> 00:05:21,039
in the 60s and 70s

136
00:05:24,150 --> 00:05:22,720
even before nasa came to be the

137
00:05:26,550 --> 00:05:24,160
international science community was

138
00:05:28,390 --> 00:05:26,560

discussing the possibility of e.t life

139
00:05:32,230 --> 00:05:28,400
and steps that might be taken to prevent

140
00:05:35,830 --> 00:05:34,230
in the early days of apollo nasa planned

141
00:05:38,230 --> 00:05:35,840
for the quarantine of astronauts and

142
00:05:40,150 --> 00:05:38,240
material samples returned from the moon

143
00:05:41,990 --> 00:05:40,160
a lunar receiving laboratory was built

144
00:05:44,230 --> 00:05:42,000
at the manned space center in houston

145
00:05:47,909 --> 00:05:44,240
now johnson space center to contain and

146
00:05:55,110 --> 00:05:49,670
i'm going to give you a little hint of

147
00:05:59,990 --> 00:05:57,830
in april 1967 nasa launched surveyor 3

148
00:06:02,469 --> 00:06:00,000
to the moon it made a soft landing

149
00:06:04,629 --> 00:06:02,479
operated for 14 days then shut down

150
00:06:06,710 --> 00:06:04,639
mission accomplished

151
00:06:16,710 --> 00:06:06,720
two years and seven months later nasa

152
00:06:21,270 --> 00:06:19,510
on november 19 1969

153
00:06:23,990 --> 00:06:21,280
pete conrad and alan bean landed their

154
00:06:25,749 --> 00:06:24,000
lunar module about 163 meters away from

155
00:06:27,590 --> 00:06:25,759
where surveyor 3 sat in the ocean of

156
00:06:29,590 --> 00:06:27,600
storms

157
00:06:31,029 --> 00:06:29,600
on november 20 the astronauts retrieved

158
00:06:33,510 --> 00:06:31,039
several pieces of equipment from

159
00:06:35,270 --> 00:06:33,520
surveyor including its camera they

160
00:06:36,870 --> 00:06:35,280
stashed the camera in a sample pack

161
00:06:38,870 --> 00:06:36,880
zipped it shut brought it back to the

162
00:06:42,550 --> 00:06:38,880
lunar module stowed it on board and took

163
00:06:46,950 --> 00:06:44,309

the crew returned to earth on november

164
00:06:48,309 --> 00:06:46,960
24 photos that splashed down show they

165
00:06:51,189 --> 00:06:48,319
are not wearing their protective

166
00:06:52,870 --> 00:06:51,199
biological isolation garments once the

167
00:06:54,469 --> 00:06:52,880
astronauts removed from their capsule to

168
00:06:56,070 --> 00:06:54,479
an aircraft carrier they don their

169
00:06:58,309 --> 00:06:56,080
protective garments and entered an

170
00:07:00,150 --> 00:06:58,319
isolation unit aboard the carrier the

171
00:07:01,670 --> 00:07:00,160
pack containing the surveyor camera was

172
00:07:03,430 --> 00:07:01,680
retrieved from the capsule and delivered

173
00:07:05,189 --> 00:07:03,440
to the lunar receiving lab where it was

174
00:07:09,029 --> 00:07:05,199
stored at room temperature in a teflon

175
00:07:13,670 --> 00:07:12,629
on january 8 1970

176
00:07:17,670 --> 00:07:13,680
lunar

177
00:07:19,350 --> 00:07:17,680
examining the camera microbial analysis

178
00:07:21,110 --> 00:07:19,360
came first as soon as the camera was

179
00:07:22,790 --> 00:07:21,120
opened working in a clean room

180
00:07:24,550 --> 00:07:22,800
environment they performed standard

181
00:07:26,950 --> 00:07:24,560
microbial assays

182
00:07:29,189 --> 00:07:26,960
and after four days of incubation one

183
00:07:31,270 --> 00:07:29,199
sample apparently produced viable

184
00:07:33,270 --> 00:07:31,280
visible microbial growth the apparently

185
00:07:35,510 --> 00:07:33,280
microblading sample had been taken from

186
00:07:37,110 --> 00:07:35,520
foam embedded inside the camera

187
00:07:39,029 --> 00:07:37,120
the isolate was identified with

188
00:07:42,309 --> 00:07:39,039

confirmation from the u.s public health

189
00:07:44,710 --> 00:07:42,319
service as streptococcus midas

190
00:07:47,110 --> 00:07:44,720
in march 1971 at the second lunar

191
00:07:49,510 --> 00:07:47,120
science conference in houston

192
00:07:51,029 --> 00:07:49,520
this is where this slide comes in

193
00:07:52,550 --> 00:07:51,039
the results of this analysis were

194
00:07:54,710 --> 00:07:52,560
reported and later published in

195
00:07:56,230 --> 00:07:54,720
conference proceedings f j mitchell a

196
00:07:58,070 --> 00:07:56,240
u.s air force major assigned to the

197
00:08:00,469 --> 00:07:58,080
preventive medicine division of nasa's

198
00:08:02,790 --> 00:08:00,479
manned space center and r.h ellis a

199
00:08:04,710 --> 00:08:02,800
contractor working at the center claimed

200
00:08:06,469 --> 00:08:04,720
that the s midas that had been cultured

201
00:08:08,629 --> 00:08:06,479
in the lab had traveled to the moon on

202
00:08:10,309 --> 00:08:08,639
surveyor 3 survived on the lunar surface

203
00:08:13,909 --> 00:08:10,319
for two and a half years and once

204
00:08:15,550 --> 00:08:13,919
returned to earth revived and reproduced

205
00:08:17,589 --> 00:08:15,560
this is a quote from their paper

206
00:08:19,589 --> 00:08:17,599
decontamination measures taken before

207
00:08:21,350 --> 00:08:19,599
the surveyor launch did not eliminate

208
00:08:24,230 --> 00:08:21,360
the possibility that the spacecraft

209
00:08:25,909 --> 00:08:24,240
carried organisms to the moon

210
00:08:28,390 --> 00:08:25,919
they described the conduct of the

211
00:08:30,710 --> 00:08:28,400
surveyor three cam camera analysis in

212
00:08:32,469 --> 00:08:30,720
excruciating detail take my word for it

213
00:08:33,829 --> 00:08:32,479

and i have a lot of those details in my

214
00:08:37,430 --> 00:08:33,839
paper

215
00:08:39,509 --> 00:08:37,440
protocol established for the aerobic and

216
00:08:41,350 --> 00:08:39,519
anaerobic analyses contained a system of

217
00:08:43,829 --> 00:08:41,360
redundancy and cross checks designed to

218
00:08:45,990 --> 00:08:43,839
identify suspected lab contamination

219
00:08:47,590 --> 00:08:46,000
only one sampled surface a one cubic

220
00:08:52,070 --> 00:08:47,600
millimeter piece of foam inside the

221
00:08:56,230 --> 00:08:54,310
extreme precautions were taken at all

222
00:08:58,310 --> 00:08:56,240
times they said in their paper during

223
00:08:59,350 --> 00:08:58,320
the analysis to prevent any handling

224
00:09:02,389 --> 00:08:59,360
errors which might have caused

225
00:09:07,350 --> 00:09:05,110
the available data indicates

226
00:09:08,710 --> 00:09:07,360
their conclusion that esmidis was

227
00:09:10,150 --> 00:09:08,720
isolated from the phone sample and

228
00:09:12,389 --> 00:09:10,160
suggests that the bacterium was

229
00:09:15,269 --> 00:09:12,399
deposited on their surveyor 3tv camera

230
00:09:17,350 --> 00:09:15,279
before spacecraft launched

231
00:09:20,230 --> 00:09:17,360
at the very same meeting

232
00:09:21,910 --> 00:09:20,240
m.d nidal ms favero and rh green

233
00:09:23,269 --> 00:09:21,920
presented a paper in which they reported

234
00:09:25,030 --> 00:09:23,279
on the results of their microbial

235
00:09:27,910 --> 00:09:25,040
sampling of returned surveyor three

236
00:09:29,110 --> 00:09:27,920
electrical cabling

237
00:09:31,030 --> 00:09:29,120
nidal and green were with the jet

238
00:09:32,949 --> 00:09:31,040

propulsion laboratory and faveros with

239
00:09:34,550 --> 00:09:32,959
the u.s public health department their

240
00:09:36,310 --> 00:09:34,560
findings raised some questions about

241
00:09:38,150 --> 00:09:36,320
mitchell and ellis's report keep in mind

242
00:09:40,790 --> 00:09:38,160
these two papers were both presented at

243
00:09:42,230 --> 00:09:40,800
the same conference and all these

244
00:09:43,509 --> 00:09:42,240
guys

245
00:09:45,509 --> 00:09:43,519
knew each other

246
00:09:47,030 --> 00:09:45,519
nidal favero and green chose to examine

247
00:09:48,470 --> 00:09:47,040
a piece of electrical wire bundling

248
00:09:50,150 --> 00:09:48,480
running from the surveyor camera to

249
00:09:51,829 --> 00:09:50,160
another part of the spacecraft because

250
00:09:53,670 --> 00:09:51,839
earlier studies had shown that a high

251
00:09:56,470 --> 00:09:53,680
level of microbial contamination was

252
00:09:58,150 --> 00:09:56,480
associated with wiring bundles

253
00:10:00,150 --> 00:09:58,160
if during the actual sampling of the

254
00:10:01,829 --> 00:10:00,160
wires they observed and i'm quoting here

255
00:10:03,670 --> 00:10:01,839
a contaminant were accidentally

256
00:10:05,910 --> 00:10:03,680
introduced it would be impossible to

257
00:10:08,150 --> 00:10:05,920
separate it from a lunar survivor thus

258
00:10:10,150 --> 00:10:08,160
it was necessary they said to perform

259
00:10:12,150 --> 00:10:10,160
several simulated assays with a piece of

260
00:10:15,430 --> 00:10:12,160
sterile wiring bundle before the lunar

261
00:10:17,350 --> 00:10:15,440
sample was acid which they did

262
00:10:19,350 --> 00:10:17,360
prior to opening the sealed container

263
00:10:21,430 --> 00:10:19,360

containing the surveyor 3 cable on other

264
00:10:23,350 --> 00:10:21,440
parts technicians discovered that it had

265
00:10:25,269 --> 00:10:23,360
leaked there was concern whether

266
00:10:27,030 --> 00:10:25,279
airborne bacterial contamination of the

267
00:10:29,350 --> 00:10:27,040
exterior wraps would penetrate to the

268
00:10:31,829 --> 00:10:29,360
interior of the bundle their work in the

269
00:10:33,590 --> 00:10:31,839
lab showed that if airborne bacteria did

270
00:10:35,269 --> 00:10:33,600
pass into the container through the leak

271
00:10:37,829 --> 00:10:35,279
the wiring bundle wraps would protect

272
00:10:39,829 --> 00:10:37,839
the wires beneath it from contamination

273
00:10:41,990 --> 00:10:39,839
their results showed quote that no

274
00:10:43,910 --> 00:10:42,000
viable microorganisms were recovered

275
00:10:46,069 --> 00:10:43,920
from that portion of surveyor 3 cable

276
00:10:48,550 --> 00:10:46,079
that was sampled

277
00:10:50,710 --> 00:10:48,560
the implication was that if no viable

278
00:10:53,110 --> 00:10:50,720
microbes were found on these protected

279
00:10:55,030 --> 00:10:53,120
wiring samples then it would not be

280
00:10:57,590 --> 00:10:55,040
likely that any viable microbes would be

281
00:10:59,829 --> 00:10:57,600
found elsewhere on the camera

282
00:11:01,990 --> 00:10:59,839
nasa published verbatim the findings of

283
00:11:04,550 --> 00:11:02,000
both mitchell and ellis and nidal eddal

284
00:11:08,630 --> 00:11:04,560
as reported at the 1970 conference in a

285
00:11:12,470 --> 00:11:10,310
here's a couple pictures

286
00:11:14,630 --> 00:11:12,480
of the camera

287
00:11:16,630 --> 00:11:14,640
and another picture and thanks to john

288
00:11:18,230 --> 00:11:16,640

rummel who's now in the back of the room

289
00:11:19,829 --> 00:11:18,240
uh who got me started on this

290
00:11:22,389 --> 00:11:19,839
investigation and he'll come into the

291
00:11:25,030 --> 00:11:22,399
story pretty soon

292
00:11:27,030 --> 00:11:25,040
in 1974 the prestigious peer review

293
00:11:29,190 --> 00:11:27,040
journal annual review of microbiology

294
00:11:30,949 --> 00:11:29,200
published a paper by jarrod taylor of

295
00:11:32,870 --> 00:11:30,959
johnson space center's life sciences

296
00:11:35,110 --> 00:11:32,880
directorate which he was formerly with

297
00:11:36,870 --> 00:11:35,120
the preventive medicine division there

298
00:11:39,990 --> 00:11:36,880
that reported on advances in space

299
00:11:41,750 --> 00:11:40,000
microbiology in this paper taylor cited

300
00:11:44,150 --> 00:11:41,760
the lunar science conference papers by

301
00:11:47,110 --> 00:11:44,160
mitchell and ellis and by nidalee at all

302
00:11:49,030 --> 00:11:47,120
in his text however taylor described

303
00:11:51,590 --> 00:11:49,040
only the findings of mitchell and ellis

304
00:11:53,670 --> 00:11:51,600
as follows quote components of the

305
00:11:56,470 --> 00:11:53,680
surveyor 3 spacecraft which had resided

306
00:11:58,069 --> 00:11:56,480
on the moon for 2.5 years were returned

307
00:11:59,670 --> 00:11:58,079
during the apollo 12 mission and

308
00:12:01,990 --> 00:11:59,680
analyzed for the presence of viable

309
00:12:03,990 --> 00:12:02,000
microorganisms except for the presence

310
00:12:06,069 --> 00:12:04,000
of s midas which was considered by the

311
00:12:08,150 --> 00:12:06,079
investigators to have been embedded

312
00:12:10,310 --> 00:12:08,160
within the camera body before it left

313
00:12:11,829 --> 00:12:10,320

the earth no viable microbes were

314
00:12:14,150 --> 00:12:11,839
recovered from any of the tested

315
00:12:16,470 --> 00:12:14,160
components end quote

316
00:12:18,710 --> 00:12:16,480
over the next three decades according to

317
00:12:21,030 --> 00:12:18,720
science citation index taylor's paper

318
00:12:22,790 --> 00:12:21,040
was cited in 31 peer-reviewed journal

319
00:12:25,110 --> 00:12:22,800
papers in publications ranging from

320
00:12:27,190 --> 00:12:25,120
icarus and infection and immunity to

321
00:12:29,670 --> 00:12:27,200
microbiology and molecular biology

322
00:12:31,750 --> 00:12:29,680
reviews microbiological research and

323
00:12:33,829 --> 00:12:31,760
trends in biotechnology

324
00:12:35,910 --> 00:12:33,839
meanwhile in places ranging from nasa

325
00:12:37,590 --> 00:12:35,920
fact sheets wikipedia entries and

326
00:12:39,829 --> 00:12:37,600
websites ranging from credible to

327
00:12:41,670 --> 00:12:39,839
dubious the account of how as midas

328
00:12:43,509 --> 00:12:41,680
survived for 27 months on the moon and

329
00:12:47,590 --> 00:12:43,519
came back to life on earth were widely

330
00:12:52,550 --> 00:12:50,230
after 30 years somebody decided to look

331
00:12:54,629 --> 00:12:52,560
into the story during his second stint

332
00:12:57,990 --> 00:12:54,639
as nasa's planetary protection officer

333
00:13:00,550 --> 00:12:58,000
from 1998 to 2006 john rummel a

334
00:13:03,910 --> 00:13:00,560
microbial ecologist by training decided

335
00:13:05,350 --> 00:13:03,920
to investigate the survivor claim

336
00:13:07,269 --> 00:13:05,360
he talked with people knowledgeable

337
00:13:09,110 --> 00:13:07,279
about the surveyor camera analysis who

338
00:13:10,550 --> 00:13:09,120

had indicated the clean room procedures

339
00:13:11,829 --> 00:13:10,560
for the analysis were less than

340
00:13:13,910 --> 00:13:11,839
stringent

341
00:13:15,990 --> 00:13:13,920
i began doing research for planetary

342
00:13:18,470 --> 00:13:16,000
protection in 2002

343
00:13:20,470 --> 00:13:18,480
in a 2002 memo responding to a query

344
00:13:22,949 --> 00:13:20,480
from me about the story of us midas as a

345
00:13:24,949 --> 00:13:22,959
lunar survivor which i'd stumbled across

346
00:13:25,990 --> 00:13:24,959
on the web and doing some routine

347
00:13:28,069 --> 00:13:26,000
research

348
00:13:30,150 --> 00:13:28,079
rommel said the claim is almost

349
00:13:31,829 --> 00:13:30,160
certainly incorrect there was no

350
00:13:36,310 --> 00:13:31,839
peer-reviewed paper with that result at

351
00:13:40,150 --> 00:13:38,310
rummel told me that in 1998 he had

352
00:13:41,829 --> 00:13:40,160
gotten in touch with jpl surveyor

353
00:13:44,069 --> 00:13:41,839
project scientist leonard jaffe about

354
00:13:45,509 --> 00:13:44,079
the survivor claim and that jaffe had

355
00:13:47,910 --> 00:13:45,519
told him there was a film of the

356
00:13:50,629 --> 00:13:47,920
procedure to sample the camera and that

357
00:13:52,550 --> 00:13:50,639
the samplers had broken sterile protocol

358
00:13:55,269 --> 00:13:52,560
inadvertently by placing their sampling

359
00:13:57,350 --> 00:13:55,279
tool outside the sterile hood

360
00:13:58,870 --> 00:13:57,360
jaffee passed along to rummel

361
00:14:01,269 --> 00:13:58,880
a message he had received from his

362
00:14:03,829 --> 00:14:01,279
surveyor project colleague richard green

363
00:14:06,230 --> 00:14:03,839

remember rh green

364
00:14:08,550 --> 00:14:06,240
of the nettle favera in green paper

365
00:14:09,590 --> 00:14:08,560
about the lrl analysis of the surveyor 3

366
00:14:11,430 --> 00:14:09,600
camera

367
00:14:13,269 --> 00:14:11,440
green had told jaffe quote you were

368
00:14:15,509 --> 00:14:13,279
correct the sampling of the camera was

369
00:14:17,910 --> 00:14:15,519
suspect i took movie film the entire

370
00:14:19,350 --> 00:14:17,920
procedure and it shows up on it as well

371
00:14:20,710 --> 00:14:19,360
i believe i still have the film

372
00:14:22,790 --> 00:14:20,720
somewhere in storage if it would be

373
00:14:24,790 --> 00:14:22,800
helpful i could try and find it

374
00:14:28,629 --> 00:14:24,800
that's a long story too

375
00:14:31,189 --> 00:14:28,639
at an astrobiology conference in 2004

376
00:14:33,590 --> 00:14:31,199
rumble discussed mitchell analysis as

377
00:14:35,030 --> 00:14:33,600
midas survivor claim and he asserted

378
00:14:37,110 --> 00:14:35,040
that the growth they had reported was

379
00:14:39,670 --> 00:14:37,120
the product of lab contamination and he

380
00:14:41,590 --> 00:14:39,680
made a good case a 2004 paper on

381
00:14:43,350 --> 00:14:41,600
biological contamination studies of

382
00:14:44,870 --> 00:14:43,360
lunar landing sites co-authored by

383
00:14:46,790 --> 00:14:44,880
rummel and published in the

384
00:14:48,550 --> 00:14:46,800
international journal of astrobiology

385
00:14:51,670 --> 00:14:48,560
also challenged the claim in a similar

386
00:14:56,230 --> 00:14:54,310
in 2006 i began exploring the story of s

387
00:14:58,389 --> 00:14:56,240
midas on the moon in earnest searching

388
00:15:00,790 --> 00:14:58,399

the web for other accounts

389
00:15:03,030 --> 00:15:00,800
on a nasa goddard web page i found a

390
00:15:04,949 --> 00:15:03,040
following science question of the week

391
00:15:06,629 --> 00:15:04,959
provided by planetary scientist david

392
00:15:08,790 --> 00:15:06,639
williams of nasa's national space

393
00:15:10,949 --> 00:15:08,800
science data center the question can

394
00:15:13,189 --> 00:15:10,959
anything from earth live on the moon the

395
00:15:15,670 --> 00:15:13,199
answer yes

396
00:15:18,470 --> 00:15:15,680
scientists the the s midas claim was

397
00:15:20,470 --> 00:15:18,480
reported here as fact and quote from

398
00:15:22,310 --> 00:15:20,480
this webpage scientists concluded that

399
00:15:24,069 --> 00:15:22,320
the s midas was inside the camera

400
00:15:25,509 --> 00:15:24,079
originally and had managed to survive on

401
00:15:27,269 --> 00:15:25,519
the moon

402
00:15:29,590 --> 00:15:27,279
at the same time i found a much more

403
00:15:31,189 --> 00:15:29,600
detailed account of the survivor story

404
00:15:34,470 --> 00:15:31,199
on a marshall space flight center

405
00:15:36,710 --> 00:15:34,480
website science at nasa dated 1998 and

406
00:15:38,550 --> 00:15:36,720
headlined earth microbes on the moon

407
00:15:40,629 --> 00:15:38,560
three decades after apollo 12 a

408
00:15:43,269 --> 00:15:40,639
remarkable colony of lunar survivors

409
00:15:45,590 --> 00:15:43,279
revisited this account reports on quote

410
00:15:47,350 --> 00:15:45,600
an inadvertent stowaway streptococcus

411
00:15:49,749 --> 00:15:47,360
midas the only known survivor of

412
00:15:51,350 --> 00:15:49,759
unprotected space travel how this

413
00:15:53,269 --> 00:15:51,360

remarkable feat of survival was

414
00:15:55,749 --> 00:15:53,279
accomplished only by strep bacteria

415
00:15:57,590 --> 00:15:55,759
remains speculative but the significance

416
00:15:59,509 --> 00:15:57,600
of a living organism surviving for

417
00:16:01,670 --> 00:15:59,519
nearly three years in the harsh lunar

418
00:16:03,670 --> 00:16:01,680
environment may only now be placed in

419
00:16:05,829 --> 00:16:03,680
perspective after three decades of the

420
00:16:07,910 --> 00:16:05,839
biological revolution in understanding

421
00:16:09,749 --> 00:16:07,920
life in its favored conditions talk

422
00:16:11,430 --> 00:16:09,759
about rhetoric

423
00:16:13,749 --> 00:16:11,440
another official nasa record found

424
00:16:16,069 --> 00:16:13,759
online the apollo 12 lunar surface

425
00:16:18,069 --> 00:16:16,079
journal surveyor crater and surveyor 3

426
00:16:20,069 --> 00:16:18,079
includes a transcript of astronauts

427
00:16:21,670 --> 00:16:20,079
conrad and bean's conversation while

428
00:16:23,509 --> 00:16:21,680
around the lunar surface plus

429
00:16:25,430 --> 00:16:23,519
post-flight commentary from them and

430
00:16:27,910 --> 00:16:25,440
others in which they address the story

431
00:16:29,670 --> 00:16:27,920
of this midas on the moon in post-flight

432
00:16:31,829 --> 00:16:29,680
comments conrad said

433
00:16:33,269 --> 00:16:31,839
quote the thing that had the bacteria in

434
00:16:35,110 --> 00:16:33,279
it was the television camera the

435
00:16:37,590 --> 00:16:35,120
styrofoam in between the inner and outer

436
00:16:39,030 --> 00:16:37,600
shells there's a report on that i always

437
00:16:41,189 --> 00:16:39,040
thought the most significant thing that

438
00:16:43,670 --> 00:16:41,199

we ever found on the whole god damn moon

439
00:16:46,150 --> 00:16:43,680
was that little bacteria who came

440
00:16:48,230 --> 00:16:46,160
back and lived and nobody ever said

441
00:16:50,710 --> 00:16:48,240
squat about it

442
00:16:52,069 --> 00:16:50,720
anyone who knows pete conrad

443
00:16:54,470 --> 00:16:52,079
would recognize that quote and that

444
00:16:57,590 --> 00:16:54,480
quote was widely replicated i i think in

445
00:16:59,269 --> 00:16:57,600
large part because of its color

446
00:17:01,509 --> 00:16:59,279
in his post-flight comments journal

447
00:17:03,430 --> 00:17:01,519
contributor ken glover noted quote there

448
00:17:05,429 --> 00:17:03,440
is this distinct possibility that the

449
00:17:07,029 --> 00:17:05,439
microbes found in the surveyor tv camera

450
00:17:09,750 --> 00:17:07,039
got there as a result of post-flight

451
00:17:11,429 --> 00:17:09,760
contamination as of 2004 it seems

452
00:17:13,590 --> 00:17:11,439
generally accepted that the history of

453
00:17:15,189 --> 00:17:13,600
this particular microbe found in the

454
00:17:16,630 --> 00:17:15,199
surveyor three parts will never be

455
00:17:19,429 --> 00:17:16,640
resolved

456
00:17:21,590 --> 00:17:19,439
i also found this is kind of disturbing

457
00:17:23,990 --> 00:17:21,600
a classroom teacher sheet for grades 9

458
00:17:25,829 --> 00:17:24,000
through 12 called all about microbes

459
00:17:27,590 --> 00:17:25,839
developed for a nasa-sponsored project

460
00:17:30,150 --> 00:17:27,600
which is now defunct called nasa

461
00:17:31,750 --> 00:17:30,160
explorers and it repeated this survivor

462
00:17:34,150 --> 00:17:31,760
story as fact citing the marshall

463
00:17:36,230 --> 00:17:34,160

website as a source of information

464
00:17:38,710 --> 00:17:36,240
there were many many other sources and

465
00:17:40,950 --> 00:17:38,720
beyond the universe of nasa.gov i found

466
00:17:43,750 --> 00:17:40,960
further accounts of the fact that s

467
00:17:46,470 --> 00:17:43,760
midas was a survivor at reference.com at

468
00:17:50,470 --> 00:17:46,480
wikipedia on a space.com reader forum

469
00:17:54,310 --> 00:17:52,870
in 2006 i began contacting people at

470
00:17:55,830 --> 00:17:54,320
johnson space center who might know

471
00:17:58,230 --> 00:17:55,840
something about the surveyor camera

472
00:18:00,470 --> 00:17:58,240
analysis rummel told me judy alton a

473
00:18:02,870 --> 00:18:00,480
curator with the jsc astro materials

474
00:18:04,950 --> 00:18:02,880
office reportedly had a list of film and

475
00:18:07,110 --> 00:18:04,960
photographic records of the analysis so

476
00:18:10,310 --> 00:18:07,120
i first contacted her she found her

477
00:18:12,150 --> 00:18:10,320
handwritten list provided it to us

478
00:18:13,590 --> 00:18:12,160
her colleague carlton allen referred us

479
00:18:15,430 --> 00:18:13,600
to john lindsay with the lunar and

480
00:18:16,710 --> 00:18:15,440
planetary institute center for advanced

481
00:18:18,470 --> 00:18:16,720
space studies for help with our

482
00:18:20,310 --> 00:18:18,480
investigation

483
00:18:22,549 --> 00:18:20,320
lindsay advised that he was part of the

484
00:18:24,870 --> 00:18:22,559
preliminary examination team on apollo

485
00:18:26,470 --> 00:18:24,880
12. so have some feel for the way things

486
00:18:29,270 --> 00:18:26,480
went and would enjoy working on the data

487
00:18:31,350 --> 00:18:29,280
once again i put my research on hold in

488
00:18:33,110 --> 00:18:31,360

late 2006 when rummels stepped down as

489
00:18:35,510 --> 00:18:33,120
planetary protection officer to take

490
00:18:37,750 --> 00:18:35,520
over the nasa astrobiology program in

491
00:18:39,909 --> 00:18:37,760
2008 rommel left nasa and john lindsay

492
00:18:41,590 --> 00:18:39,919
passed away unrelated events

493
00:18:43,669 --> 00:18:41,600
nonetheless rummel still seemed

494
00:18:46,070 --> 00:18:43,679
determined to prove if possible that s

495
00:18:48,789 --> 00:18:46,080
midas survivor was actually s midas lab

496
00:18:50,470 --> 00:18:48,799
contamination ultimately rummel alston

497
00:18:52,310 --> 00:18:50,480
and don morrison completed an

498
00:18:54,150 --> 00:18:52,320
investigation into the matter and rummel

499
00:18:55,590 --> 00:18:54,160
reported their results at a workshop in

500
00:18:57,029 --> 00:18:55,600
2011.

501
00:18:58,710 --> 00:18:57,039
rommel said that according to nasa

502
00:19:00,950 --> 00:18:58,720
records the surveyor 3 camera reached a

503
00:19:03,029 --> 00:19:00,960
maximum temperature of around 70 degrees

504
00:19:04,950 --> 00:19:03,039
celsius on the moon

505
00:19:07,029 --> 00:19:04,960
nasa records also showed that s midas

506
00:19:09,909 --> 00:19:07,039
quote was isolated from the apollo 12

507
00:19:12,230 --> 00:19:09,919
crew in routine microbial testing the

508
00:19:14,070 --> 00:19:12,240
team's investigation verified that no

509
00:19:16,789 --> 00:19:14,080
viable microbes were isolated from the

510
00:19:19,190 --> 00:19:16,799
surveyor 3 cables or foam

511
00:19:21,029 --> 00:19:19,200
or for many apollo surface samples

512
00:19:23,029 --> 00:19:21,039
excuse me return to earth and that no

513
00:19:25,909 --> 00:19:23,039

viable microbes were isolated from 10 of

514
00:19:27,510 --> 00:19:25,919
11 sampling locations 32 of 33 samples

515
00:19:29,430 --> 00:19:27,520
within the camera body

516
00:19:31,510 --> 00:19:29,440
what clinched the trio's investigation

517
00:19:34,390 --> 00:19:31,520
however was that in 2010 they found the

518
00:19:36,230 --> 00:19:34,400
16 millimeter film records of the 1970

519
00:19:38,630 --> 00:19:36,240
surveyor camera analysis

520
00:19:41,110 --> 00:19:38,640
quote in in john john's words

521
00:19:42,549 --> 00:19:41,120
languishing in maryland

522
00:19:44,549 --> 00:19:42,559
all three researchers viewed and

523
00:19:46,950 --> 00:19:44,559
analyzed the film and again in john

524
00:19:48,950 --> 00:19:46,960
rummel's words it wasn't pretty

525
00:19:50,630 --> 00:19:48,960
the film showed lab technicians working

526
00:19:52,710 --> 00:19:50,640
in short sleeves with only their mouths

527
00:19:54,630 --> 00:19:52,720
and noses covered by masks at some

528
00:19:56,470 --> 00:19:54,640
points they were working with bare hands

529
00:19:58,070 --> 00:19:56,480
as rummel observed after all of that how

530
00:19:59,029 --> 00:19:58,080
can you be sure where your microbes came

531
00:20:01,190 --> 00:19:59,039
from

532
00:20:03,350 --> 00:20:01,200
more specifically morrison pinpointed an

533
00:20:05,350 --> 00:20:03,360
anomaly in camera foam sampling which i

534
00:20:08,630 --> 00:20:05,360
detailed in my paper

535
00:20:10,310 --> 00:20:08,640
as to general protocol judy alton noted

536
00:20:12,149 --> 00:20:10,320
i will add that the participants were

537
00:20:14,390 --> 00:20:12,159
wearing short sleeve scrubs thus arms

538
00:20:16,149 --> 00:20:14,400

were exposed also that the scrub shirt

539
00:20:17,909 --> 00:20:16,159
tails were higher than the flow bench

540
00:20:21,430 --> 00:20:17,919
level and would act as a bellows for

541
00:20:24,710 --> 00:20:21,440
particulates from inside the shirt

542
00:20:26,710 --> 00:20:24,720
on may 2 2011 space.com reported on ramo

543
00:20:28,870 --> 00:20:26,720
adele's findings describing the story of

544
00:20:31,029 --> 00:20:28,880
this midas survivor as a long-lived bit

545
00:20:36,310 --> 00:20:31,039
of apollo moon landing folklore that now

546
00:20:40,630 --> 00:20:38,789
oh i missed some slides now here's a

547
00:20:42,630 --> 00:20:40,640
lovely picture it's a little blurry

548
00:20:45,190 --> 00:20:42,640
because of course this is a still still

549
00:20:46,789 --> 00:20:45,200
imagery taken from 16 millimeter film

550
00:20:48,149 --> 00:20:46,799
but you can see

551
00:20:51,750 --> 00:20:48,159
get a good idea of what we're talking

552
00:20:55,430 --> 00:20:53,510
the contestation or shall we say

553
00:20:56,789 --> 00:20:55,440
refutation of mitchell analysis claim

554
00:20:58,230 --> 00:20:56,799
has had some effect on the public

555
00:21:00,789 --> 00:20:58,240
records so far

556
00:21:02,549 --> 00:21:00,799
while in 2006 i found numerous websites

557
00:21:05,110 --> 00:21:02,559
replicating the story of s midas

558
00:21:07,029 --> 00:21:05,120
survivor in 2012 i found only a few that

559
00:21:09,510 --> 00:21:07,039
were sticking with the story

560
00:21:11,750 --> 00:21:09,520
in 2006 i had contacted david williams

561
00:21:14,870 --> 00:21:11,760
at goddard to advise that the claim he

562
00:21:16,390 --> 00:21:14,880
reported as fact was contested in 2012 i

563
00:21:17,590 --> 00:21:16,400

looked for this page and it no longer

564
00:21:20,549 --> 00:21:17,600
exists

565
00:21:23,110 --> 00:21:20,559
in 2012 at reference.com

566
00:21:26,230 --> 00:21:23,120
online entry for surveyor 3 at the very

567
00:21:27,909 --> 00:21:26,240
same url that i checked in 2006 i found

568
00:21:29,510 --> 00:21:27,919
a completely different story about us

569
00:21:31,029 --> 00:21:29,520
midas on the moon

570
00:21:31,990 --> 00:21:31,039
and now this story reported that the

571
00:21:34,310 --> 00:21:32,000
claim

572
00:21:36,390 --> 00:21:34,320
of s midas surviving on the moon and

573
00:21:38,950 --> 00:21:36,400
coming back to life on earth has been

574
00:21:41,590 --> 00:21:38,960
cited as providing credence to the idea

575
00:21:43,909 --> 00:21:41,600
of interplanetary panspermia however

576
00:21:45,430 --> 00:21:43,919
nasa officials now no longer support

577
00:21:46,470 --> 00:21:45,440
this claim

578
00:21:47,990 --> 00:21:46,480
now

579
00:21:49,830 --> 00:21:48,000
i believe even today because i just

580
00:21:53,110 --> 00:21:49,840
checked this about a week ago nasa

581
00:21:55,110 --> 00:21:53,120
marshall signs that nasa entry of 1998

582
00:21:56,230 --> 00:21:55,120
has not been revised since it was posted

583
00:21:58,789 --> 00:21:56,240
there

584
00:22:00,630 --> 00:21:58,799
thus in 2012 at least one nasa.gov

585
00:22:02,710 --> 00:22:00,640
webpage continues to report without

586
00:22:04,950 --> 00:22:02,720
question or qualification

587
00:22:06,390 --> 00:22:04,960
that s midas did indeed survive for two

588
00:22:09,350 --> 00:22:06,400

and a half years on the moon come back

589
00:22:11,110 --> 00:22:09,360
to earth and come back to life

590
00:22:12,950 --> 00:22:11,120
so it remains to be seen we'll have to

591
00:22:13,990 --> 00:22:12,960
wait a few more years to see how long it

592
00:22:16,230 --> 00:22:14,000
will take

593
00:22:18,950 --> 00:22:16,240
to correct the public record

594
00:22:21,350 --> 00:22:18,960
it's still with us on the september 14

595
00:22:23,830 --> 00:22:21,360
edition just last month of national

596
00:22:26,390 --> 00:22:23,840
public radio science friday show ira

597
00:22:28,310 --> 00:22:26,400
flado asked cassie conley nasa's current

598
00:22:31,110 --> 00:22:28,320
planetary protection officer about the

599
00:22:33,110 --> 00:22:31,120
bioassays of the surveyor camera parts

600
00:22:34,630 --> 00:22:33,120
and cassie said quote it turns out that

601
00:22:36,470 --> 00:22:34,640
the way they were taking those samples

602
00:22:38,149 --> 00:22:36,480
was about the same level of sterility as

603
00:22:39,909 --> 00:22:38,159
you do in surgery so they had short

604
00:22:41,590 --> 00:22:39,919
sleeve scrubs they didn't really have

605
00:22:43,510 --> 00:22:41,600
good masks so the samples that were

606
00:22:45,590 --> 00:22:43,520
contaminated were taken at the very end

607
00:22:47,270 --> 00:22:45,600
of this whole sampling process and just

608
00:22:49,430 --> 00:22:47,280
after somebody breathed right on that

609
00:22:51,270 --> 00:22:49,440
location on the camera so it probably

610
00:22:54,870 --> 00:22:51,280
was contamination after the camera was

611
00:22:59,750 --> 00:22:56,789
there's another picture

612
00:23:01,350 --> 00:22:59,760
just to show up close and personal

613
00:23:03,110 --> 00:23:01,360

to wrap up

614
00:23:05,430 --> 00:23:03,120
this story shows how a claim became a

615
00:23:07,669 --> 00:23:05,440
widely accepted fact without passing the

616
00:23:09,110 --> 00:23:07,679
conventional test of peer review

617
00:23:10,870 --> 00:23:09,120
how initial counter claims that

618
00:23:13,590 --> 00:23:10,880
challenge the status of the first claim

619
00:23:15,510 --> 00:23:13,600
is fact failed to register how a later

620
00:23:17,430 --> 00:23:15,520
and perhaps more vigorous counter claim

621
00:23:19,510 --> 00:23:17,440
ultimately led to a solid case against

622
00:23:21,990 --> 00:23:19,520
the first claim and how consequently the

623
00:23:27,909 --> 00:23:22,000
first claim is losing its status as fact

624
00:23:30,950 --> 00:23:29,430
rommel at all are interested in this

625
00:23:32,549 --> 00:23:30,960
story is a case that illustrates the

626
00:23:33,990 --> 00:23:32,559
importance of stringent compliance with

627
00:23:36,149 --> 00:23:34,000
planetary protection policy and

628
00:23:38,230 --> 00:23:36,159
procedures and as we've heard from other

629
00:23:39,750 --> 00:23:38,240
speakers in recent years microbiology

630
00:23:41,590 --> 00:23:39,760
research has revealed the extent to

631
00:23:43,510 --> 00:23:41,600
which humans are teeming with microbial

632
00:23:45,269 --> 00:23:43,520
life and the prospect of sending humans

633
00:23:47,190 --> 00:23:45,279
to extraterrestrial environments that

634
00:23:48,789 --> 00:23:47,200
might be habitable for earth life

635
00:23:50,310 --> 00:23:48,799
greatly complicates the task of

636
00:23:51,510 --> 00:23:50,320
compliance with planetary protection

637
00:23:53,830 --> 00:23:51,520
requirements

638
00:23:55,350 --> 00:23:53,840

nasa clean room practices have evolved

639
00:23:57,269 --> 00:23:55,360
considerably since the days of the

640
00:23:58,950 --> 00:23:57,279
surveyor analysis where clean room

641
00:24:00,549 --> 00:23:58,960
technicians wore short sleeves to the

642
00:24:03,590 --> 00:24:00,559
present-day planetary protection

643
00:24:05,350 --> 00:24:03,600
requirement of bunny suits there you go

644
00:24:06,470 --> 00:24:05,360
i think this was from genesis john is

645
00:24:08,630 --> 00:24:06,480
that right

646
00:24:10,390 --> 00:24:08,640
the genesis crew

647
00:24:12,070 --> 00:24:10,400
today the scientific consensus is that

648
00:24:13,669 --> 00:24:12,080
it is not likely that terrestrial

649
00:24:15,590 --> 00:24:13,679
microbes could survive and thrive on the

650
00:24:17,590 --> 00:24:15,600
moon and this consensus is reflected in

651
00:24:19,430 --> 00:24:17,600
planetary protection policy for missions

652
00:24:22,390 --> 00:24:19,440
to the moon which designates those

653
00:24:23,990 --> 00:24:22,400
missions category 2 forays to a body of

654
00:24:25,590 --> 00:24:24,000
significant interest relative to the

655
00:24:27,110 --> 00:24:25,600
process of chemical evolution in the

656
00:24:29,110 --> 00:24:27,120
origin of life but where there is only

657
00:24:30,950 --> 00:24:29,120
remote chance that contamination carried

658
00:24:33,269 --> 00:24:30,960
by a spacecraft could compromise future

659
00:24:34,870 --> 00:24:33,279
investigations

660
00:24:37,029 --> 00:24:34,880
for category two missions forward

661
00:24:38,230 --> 00:24:37,039
contamination is not a concern however

662
00:24:39,590 --> 00:24:38,240
there is a concern that an

663
00:24:41,110 --> 00:24:39,600

extraterrestrial environment is where

664
00:24:43,909 --> 00:24:41,120
liquid water might exist and we've

665
00:24:45,430 --> 00:24:43,919
discussed many of them today

666
00:24:47,750 --> 00:24:45,440
it could be possible for terrestrial

667
00:24:49,430 --> 00:24:47,760
microbes to thrive and replicate

668
00:24:51,269 --> 00:24:49,440
and then forward contamination for

669
00:24:53,350 --> 00:24:51,279
missions to those targets is a serious

670
00:24:55,669 --> 00:24:53,360
concern and planetary protection

671
00:24:57,350 --> 00:24:55,679
requirements are strict so for planetary

672
00:24:58,630 --> 00:24:57,360
protection this case illustrates among

673
00:25:00,789 --> 00:24:58,640
other things that microbes are

674
00:25:02,950 --> 00:25:00,799
everywhere at least on earth clean room

675
00:25:05,430 --> 00:25:02,960
procedures for microbial assays can't be

676
00:25:07,669 --> 00:25:05,440
too careful and meticulous and complete

677
00:25:10,549 --> 00:25:07,679
records of such procedures must be made

678
00:25:12,149 --> 00:25:10,559
and preserved for astrobiology this case

679
00:25:14,149 --> 00:25:12,159
illustrates how difficult it will be to

680
00:25:16,149 --> 00:25:14,159
verify any claims of the detection of

681
00:25:18,149 --> 00:25:16,159
extraterrestrial life something else

682
00:25:20,149 --> 00:25:18,159
we've been talking about today consider

683
00:25:21,909 --> 00:25:20,159
the mars science laboratory nasa's first

684
00:25:24,470 --> 00:25:21,919
astrobiology mission to mars since

685
00:25:26,789 --> 00:25:24,480
biking now roving around gale crater

686
00:25:28,549 --> 00:25:26,799
seeking evidence of habitability

687
00:25:30,230 --> 00:25:28,559
questions will continue to arise from

688
00:25:31,830 --> 00:25:30,240

the press and the public and the science

689
00:25:33,830 --> 00:25:31,840
community about the possibility of

690
00:25:35,909 --> 00:25:33,840
finding life on mars or in other

691
00:25:38,310 --> 00:25:35,919
extraterrestrial environments

692
00:25:40,310 --> 00:25:38,320
and how will we ever know for sure

693
00:25:41,990 --> 00:25:40,320
for the history and sociology of science

694
00:25:43,909 --> 00:25:42,000
this case shows how a claim that was

695
00:25:46,310 --> 00:25:43,919
never subjected to formal peer review

696
00:25:48,310 --> 00:25:46,320
became and remained a fact for decades

697
00:25:50,310 --> 00:25:48,320
before it was seriously challenged and

698
00:25:52,070 --> 00:25:50,320
how it took visual evidence to finally

699
00:25:54,310 --> 00:25:52,080
make the case that multiple sources had

700
00:25:56,390 --> 00:25:54,320
made verbally it shows how the paper

701
00:25:58,470 --> 00:25:56,400
trails that we researchers like to

702
00:26:00,630 --> 00:25:58,480
excavate for information are now

703
00:26:02,870 --> 00:26:00,640
intermingled with digital documentation

704
00:26:05,190 --> 00:26:02,880
that can be altered at any time without

705
00:26:07,350 --> 00:26:05,200
leaving any detectable evidence of an

706
00:26:09,510 --> 00:26:07,360
alteration and it shows something that

707
00:26:17,350 --> 00:26:09,520
historians already know that the record

708
00:26:17,360 --> 00:26:36,789
thank you are there questions for linda

709
00:26:40,710 --> 00:26:39,029
innumerable extremophiles that he has

710
00:26:42,870 --> 00:26:40,720
collected all around and i wonder what

711
00:26:44,710 --> 00:26:42,880
his comments were on this i did not

712
00:26:49,990 --> 00:26:44,720
speak to him for this particular paper

713
00:26:53,830 --> 00:26:51,590

i did not speak to him doing research

714
00:26:55,190 --> 00:26:53,840
for this uh particular paper because his

715
00:26:56,789 --> 00:26:55,200
name did not show up in any of these

716
00:26:58,710 --> 00:26:56,799
records he just retired from nasa

717
00:27:00,870 --> 00:26:58,720
because he's still active so you might

718
00:27:02,630 --> 00:27:00,880
want to do that yes there are lots and

719
00:27:05,830 --> 00:27:02,640
lots of people i'm sure historians in

720
00:27:07,430 --> 00:27:05,840
the audience realize how much more i can

721
00:27:09,909 --> 00:27:07,440
do to fill out this story this is just

722
00:27:11,830 --> 00:27:09,919
scratching the surface i did not

723
00:27:13,590 --> 00:27:11,840
sit down and do a formal interview with

724
00:27:16,549 --> 00:27:13,600
anybody i mean i had some conversations

725
00:27:18,389 --> 00:27:16,559
on the phone and emailed the questions

726
00:27:20,389 --> 00:27:18,399
okay thank you

727
00:27:22,710 --> 00:27:20,399
yeah i will point out that it is

728
00:27:24,870 --> 00:27:22,720
possible for streptococcus midas to

729
00:27:27,029 --> 00:27:24,880
survive on the surface of moon for two

730
00:27:33,110 --> 00:27:27,039
and a half years if an astronaut is

731
00:27:38,230 --> 00:27:34,789
yeah moon

732
00:27:39,830 --> 00:27:38,240
your talk is very instructive indeed and

733
00:27:40,950 --> 00:27:39,840
this is showing

734
00:27:44,389 --> 00:27:40,960
um

735
00:27:47,830 --> 00:27:44,399
well how easily the different microbes

736
00:27:48,870 --> 00:27:47,840
adapt to the hostile environment in this

737
00:27:49,990 --> 00:27:48,880
regard

738
00:27:53,510 --> 00:27:50,000

i just

739
00:27:56,789 --> 00:27:53,520
would like to ask you you know we try to

740
00:27:58,310 --> 00:27:56,799
sterilize many martial missions which we

741
00:28:00,549 --> 00:27:58,320
send okay

742
00:28:03,110 --> 00:28:00,559
but it's impossible to sterilize for

743
00:28:07,750 --> 00:28:03,120
reliably completely and some of them

744
00:28:11,110 --> 00:28:07,760
crashed when just landing on mars so the

745
00:28:14,230 --> 00:28:11,120
microbes possibly re easily adapted to

746
00:28:16,789 --> 00:28:14,240
the natural environment on mars and even

747
00:28:19,029 --> 00:28:16,799
in the dynamical very dynamical

748
00:28:22,310 --> 00:28:19,039
conditions in the martian atmosphere

749
00:28:25,510 --> 00:28:22,320
just easily proliferated over the

750
00:28:28,310 --> 00:28:25,520
merchant that the whole globe so the

751
00:28:30,230 --> 00:28:28,320
question is whether we need to take care

752
00:28:32,870 --> 00:28:30,240
about sterilization for the future

753
00:28:35,750 --> 00:28:32,880
mission what we are going to find out

754
00:28:38,630 --> 00:28:35,760
some kind of the mutations or just

755
00:28:41,190 --> 00:28:38,640
completely original terrestrial life

756
00:28:43,510 --> 00:28:41,200
forms what do you think about that

757
00:28:46,630 --> 00:28:43,520
it's a serious challenge in the search

758
00:28:48,310 --> 00:28:46,640
for evidence of life elsewhere to know

759
00:28:50,310 --> 00:28:48,320
whether it's

760
00:28:52,710 --> 00:28:50,320
life we've never seen before

761
00:28:55,110 --> 00:28:52,720
our life that used to be like us that as

762
00:28:56,870 --> 00:28:55,120
you mentioned might have evolved changed

763
00:29:00,230 --> 00:28:56,880

mutated

764
00:29:02,070 --> 00:29:00,240
this is why the more we learn about um

765
00:29:04,470 --> 00:29:02,080
planetary environments potential

766
00:29:06,950 --> 00:29:04,480
habitability and the more we learn about

767
00:29:09,350 --> 00:29:06,960
life as as david grinspoon and others

768
00:29:12,789 --> 00:29:09,360
have discussed today

769
00:29:14,389 --> 00:29:12,799
and how how weird life really is i mean

770
00:29:16,149 --> 00:29:14,399
it's just amazing to me it's

771
00:29:19,909 --> 00:29:16,159
mind-blowing to me i'm not a biologist

772
00:29:21,909 --> 00:29:19,919
obviously um the the more difficult it

773
00:29:24,630 --> 00:29:21,919
will be for us to determine how to make

774
00:29:26,470 --> 00:29:24,640
sure that when we send that uh melter

775
00:29:27,830 --> 00:29:26,480
who showed the slide of the the nuclear

776
00:29:30,149 --> 00:29:27,840
oh that was last night at national

777
00:29:33,190 --> 00:29:30,159
geograph the melt probe yeah through the

778
00:29:34,870 --> 00:29:33,200
the icy surface of europa uh that if we

779
00:29:36,470 --> 00:29:34,880
find anything it there it's not

780
00:29:38,830 --> 00:29:36,480
something that we brought with us it's

781
00:29:41,909 --> 00:29:38,840
an extremely

782
00:29:44,549 --> 00:29:41,919
extremely difficult challenge to me we

783
00:29:45,990 --> 00:29:44,559
have i see vicky hipkin who's uh the

784
00:29:47,830 --> 00:29:46,000
queen of planetary protection for the

785
00:29:49,590 --> 00:29:47,840
canadian space agency she's biting her

786
00:29:51,350 --> 00:29:49,600
lip you know so

787
00:29:52,389 --> 00:29:51,360
it's a very very hard job to do but

788
00:29:55,269 --> 00:29:52,399

people are

789
00:30:00,710 --> 00:29:55,279
working at it thank you

790
00:30:05,350 --> 00:30:03,110
my only comment about that linda is that

791
00:30:08,549 --> 00:30:05,360
you know somehow your work has been able

792
00:30:11,029 --> 00:30:08,559
to get this out of the web and why can't

793
00:30:13,190 --> 00:30:11,039
they get rid of the story about the mars

794
00:30:15,750 --> 00:30:13,200
being you know the size of the full moon

795
00:30:17,909 --> 00:30:15,760
out which comes around every august like

796
00:30:20,470 --> 00:30:17,919
clockwork if you could work on that one

797
00:30:23,750 --> 00:30:20,480
next i'd really appreciate it

798
00:30:25,990 --> 00:30:23,760
um our next talk by william mccauley um

799
00:30:28,470 --> 00:30:26,000
instant science space probes planetary

800
00:30:30,389 --> 00:30:28,480
exploration and television

801
00:30:32,710 --> 00:30:30,399
unfortunately had to be withdrawn there

802
00:30:34,549 --> 00:30:32,720
were visa troubles uh for

803
00:30:37,110 --> 00:30:34,559
uh william mccauley and he can't be here

804
00:30:39,510 --> 00:30:37,120
but his paper is quite interesting and

805
00:30:42,950 --> 00:30:39,520
if you are interested in the use of

806
00:30:45,430 --> 00:30:42,960
visual imagery in space the history of

807
00:30:47,750 --> 00:30:45,440
how visual imagery came to be such a big

808
00:30:49,269 --> 00:30:47,760
part of this space program i suggest

809
00:30:53,990 --> 00:30:49,279
that you do track that paper down

810
00:30:58,870 --> 00:30:56,470
and our next topic

811
00:31:02,070 --> 00:30:58,880
is one that's near and dear to my heart

812
00:31:05,750 --> 00:31:02,080
because i happen to be in charge of the

813
00:31:08,710 --> 00:31:05,760

hubble space telescope in 1994

814
00:31:12,310 --> 00:31:08,720
when a comet fragmented comet schumacher

815
00:31:15,190 --> 00:31:12,320
v9 crashed into jupiter creating massive

816
00:31:18,230 --> 00:31:15,200
explosions on the planet which was

817
00:31:20,549 --> 00:31:18,240
headline news for a full week

818
00:31:21,590 --> 00:31:20,559
and how many of you saw that i'm just

819
00:31:23,509 --> 00:31:21,600
curious

820
00:31:25,990 --> 00:31:23,519
yeah a lot of you did and that comes

821
00:31:28,950 --> 00:31:26,000
into the next story which is entitled

822
00:31:31,750 --> 00:31:28,960
killer asteroids popular depictions and

823
00:31:33,590 --> 00:31:31,760
public policy influence by lara delgado

824
00:31:41,509 --> 00:31:33,600
lopez

825
00:31:45,669 --> 00:31:43,590
hello everyone i'm really happy to be

826
00:31:47,350 --> 00:31:45,679
here and before i begin i would just

827
00:31:49,509 --> 00:31:47,360
like to

828
00:31:51,350 --> 00:31:49,519
acknowledge that this paper came as a

829
00:31:53,190 --> 00:31:51,360
collaboration between myself and duane

830
00:31:56,149 --> 00:31:53,200
day from the nrc whom you've heard um

831
00:31:57,509 --> 00:31:56,159
earlier this morning and um so now let's

832
00:31:59,909 --> 00:31:57,519
just move right on to it killer

833
00:32:02,470 --> 00:31:59,919
asteroids we know the story so well

834
00:32:04,950 --> 00:32:02,480
basically we find out usually that pure

835
00:32:06,789 --> 00:32:04,960
chance that this that a monstrous

836
00:32:08,310 --> 00:32:06,799
asteroid is heading you know hurling

837
00:32:10,310 --> 00:32:08,320
toward the planet and it's threatening

838
00:32:11,909 --> 00:32:10,320

civilization and you know do we have

839
00:32:13,590 --> 00:32:11,919
time to do anything can we do anything

840
00:32:14,389 --> 00:32:13,600
about it and so the story goes and bruce

841
00:32:15,590 --> 00:32:14,399
willis

842
00:32:19,110 --> 00:32:15,600
you know makes an appearance or

843
00:32:21,590 --> 00:32:19,120
something um but what we may not know is

844
00:32:23,750 --> 00:32:21,600
that this narrative is actually um goes

845
00:32:25,590 --> 00:32:23,760
back much further than we may believe

846
00:32:27,190 --> 00:32:25,600
and so when we look at all these

847
00:32:29,669 --> 00:32:27,200
examples some of which i will mention

848
00:32:31,190 --> 00:32:29,679
today we have to ask ourselves you know

849
00:32:33,269 --> 00:32:31,200
what is behind this narrative was it

850
00:32:34,549 --> 00:32:33,279
prompted by real events can it tell us

851
00:32:36,950 --> 00:32:34,559
anything about

852
00:32:38,630 --> 00:32:36,960
real policy impacts or public opinion

853
00:32:40,470 --> 00:32:38,640
about it

854
00:32:42,630 --> 00:32:40,480
and so to begin with i'll tell you a

855
00:32:43,830 --> 00:32:42,640
little bit about the long and explosive

856
00:32:45,909 --> 00:32:43,840
history

857
00:32:47,669 --> 00:32:45,919
and in the paper which you may have an

858
00:32:50,310 --> 00:32:47,679
opportunity to see

859
00:32:52,070 --> 00:32:50,320
there is a there's a list at the end of

860
00:32:54,070 --> 00:32:52,080
a bunch of examples that we were able to

861
00:32:54,870 --> 00:32:54,080
find some in other languages as you see

862
00:32:57,750 --> 00:32:54,880
here

863
00:32:59,669 --> 00:32:57,760

but just to show that this has been

864
00:33:01,990 --> 00:32:59,679
around a long time

865
00:33:04,950 --> 00:33:02,000
the earliest example we found was a

866
00:33:06,070 --> 00:33:04,960
french novel published in 1890 titular

867
00:33:08,470 --> 00:33:06,080
fondue

868
00:33:11,350 --> 00:33:08,480
and it was republished again in the 30s

869
00:33:13,110 --> 00:33:11,360
and made into a movie in the 90s

870
00:33:15,990 --> 00:33:13,120
and it was again one of the very

871
00:33:17,509 --> 00:33:16,000
earliest examples and also at the time

872
00:33:19,590 --> 00:33:17,519
and the time you know we see the 40s the

873
00:33:21,590 --> 00:33:19,600
50s also some other movies and books

874
00:33:24,149 --> 00:33:21,600
exploring the issue

875
00:33:26,389 --> 00:33:24,159
in non-fiction we see some work looking

876
00:33:29,909 --> 00:33:26,399
at asteroids comments and other

877
00:33:34,230 --> 00:33:29,919
planetary bodies you know as a threat of

878
00:33:36,549 --> 00:33:34,240
a potential impact and what that meant

879
00:33:39,350 --> 00:33:36,559
and so

880
00:33:41,590 --> 00:33:39,360
what those early events many of them

881
00:33:44,310 --> 00:33:41,600
came as a result of probably came as a

882
00:33:46,789 --> 00:33:44,320
result of an early impact event um in

883
00:33:48,789 --> 00:33:46,799
the 20th century the 1908 tunguska

884
00:33:50,310 --> 00:33:48,799
impact in siberia there are literally

885
00:33:51,990 --> 00:33:50,320
hundreds of works both fiction and

886
00:33:54,950 --> 00:33:52,000
non-fiction exploring exactly what

887
00:33:57,190 --> 00:33:54,960
happened there and even as far back as

888
00:33:59,350 --> 00:33:57,200

excuse me as recently as 2010 in the

889
00:34:02,470 --> 00:33:59,360
national research council report

890
00:34:04,630 --> 00:34:02,480
on on asteroids and new earth objects

891
00:34:07,029 --> 00:34:04,640
more recent research of what it is that

892
00:34:08,710 --> 00:34:07,039
happened that day was actually come come

893
00:34:11,589 --> 00:34:08,720
to come to bear

894
00:34:15,430 --> 00:34:11,599
um other important events that kind of

895
00:34:17,750 --> 00:34:15,440
help drive these narratives um include

896
00:34:20,230 --> 00:34:17,760
the 1980 alvarez hypothesis that for the

897
00:34:22,230 --> 00:34:20,240
first time links to cataclysmic events

898
00:34:25,669 --> 00:34:22,240
that led to extinction of the dinosaurs

899
00:34:28,389 --> 00:34:25,679
with an asteroid impact and as as

900
00:34:30,550 --> 00:34:28,399
haiti mentioned the 1994 shoemaker-levy

901
00:34:32,470 --> 00:34:30,560
9 impact that again captured the

902
00:34:35,669 --> 00:34:32,480
attention of the world and so as a

903
00:34:38,869 --> 00:34:35,679
result particularly in the 90s we see so

904
00:34:41,030 --> 00:34:38,879
many so many of these examples over 25

905
00:34:43,909 --> 00:34:41,040
in our survey alone

906
00:34:46,069 --> 00:34:43,919
also during that time planetary research

907
00:34:47,510 --> 00:34:46,079
had a role to play because

908
00:34:49,589 --> 00:34:47,520
the research that

909
00:34:51,270 --> 00:34:49,599
from from several of the spacecraft that

910
00:34:52,790 --> 00:34:51,280
we had sent out were just confirming the

911
00:34:54,550 --> 00:34:52,800
role that impacts have had in

912
00:34:57,030 --> 00:34:54,560
transforming not just the face but also

913
00:34:58,230 --> 00:34:57,040

the composition of other planets and

914
00:35:00,470 --> 00:34:58,240
also that

915
00:35:03,270 --> 00:35:00,480
um it became clear that our own planet

916
00:35:05,190 --> 00:35:03,280
had had impacts before and that those

917
00:35:08,390 --> 00:35:05,200
things were not just a thing of the past

918
00:35:10,710 --> 00:35:08,400
that they could continue happening

919
00:35:11,829 --> 00:35:10,720
they continued these examples continued

920
00:35:14,069 --> 00:35:11,839
i think

921
00:35:16,230 --> 00:35:14,079
events such as the debate over the

922
00:35:19,990 --> 00:35:16,240
non-negligible possibility of impact of

923
00:35:21,670 --> 00:35:20,000
asteroids such as apophis or ag5 helped

924
00:35:24,470 --> 00:35:21,680
feed the sustaining narrative there's

925
00:35:26,150 --> 00:35:24,480
also the misinterpretation of the mayan

926
00:35:28,950 --> 00:35:26,160
prophecy that the world was going to end

927
00:35:31,910 --> 00:35:28,960
in 2012. that prompted more examples

928
00:35:34,630 --> 00:35:31,920
even this year in 2012.

929
00:35:35,910 --> 00:35:34,640
and so this survey and some of the

930
00:35:38,310 --> 00:35:35,920
examples that i've

931
00:35:39,670 --> 00:35:38,320
selected here are not exhaustive i'm

932
00:35:41,829 --> 00:35:39,680
sure that if we keep looking we will

933
00:35:43,910 --> 00:35:41,839
find more examples in maybe in other

934
00:35:45,349 --> 00:35:43,920
languages and other countries but just

935
00:35:48,230 --> 00:35:45,359
to show that

936
00:35:49,990 --> 00:35:48,240
this was not born with armageddon and

937
00:35:52,150 --> 00:35:50,000
deep impact which are the examples that

938
00:35:54,630 --> 00:35:52,160

very easily come to mind

939
00:35:56,390 --> 00:35:54,640
but in fact this narrative that has been

940
00:35:58,950 --> 00:35:56,400
very present throughout history and that

941
00:36:02,390 --> 00:35:58,960
was just strengthened by this events

942
00:36:05,430 --> 00:36:02,400
that captured the attention of the world

943
00:36:07,910 --> 00:36:05,440
and so um science fiction studies

944
00:36:09,750 --> 00:36:07,920
research will suggest to us that if we

945
00:36:11,589 --> 00:36:09,760
see a sustaining narrative it should

946
00:36:13,510 --> 00:36:11,599
tell us something about

947
00:36:15,750 --> 00:36:13,520
real deep-rooted perceptions in the

948
00:36:17,990 --> 00:36:15,760
public and so if we look at all these

949
00:36:20,150 --> 00:36:18,000
examples we have to ask ourselves well

950
00:36:21,829 --> 00:36:20,160
um are people really concerned about

951
00:36:24,470 --> 00:36:21,839
asteroid impacts

952
00:36:26,390 --> 00:36:24,480
and the fact is they're not at least um

953
00:36:27,990 --> 00:36:26,400
at least with little research exists on

954
00:36:30,150 --> 00:36:28,000
the subject that has asked this very

955
00:36:32,950 --> 00:36:30,160
question um the first one that may be

956
00:36:35,270 --> 00:36:32,960
the first one of its kind in 1993 slovak

957
00:36:37,670 --> 00:36:35,280
and peterson made a survey of 200 grad

958
00:36:39,510 --> 00:36:37,680
students and they asked them to rank

959
00:36:42,870 --> 00:36:39,520
their risks

960
00:36:46,150 --> 00:36:42,880
in terms of concern and impact risks

961
00:36:48,710 --> 00:36:46,160
ranked 24 and we're just it excuse me 14

962
00:36:49,750 --> 00:36:48,720
out of 24 and were described as distant

963
00:36:52,150 --> 00:36:49,760

in time

964
00:36:54,069 --> 00:36:52,160
and non-immediate and that result

965
00:36:57,349 --> 00:36:54,079
continued

966
00:37:00,630 --> 00:36:57,359
even in a survey that was performed at a

967
00:37:02,870 --> 00:37:00,640
pew research center in 1999 and again in

968
00:37:05,030 --> 00:37:02,880
2012 with almost identical results the

969
00:37:06,870 --> 00:37:05,040
majority of the people surveyed

970
00:37:09,670 --> 00:37:06,880
described it as something that will

971
00:37:10,870 --> 00:37:09,680
probably not happen or will definitely

972
00:37:14,150 --> 00:37:10,880
not happen

973
00:37:15,990 --> 00:37:14,160
and so you know we have to ask ourselves

974
00:37:17,349 --> 00:37:16,000
where why is that contradiction there

975
00:37:19,349 --> 00:37:17,359
you know if if

976
00:37:23,030 --> 00:37:19,359
why does that narrative keep occurring

977
00:37:25,349 --> 00:37:23,040
if we if it finds an indifferent public

978
00:37:27,349 --> 00:37:25,359
and so for that i think

979
00:37:29,030 --> 00:37:27,359
that we have to see

980
00:37:31,829 --> 00:37:29,040
we have to look at what kind of threat

981
00:37:34,470 --> 00:37:31,839
we're talking about and first we have to

982
00:37:36,230 --> 00:37:34,480
consider the uniqueness of the threat

983
00:37:38,870 --> 00:37:36,240
if we look again at paul slovak's

984
00:37:41,190 --> 00:37:38,880
research on risk assessment and they've

985
00:37:45,190 --> 00:37:41,200
developed a matrix where

986
00:37:47,349 --> 00:37:45,200
there's a couple of variables including

987
00:37:48,630 --> 00:37:47,359
dread risk and unknown risk that help

988
00:37:49,670 --> 00:37:48,640

rank

989
00:37:53,109 --> 00:37:49,680
risk

990
00:37:56,310 --> 00:37:53,119
towards specific issues

991
00:37:58,950 --> 00:37:56,320
and we see that asteroid impacts would

992
00:38:01,109 --> 00:37:58,960
be described very highly by all of these

993
00:38:03,750 --> 00:38:01,119
characteristics you know uncontrollable

994
00:38:05,670 --> 00:38:03,760
indiscriminate catastrophic consequences

995
00:38:06,710 --> 00:38:05,680
unknown to science

996
00:38:09,030 --> 00:38:06,720
and

997
00:38:11,190 --> 00:38:09,040
that is how it is continually presented

998
00:38:13,430 --> 00:38:11,200
the dominant narrative it is captured as

999
00:38:15,829 --> 00:38:13,440
very risky and catastrophic and as

1000
00:38:17,190 --> 00:38:15,839
slovak accurately describes it has a

1001
00:38:20,310 --> 00:38:17,200
unique combination of very low

1002
00:38:21,750 --> 00:38:20,320
probability and very great consequence

1003
00:38:23,190 --> 00:38:21,760
in addition

1004
00:38:25,270 --> 00:38:23,200
the threat is also the more compelling

1005
00:38:27,510 --> 00:38:25,280
because it is always presented as urgent

1006
00:38:30,230 --> 00:38:27,520
even though we've been surveying

1007
00:38:32,550 --> 00:38:30,240
asteroids for many decades it always is

1008
00:38:34,150 --> 00:38:32,560
just hiding behind the moon or

1009
00:38:35,829 --> 00:38:34,160
you know it's it's

1010
00:38:37,109 --> 00:38:35,839
you know we can't see it we only find

1011
00:38:40,230 --> 00:38:37,119
out about it

1012
00:38:42,870 --> 00:38:40,240
months or weeks or hours before it's um

1013
00:38:45,109 --> 00:38:42,880

supposed to impact the planet

1014
00:38:47,670 --> 00:38:45,119
another element that's interesting is

1015
00:38:49,750 --> 00:38:47,680
the tools that we use to tell that story

1016
00:38:51,589 --> 00:38:49,760
the tools of the trade and so

1017
00:38:54,230 --> 00:38:51,599
i think that

1018
00:38:55,990 --> 00:38:54,240
this this threat is particularly

1019
00:38:57,750 --> 00:38:56,000
visually appealing

1020
00:39:02,870 --> 00:38:57,760
and

1021
00:39:04,790 --> 00:39:02,880
in special effects than the cgi

1022
00:39:06,870 --> 00:39:04,800
what was in the 90s something that was

1023
00:39:09,510 --> 00:39:06,880
very surprising that we could we were

1024
00:39:11,349 --> 00:39:09,520
very impressed as an audience that movie

1025
00:39:14,550 --> 00:39:11,359
movie makers could do became an

1026
00:39:17,349 --> 00:39:14,560
expectation in the in the in the 2000s

1027
00:39:20,710 --> 00:39:17,359
and afterwards and so at now at this

1028
00:39:21,670 --> 00:39:20,720
point with relatively little cost you

1029
00:39:23,670 --> 00:39:21,680
can make

1030
00:39:26,710 --> 00:39:23,680
pretty impressive imaginary of the

1031
00:39:29,829 --> 00:39:26,720
asteroid um you know the track and the

1032
00:39:31,349 --> 00:39:29,839
moment of impact and interestingly um

1033
00:39:33,910 --> 00:39:31,359
you can keep going with that because

1034
00:39:35,910 --> 00:39:33,920
what happens after if the impact happens

1035
00:39:38,790 --> 00:39:35,920
i think the asteroid threat presents a

1036
00:39:40,550 --> 00:39:38,800
lot of opportunities for um developers

1037
00:39:42,630 --> 00:39:40,560
particularly in film

1038
00:39:45,270 --> 00:39:42,640

to showcase advanced special effects

1039
00:39:47,670 --> 00:39:45,280
that are not presented by other natural

1040
00:39:49,589 --> 00:39:47,680
disasters such as earthquakes or um

1041
00:39:51,910 --> 00:39:49,599
hurricanes

1042
00:39:54,069 --> 00:39:51,920
um and and and that's this worth a

1043
00:39:56,550 --> 00:39:54,079
mention you know even in

1044
00:39:58,950 --> 00:39:56,560
non-fiction works like um

1045
00:40:00,150 --> 00:39:58,960
documentaries like this one titled mega

1046
00:40:01,750 --> 00:40:00,160
disasters

1047
00:40:03,270 --> 00:40:01,760
um asteroids are not the only thing

1048
00:40:04,790 --> 00:40:03,280
that's discussed in that in that

1049
00:40:07,270 --> 00:40:04,800
documentary but they still made the

1050
00:40:09,349 --> 00:40:07,280
cover and so even in box you have that

1051
00:40:10,790 --> 00:40:09,359
maybe the asteroid impact happens in

1052
00:40:12,150 --> 00:40:10,800
five pages but

1053
00:40:14,710 --> 00:40:12,160
you know it's compelling enough that you

1054
00:40:16,309 --> 00:40:14,720
will put it on the on the cover

1055
00:40:17,750 --> 00:40:16,319
and then the third element is i think

1056
00:40:19,589 --> 00:40:17,760
the reason why we're here today is to

1057
00:40:22,470 --> 00:40:19,599
draw space the fact that the threat

1058
00:40:24,790 --> 00:40:22,480
comes from space is very powerful

1059
00:40:26,309 --> 00:40:24,800
as mccarty notes in his

1060
00:40:29,030 --> 00:40:26,319
books based on the america and the

1061
00:40:31,270 --> 00:40:29,040
american imagination he talks about how

1062
00:40:33,910 --> 00:40:31,280
space um became entrenched to the

1063
00:40:36,230 --> 00:40:33,920

american imagination particularly after

1064
00:40:38,069 --> 00:40:36,240
the second world war and so the idea

1065
00:40:40,069 --> 00:40:38,079
that both threats and salvation would

1066
00:40:42,069 --> 00:40:40,079
come from space was very compelling and

1067
00:40:43,670 --> 00:40:42,079
i think that that has continued since

1068
00:40:45,670 --> 00:40:43,680
then i think

1069
00:40:47,589 --> 00:40:45,680
you know all these elements together

1070
00:40:50,829 --> 00:40:47,599
make for a very

1071
00:40:54,550 --> 00:40:50,839
compelling if unbelievable

1072
00:40:56,390 --> 00:40:54,560
threat um and so again with

1073
00:40:57,990 --> 00:40:56,400
we see you know taking this slide and

1074
00:40:59,910 --> 00:40:58,000
the previous site together we see its

1075
00:41:01,430 --> 00:40:59,920
narrative that has continued but all

1076
00:41:02,870 --> 00:41:01,440
these elements together and particularly

1077
00:41:04,309 --> 00:41:02,880
the tools of the trade

1078
00:41:06,069 --> 00:41:04,319
and the opportunity to make this

1079
00:41:07,670 --> 00:41:06,079
narrative even more entertaining even

1080
00:41:11,109 --> 00:41:07,680
more

1081
00:41:13,190 --> 00:41:11,119
amazing visually just has this feedback

1082
00:41:16,150 --> 00:41:13,200
loop continuing and so you know there's

1083
00:41:18,550 --> 00:41:16,160
almost no end we will probably continue

1084
00:41:20,870 --> 00:41:18,560
seeing even more examples about it

1085
00:41:23,430 --> 00:41:20,880
so we have that explained we we kind of

1086
00:41:25,430 --> 00:41:23,440
understand now why we keep seeing it but

1087
00:41:27,270 --> 00:41:25,440
we still understand why people are not

1088
00:41:28,470 --> 00:41:27,280

concerned about it when they think about

1089
00:41:30,390 --> 00:41:28,480
the issue

1090
00:41:32,550 --> 00:41:30,400
and so for that i think

1091
00:41:34,630 --> 00:41:32,560
we have to look at how the story is

1092
00:41:36,790 --> 00:41:34,640
represented as depicted

1093
00:41:40,230 --> 00:41:36,800
and

1094
00:41:42,710 --> 00:41:40,240
why is this giggle factor that the

1095
00:41:45,270 --> 00:41:42,720
scientists would usually be moan still

1096
00:41:46,790 --> 00:41:45,280
alive well you know houston we have a

1097
00:41:48,230 --> 00:41:46,800
problem cliches like that are

1098
00:41:50,309 --> 00:41:48,240
particularly common in this kind of

1099
00:41:52,069 --> 00:41:50,319
movie with few exceptions asteroid

1100
00:41:54,150 --> 00:41:52,079
impact narratives make for decidedly

1101
00:41:56,309 --> 00:41:54,160
unsuccessful movies often only made

1102
00:41:58,390 --> 00:41:56,319
watchable by the special effects used to

1103
00:42:00,230 --> 00:41:58,400
image the asteroid and its path of

1104
00:42:01,670 --> 00:42:00,240
destruction there's

1105
00:42:03,829 --> 00:42:01,680
narrative gaps through incorrect

1106
00:42:05,750 --> 00:42:03,839
scientific and technological assumptions

1107
00:42:08,870 --> 00:42:05,760
predictable storylines you can keep

1108
00:42:10,390 --> 00:42:08,880
going and so these are some of these

1109
00:42:12,550 --> 00:42:10,400
one of them is for example incorrect

1110
00:42:14,470 --> 00:42:12,560
science and technology and i'm sure when

1111
00:42:16,150 --> 00:42:14,480
you're in the audience as well you start

1112
00:42:18,390 --> 00:42:16,160
naming all of these using the space

1113
00:42:20,390 --> 00:42:18,400

shuttle to go to the asteroid and you

1114
00:42:21,270 --> 00:42:20,400
know deploy the nuclear weapons

1115
00:42:23,270 --> 00:42:21,280
um

1116
00:42:24,950 --> 00:42:23,280
another one that's interesting is this

1117
00:42:25,990 --> 00:42:24,960
inflated nasa role it's interesting to

1118
00:42:28,309 --> 00:42:26,000
me that

1119
00:42:29,910 --> 00:42:28,319
in the real world when we talk about the

1120
00:42:31,589 --> 00:42:29,920
possibility of an asteroid impact and

1121
00:42:33,829 --> 00:42:31,599
what do we do there's all these

1122
00:42:35,030 --> 00:42:33,839
discussions about you know it's a dod is

1123
00:42:36,710 --> 00:42:35,040
it um

1124
00:42:38,309 --> 00:42:36,720
department of energy is it nasus that

1125
00:42:39,589 --> 00:42:38,319
all that together what happens with

1126
00:42:41,990 --> 00:42:39,599
other countries you know do we want to

1127
00:42:44,550 --> 00:42:42,000
cooperate with them if we want to solve

1128
00:42:46,470 --> 00:42:44,560
this issue none of that none of that is

1129
00:42:48,150 --> 00:42:46,480
in the main area you know nasa is

1130
00:42:50,470 --> 00:42:48,160
automatically the source of the

1131
00:42:54,150 --> 00:42:50,480
solutions and they have this amazing

1132
00:42:58,309 --> 00:42:56,230
so you know it's fiction but um

1133
00:42:59,589 --> 00:42:58,319
so a third element that again is also

1134
00:43:01,589 --> 00:42:59,599
very interesting is this focus on

1135
00:43:02,710 --> 00:43:01,599
science limitations you know again

1136
00:43:05,030 --> 00:43:02,720
despite the fact that we've been

1137
00:43:07,349 --> 00:43:05,040
surveying asteroids for decades um the

1138
00:43:09,349 --> 00:43:07,359

asteroid is always a surprise in deep

1139
00:43:11,030 --> 00:43:09,359
impact for example the asteroid is found

1140
00:43:13,109 --> 00:43:11,040
out by a 12 year

1141
00:43:15,829 --> 00:43:13,119
12 year old with a not impressive

1142
00:43:18,230 --> 00:43:15,839
telescope not by a ground observatory

1143
00:43:21,670 --> 00:43:18,240
not by an academic institution not by

1144
00:43:24,150 --> 00:43:21,680
nasa it's by a kid with a telescope

1145
00:43:25,990 --> 00:43:24,160
so um and then you see that also as well

1146
00:43:27,349 --> 00:43:26,000
with the kind of fumbling with how what

1147
00:43:28,790 --> 00:43:27,359
do you do about it do you even know

1148
00:43:30,790 --> 00:43:28,800
what's going on

1149
00:43:33,910 --> 00:43:30,800
um and then finally and i think this is

1150
00:43:36,550 --> 00:43:33,920
a very important point too is that

1151
00:43:39,190 --> 00:43:36,560
asteroids are not the focal point of the

1152
00:43:41,990 --> 00:43:39,200
of the story um they are the cover to

1153
00:43:43,670 --> 00:43:42,000
discuss a lot of other issues namely um

1154
00:43:45,589 --> 00:43:43,680
american values the true nature of

1155
00:43:47,030 --> 00:43:45,599
things you know when when crisis comes

1156
00:43:49,829 --> 00:43:47,040
you see the true nature of people that

1157
00:43:53,109 --> 00:43:49,839
kind of thing and so i think as a result

1158
00:43:55,829 --> 00:43:53,119
um there is no requirement from either

1159
00:43:57,190 --> 00:43:55,839
the movie makers or from us the audience

1160
00:43:58,710 --> 00:43:57,200
to have an accurate depiction of

1161
00:44:01,430 --> 00:43:58,720
asteroids because the movies are not

1162
00:44:03,190 --> 00:44:01,440
about that and so when you think of

1163
00:44:05,109 --> 00:44:03,200

again armageddon you think about that

1164
00:44:07,030 --> 00:44:05,119
scene that has been recreated in

1165
00:44:10,710 --> 00:44:07,040
countless movies you don't think about

1166
00:44:12,230 --> 00:44:10,720
the asteroid as the main main character

1167
00:44:14,870 --> 00:44:12,240
in that movie

1168
00:44:16,309 --> 00:44:14,880
and so what comes to mind for us in the

1169
00:44:18,390 --> 00:44:16,319
audience is not a film about a threat

1170
00:44:19,510 --> 00:44:18,400
that should concern us but one where

1171
00:44:21,190 --> 00:44:19,520
individual characters and their

1172
00:44:22,870 --> 00:44:21,200
successes and failures and a lively

1173
00:44:25,030 --> 00:44:22,880
scene or two of destruction

1174
00:44:27,270 --> 00:44:25,040
are the focal point again believable

1175
00:44:29,589 --> 00:44:27,280
enough to keep us entertained but not to

1176
00:44:32,069 --> 00:44:29,599
wake us up at night

1177
00:44:34,390 --> 00:44:32,079
now in contrast to that we have our

1178
00:44:35,349 --> 00:44:34,400
scientific understanding of of the

1179
00:44:37,190 --> 00:44:35,359
thread

1180
00:44:38,710 --> 00:44:37,200
and while the public is entertained but

1181
00:44:40,230 --> 00:44:38,720
i'm concerned the scientific community

1182
00:44:42,309 --> 00:44:40,240
has been preoccupied with it with the

1183
00:44:45,510 --> 00:44:42,319
issue for at least three decades and

1184
00:44:48,309 --> 00:44:45,520
i'll go very briefly through this but um

1185
00:44:50,230 --> 00:44:48,319
this idea that imparts constitute a

1186
00:44:51,910 --> 00:44:50,240
contemporary hazard did not emerge until

1187
00:44:53,990 --> 00:44:51,920
the end of the 20th century so we're not

1188
00:44:55,109 --> 00:44:54,000

looking at a very long history

1189
00:44:56,550 --> 00:44:55,119
but um

1190
00:44:58,630 --> 00:44:56,560
and it was as chapman and morrison

1191
00:45:00,630 --> 00:44:58,640
described even deemed a curiosity before

1192
00:45:03,589 --> 00:45:00,640
this but again these catalysts you know

1193
00:45:06,470 --> 00:45:03,599
the 1980 hypothesis 1994 shoemaker levy

1194
00:45:08,790 --> 00:45:06,480
planetary research it um motivated a

1195
00:45:11,829 --> 00:45:08,800
more urgent appeal to look at this issue

1196
00:45:14,550 --> 00:45:11,839
so in 1990 in 1981 nasa sponsored the

1197
00:45:16,790 --> 00:45:14,560
space watch workshop um in the 90s we

1198
00:45:20,390 --> 00:45:16,800
have the spaceguard survey which was the

1199
00:45:23,510 --> 00:45:20,400
first um comprehensive survey of um

1200
00:45:24,790 --> 00:45:23,520
asteroids over larger than one kilometer

1201
00:45:26,950 --> 00:45:24,800
in diameter

1202
00:45:28,550 --> 00:45:26,960
and and that kind of snowballed and you

1203
00:45:31,270 --> 00:45:28,560
know the the government the us

1204
00:45:33,430 --> 00:45:31,280
government in particular has taken

1205
00:45:35,510 --> 00:45:33,440
consistent steps to understand the issue

1206
00:45:37,670 --> 00:45:35,520
more and there's about four million

1207
00:45:39,430 --> 00:45:37,680
dollars in in funding that go to this

1208
00:45:41,510 --> 00:45:39,440
issue annually

1209
00:45:43,270 --> 00:45:41,520
now as a result of all of this uh

1210
00:45:45,510 --> 00:45:43,280
scientific understanding of the issue

1211
00:45:48,069 --> 00:45:45,520
has advanced greatly so much in fact

1212
00:45:49,670 --> 00:45:48,079
that as morrison says astronomers have

1213
00:45:51,510 --> 00:45:49,680

already assured us that we are not due

1214
00:45:53,829 --> 00:45:51,520
for an extinction level impact from an

1215
00:45:55,750 --> 00:45:53,839
asteroid within the next century

1216
00:45:57,750 --> 00:45:55,760
bearing an unlikely strike by a large

1217
00:46:01,829 --> 00:45:57,760
comet we are not about to go the way of

1218
00:46:02,950 --> 00:46:01,839
the dinosaurs so you can breathe easy

1219
00:46:03,750 --> 00:46:02,960
um

1220
00:46:05,270 --> 00:46:03,760
but

1221
00:46:06,710 --> 00:46:05,280
that is in sharp contrast with the

1222
00:46:09,510 --> 00:46:06,720
dominant narrative you know were you to

1223
00:46:12,309 --> 00:46:09,520
watch the movies only by themselves you

1224
00:46:14,950 --> 00:46:12,319
would think that you know this is

1225
00:46:17,190 --> 00:46:14,960
likely going to happen and so um you

1226
00:46:19,750 --> 00:46:17,200
know as as morrison says asteroids do

1227
00:46:22,390 --> 00:46:19,760
not accepting hollywood change orbits

1228
00:46:23,829 --> 00:46:22,400
capriciously and that's because

1229
00:46:25,510 --> 00:46:23,839
this this narrative that we've just

1230
00:46:27,270 --> 00:46:25,520
talked a little bit about

1231
00:46:28,630 --> 00:46:27,280
ignores this at this element of

1232
00:46:30,550 --> 00:46:28,640
predictability

1233
00:46:31,349 --> 00:46:30,560
you know in in science we understand

1234
00:46:33,430 --> 00:46:31,359
that

1235
00:46:35,030 --> 00:46:33,440
chances are we understand enough of the

1236
00:46:36,309 --> 00:46:35,040
orbits of the larger

1237
00:46:38,470 --> 00:46:36,319
asteroids that we don't need to be

1238
00:46:40,309 --> 00:46:38,480

concerned about those about those in

1239
00:46:42,390 --> 00:46:40,319
fact we are now concerned about the

1240
00:46:44,230 --> 00:46:42,400
sub-kilometer items

1241
00:46:46,390 --> 00:46:44,240
not the larger ones

1242
00:46:49,270 --> 00:46:46,400
but then that element of predictability

1243
00:46:50,390 --> 00:46:49,280
and that nuance of how different sizes

1244
00:46:53,430 --> 00:46:50,400
of items could have different

1245
00:46:55,030 --> 00:46:53,440
consequences completely lost in film and

1246
00:46:58,470 --> 00:46:55,040
particularly in film

1247
00:47:00,710 --> 00:46:58,480
but in general in fiction

1248
00:47:02,550 --> 00:47:00,720
another element that's that's that's

1249
00:47:05,109 --> 00:47:02,560
lost is this this

1250
00:47:07,190 --> 00:47:05,119
tied to the idea that we put aside the

1251
00:47:10,870 --> 00:47:07,200
major threat and there's no sense of

1252
00:47:11,990 --> 00:47:10,880
panic if you read for example the nrc

1253
00:47:13,670 --> 00:47:12,000
report

1254
00:47:15,670 --> 00:47:13,680
it it says and i quote and it's right

1255
00:47:17,190 --> 00:47:15,680
there the time required to mitigate

1256
00:47:19,190 --> 00:47:17,200
optimally is in a range of years to

1257
00:47:21,270 --> 00:47:19,200
decades but this long period may require

1258
00:47:23,829 --> 00:47:21,280
acting before it is known with certainty

1259
00:47:25,829 --> 00:47:23,839
that an neo will impact earth and so the

1260
00:47:29,030 --> 00:47:25,839
arguments are for funding the sub

1261
00:47:30,950 --> 00:47:29,040
kilometers survey called for in 2005 and

1262
00:47:32,870 --> 00:47:30,960
for exploring new technologies to

1263
00:47:34,549 --> 00:47:32,880

identify smaller objects and they are

1264
00:47:36,390 --> 00:47:34,559
rooted in the desire to continue to

1265
00:47:38,069 --> 00:47:36,400
dispel the threat and give us decades or

1266
00:47:39,349 --> 00:47:38,079
centuries to get ready for an

1267
00:47:41,670 --> 00:47:39,359
eventuality

1268
00:47:43,589 --> 00:47:41,680
but as you can see it's a very different

1269
00:47:45,750 --> 00:47:43,599
scenario from what is the main focal

1270
00:47:48,069 --> 00:47:45,760
point of the dominant narrative

1271
00:47:50,390 --> 00:47:48,079
so this mismatch exists between public

1272
00:47:52,790 --> 00:47:50,400
and scientific perception of the issue

1273
00:47:54,309 --> 00:47:52,800
and it helps explain why despite the

1274
00:47:56,150 --> 00:47:54,319
concerted efforts of prominent

1275
00:47:58,069 --> 00:47:56,160
scientists to foster public concern and

1276
00:48:00,150 --> 00:47:58,079
understanding of the issue the public is

1277
00:48:01,510 --> 00:48:00,160
not an active player in lobbying for

1278
00:48:03,910 --> 00:48:01,520
what could be construed as the biggest

1279
00:48:06,390 --> 00:48:03,920
threat the world could ever face

1280
00:48:08,150 --> 00:48:06,400
and there are many many reasons to help

1281
00:48:10,150 --> 00:48:08,160
explain this

1282
00:48:12,150 --> 00:48:10,160
which i won't go into today

1283
00:48:13,670 --> 00:48:12,160
but i think that the link to education

1284
00:48:14,790 --> 00:48:13,680
is interesting and this is what i want

1285
00:48:15,670 --> 00:48:14,800
to leave you with

1286
00:48:17,030 --> 00:48:15,680
um

1287
00:48:19,190 --> 00:48:17,040
because

1288
00:48:21,030 --> 00:48:19,200

many many of the authors say that well

1289
00:48:22,710 --> 00:48:21,040
if we want the public on our side we

1290
00:48:24,549 --> 00:48:22,720
have to design a very aggressive

1291
00:48:26,950 --> 00:48:24,559
educational campaign where they can

1292
00:48:28,549 --> 00:48:26,960
understand the issue and

1293
00:48:32,069 --> 00:48:28,559
chances are that they are just not as

1294
00:48:33,349 --> 00:48:32,079
aware of impacts and impact threats

1295
00:48:35,750 --> 00:48:33,359
as we are

1296
00:48:38,630 --> 00:48:35,760
but i would argue that that situation is

1297
00:48:41,270 --> 00:48:38,640
no longer true um

1298
00:48:43,190 --> 00:48:41,280
you know if you did not watch that great

1299
00:48:45,430 --> 00:48:43,200
science documentary on asteroids you

1300
00:48:47,990 --> 00:48:45,440
probably sat through armageddon and deep

1301
00:48:49,349 --> 00:48:48,000
impact and seeking a friend for the end

1302
00:48:50,150 --> 00:48:49,359
of the world or

1303
00:48:52,230 --> 00:48:50,160
so

1304
00:48:55,109 --> 00:48:52,240
you know culturally we are aware of the

1305
00:48:57,270 --> 00:48:55,119
threat so i think the idea that um the

1306
00:48:59,589 --> 00:48:57,280
public just doesn't know about it no

1307
00:49:02,710 --> 00:48:59,599
longer applies i think there are other

1308
00:49:04,870 --> 00:49:02,720
reasons that help explain why the public

1309
00:49:06,150 --> 00:49:04,880
is not as concerned

1310
00:49:07,750 --> 00:49:06,160
and so i think that's one of the

1311
00:49:09,510 --> 00:49:07,760
assumptions that needs to be questioned

1312
00:49:11,349 --> 00:49:09,520
the other one is

1313
00:49:14,390 --> 00:49:11,359

this idea that improved education would

1314
00:49:17,510 --> 00:49:14,400
lead to greater policy relevance

1315
00:49:18,790 --> 00:49:17,520
and that hollywood and these films and

1316
00:49:20,630 --> 00:49:18,800
these stories

1317
00:49:23,270 --> 00:49:20,640
have a role to play in advancing that

1318
00:49:25,589 --> 00:49:23,280
education um hartwell says scientists

1319
00:49:27,349 --> 00:49:25,599
are a great debt of gratitude to the

1320
00:49:29,270 --> 00:49:27,359
hollywood blockbuster and that's

1321
00:49:31,510 --> 00:49:29,280
something that i would question i think

1322
00:49:33,670 --> 00:49:31,520
that

1323
00:49:35,910 --> 00:49:33,680
what we may be what we may have seen is

1324
00:49:37,910 --> 00:49:35,920
that these depictions only demonstrate

1325
00:49:39,990 --> 00:49:37,920
the perpetuation of a specific view of

1326
00:49:42,069 --> 00:49:40,000
the asteroid threat that is removed from

1327
00:49:44,470 --> 00:49:42,079
a current scientific understanding of

1328
00:49:47,190 --> 00:49:44,480
the issue and therefore it's real risk

1329
00:49:49,190 --> 00:49:47,200
and so um i would leave you with just

1330
00:49:51,270 --> 00:49:49,200
thinking that more research and public

1331
00:49:53,510 --> 00:49:51,280
attitudes will probably be very helpful

1332
00:49:55,670 --> 00:49:53,520
and also considering the lessons from

1333
00:49:57,190 --> 00:49:55,680
field such as risk assessment

1334
00:49:58,390 --> 00:49:57,200
to understand

1335
00:49:59,829 --> 00:49:58,400
and to inform

1336
00:50:06,309 --> 00:49:59,839
educational

1337
00:50:07,670 --> 00:50:06,319
having a real public policy impact

1338
00:50:09,349 --> 00:50:07,680

so with that i thank you very much for

1339
00:50:17,510 --> 00:50:09,359
your attention and i look forward to

1340
00:50:21,910 --> 00:50:20,150
i realized that i forgot to read the bio

1341
00:50:23,030 --> 00:50:21,920
but i want to make sure that you know no

1342
00:50:24,630 --> 00:50:23,040
it's not long so i'm going to read it

1343
00:50:27,270 --> 00:50:24,640
right now so that you all know who laura

1344
00:50:29,750 --> 00:50:27,280
is um she is the uh she is the earth

1345
00:50:31,990 --> 00:50:29,760
observations associate at the institute

1346
00:50:33,510 --> 00:50:32,000
for global environmental strategies and

1347
00:50:35,349 --> 00:50:33,520
she's also a correspondent for

1348
00:50:37,829 --> 00:50:35,359
spacepolicyonline.com

1349
00:50:39,670 --> 00:50:37,839
and a recent graduate like almost

1350
00:50:41,510 --> 00:50:39,680
everyone in the room it seems of george

1351
00:50:43,270 --> 00:50:41,520
washington university space policy

1352
00:50:46,390 --> 00:50:43,280
institute

1353
00:50:47,990 --> 00:50:46,400
questions torns just a comment is a very

1354
00:50:50,309 --> 00:50:48,000
interesting study i

1355
00:50:52,950 --> 00:50:50,319
appreciated it i used to talk about the

1356
00:50:54,710 --> 00:50:52,960
public perception problem with gene

1357
00:50:56,870 --> 00:50:54,720
shoemaker quite a bit

1358
00:50:59,030 --> 00:50:56,880
and

1359
00:51:00,950 --> 00:50:59,040
one take on this obviously is that

1360
00:51:03,670 --> 00:51:00,960
humans have a hard time relating to

1361
00:51:05,750 --> 00:51:03,680
threats that happen very infrequently on

1362
00:51:07,349 --> 00:51:05,760
the time scale of the human lifetime

1363
00:51:09,430 --> 00:51:07,359

that's something everybody deals with

1364
00:51:11,910 --> 00:51:09,440
this is and it's interesting just as a

1365
00:51:15,430 --> 00:51:11,920
comment to consider a a thought

1366
00:51:17,750 --> 00:51:15,440
experiment that in 1906 the san andreas

1367
00:51:20,470 --> 00:51:17,760
decided to break down in koalinga

1368
00:51:22,390 --> 00:51:20,480
instead of san francisco and the object

1369
00:51:23,670 --> 00:51:22,400
that hit tunguska was on a slightly

1370
00:51:25,750 --> 00:51:23,680
different trajectory and took out

1371
00:51:27,990 --> 00:51:25,760
downtown moscow we might have a

1372
00:51:30,710 --> 00:51:28,000
different public perception

1373
00:51:32,069 --> 00:51:30,720
yes i agree um and and that's something

1374
00:51:34,470 --> 00:51:32,079
that you find a lot in the research your

1375
00:51:35,910 --> 00:51:34,480
first comment about how you know and you

1376
00:51:37,750 --> 00:51:35,920
see it you know there's a big spike in

1377
00:51:39,990 --> 00:51:37,760
interest after a real event after an

1378
00:51:42,069 --> 00:51:40,000
impact after the discussion on the media

1379
00:51:44,309 --> 00:51:42,079
that an asteroid may hit the planet and

1380
00:51:46,870 --> 00:51:44,319
then it wanes and i wouldn't necessarily

1381
00:51:48,549 --> 00:51:46,880
think that that's um that's a bad thing

1382
00:51:50,150 --> 00:51:48,559
because that's that's in our nature i

1383
00:51:51,910 --> 00:51:50,160
mean the public response that way but

1384
00:51:53,349 --> 00:51:51,920
policymakers respond that way and i

1385
00:51:55,270 --> 00:51:53,359
think scientists respond that way too

1386
00:51:57,030 --> 00:51:55,280
because um you know we can be concerned

1387
00:51:58,630 --> 00:51:57,040
about every single threat all the time

1388
00:52:04,309 --> 00:51:58,640

and so it's just it's just one more

1389
00:52:10,069 --> 00:52:07,910
marsha freeman with the eir magazine

1390
00:52:12,630 --> 00:52:10,079
it doesn't help me sleep too much better

1391
00:52:14,309 --> 00:52:12,640
at night to know that scientists think

1392
00:52:16,790 --> 00:52:14,319
that it'll be a hundred years before

1393
00:52:20,549 --> 00:52:16,800
there's a big impact

1394
00:52:21,829 --> 00:52:20,559
i think we need to know a lot more than

1395
00:52:23,510 --> 00:52:21,839
we know

1396
00:52:25,430 --> 00:52:23,520
and that there's a very interesting

1397
00:52:28,470 --> 00:52:25,440
proposal i was wondering if you knew

1398
00:52:30,790 --> 00:52:28,480
about it or had any thoughts about it

1399
00:52:34,470 --> 00:52:30,800
that the russians have made over the

1400
00:52:37,270 --> 00:52:34,480
last year it's part of the larger

1401
00:52:38,950 --> 00:52:37,280
proposal it was actually by

1402
00:52:41,750 --> 00:52:38,960
general permanenoff who had been the

1403
00:52:44,829 --> 00:52:41,760
head of the russian space program

1404
00:52:47,990 --> 00:52:44,839
which is for a whole global

1405
00:52:49,829 --> 00:52:48,000
coordination between global threats to

1406
00:52:53,030 --> 00:52:49,839
earth it certainly includes something

1407
00:52:55,109 --> 00:52:53,040
coming in here from somewhere else but

1408
00:52:58,549 --> 00:52:55,119
even the kinds of things that have large

1409
00:53:00,870 --> 00:52:58,559
scale impacts in terms of tsunamis

1410
00:53:03,829 --> 00:53:00,880
extreme weather events which can affect

1411
00:53:05,190 --> 00:53:03,839
a lot of countries etc and then a sort

1412
00:53:07,670 --> 00:53:05,200
of more

1413
00:53:10,390 --> 00:53:07,680

confined proposal for what's been called

1414
00:53:12,390 --> 00:53:10,400
the strategic defense of earth

1415
00:53:14,630 --> 00:53:12,400
now there are a lot of individual

1416
00:53:17,510 --> 00:53:14,640
programs through the united nations you

1417
00:53:19,670 --> 00:53:17,520
mentioned the us programs but really to

1418
00:53:20,710 --> 00:53:19,680
bring this together and more of a global

1419
00:53:22,470 --> 00:53:20,720
effort and

1420
00:53:24,390 --> 00:53:22,480
to give it you know to take away a

1421
00:53:26,710 --> 00:53:24,400
little bit of the giggle factors you

1422
00:53:29,190 --> 00:53:26,720
mentioned you know and to say this is a

1423
00:53:32,150 --> 00:53:29,200
scientific project that concerns us all

1424
00:53:34,390 --> 00:53:32,160
globally and the world scientists are

1425
00:53:36,390 --> 00:53:34,400
working on it that's a great point i am

1426
00:53:38,309 --> 00:53:36,400
aware of it and i think that again that

1427
00:53:40,230 --> 00:53:38,319
shows a whole very interesting

1428
00:53:41,750 --> 00:53:40,240
discussion that is missing from the

1429
00:53:43,670 --> 00:53:41,760
dominant narrative i think you would

1430
00:53:46,309 --> 00:53:43,680
make a great film talking about how the

1431
00:53:47,670 --> 00:53:46,319
different countries um and the proposals

1432
00:53:49,829 --> 00:53:47,680
that they have and whether they'll be

1433
00:53:50,630 --> 00:53:49,839
successful or not um another point is

1434
00:53:57,990 --> 00:53:50,640
that

1435
00:53:59,190 --> 00:53:58,000
of suggest in my in my very fast

1436
00:54:01,910 --> 00:53:59,200
presentation

1437
00:54:03,990 --> 00:54:01,920
is that you know we understand that even

1438
00:54:06,710 --> 00:54:04,000

sub kilometer um

1439
00:54:07,990 --> 00:54:06,720
impact would would have damaged

1440
00:54:09,030 --> 00:54:08,000
particularly depending on where they

1441
00:54:10,710 --> 00:54:09,040
fall you know

1442
00:54:12,870 --> 00:54:10,720
if they fell in certain locations you

1443
00:54:15,430 --> 00:54:12,880
know in big cities they would have a

1444
00:54:17,349 --> 00:54:15,440
legitimate um and very an impact of a

1445
00:54:19,829 --> 00:54:17,359
lot of concern and so it's interesting

1446
00:54:22,069 --> 00:54:19,839
that that is missing from the popular

1447
00:54:23,510 --> 00:54:22,079
discussion because i think it is

1448
00:54:26,790 --> 00:54:23,520
something that the public would be

1449
00:54:30,549 --> 00:54:27,910
hey laura

1450
00:54:32,549 --> 00:54:30,559
so uh one of the slides had a dollar

1451
00:54:33,910 --> 00:54:32,559
figure of about four million dollars for

1452
00:54:35,510 --> 00:54:33,920
tracking

1453
00:54:39,910 --> 00:54:35,520
earth

1454
00:54:41,190 --> 00:54:39,920
which i noticed probably about two

1455
00:54:43,030 --> 00:54:41,200
percent of the budget of the movie

1456
00:54:45,270 --> 00:54:43,040
armageddon uh

1457
00:54:46,950 --> 00:54:45,280
but i noticed

1458
00:54:49,589 --> 00:54:46,960
you also had another slide that showed

1459
00:54:51,430 --> 00:54:49,599
uh statistics talking about the public

1460
00:54:53,430 --> 00:54:51,440
perception and saying that that you know

1461
00:54:54,950 --> 00:54:53,440
large percentages view this as a very

1462
00:54:57,190 --> 00:54:54,960
low uh

1463
00:55:00,549 --> 00:54:57,200

concern do you think that

1464
00:55:02,549 --> 00:55:00,559
the public uh opinion drives the policy

1465
00:55:04,870 --> 00:55:02,559
on that that drives the the low amount

1466
00:55:06,390 --> 00:55:04,880
of funding do you think that perhaps the

1467
00:55:07,910 --> 00:55:06,400
the low amount of funding is the reason

1468
00:55:09,510 --> 00:55:07,920
that the public is

1469
00:55:11,910 --> 00:55:09,520
less concerned or do you think that the

1470
00:55:13,670 --> 00:55:11,920
two are detached

1471
00:55:15,589 --> 00:55:13,680
um

1472
00:55:17,030 --> 00:55:15,599
no i don't think i don't think the

1473
00:55:19,270 --> 00:55:17,040
public um

1474
00:55:22,309 --> 00:55:19,280
public concern drives it

1475
00:55:24,390 --> 00:55:22,319
um i think in this case the public and

1476
00:55:26,950 --> 00:55:24,400
the policy makers are on the same side

1477
00:55:29,190 --> 00:55:26,960
of the table and so like you said before

1478
00:55:31,349 --> 00:55:29,200
their interest is spiked by by real

1479
00:55:33,670 --> 00:55:31,359
events and they do put more funding in

1480
00:55:36,710 --> 00:55:33,680
it but then when it's not well you know

1481
00:55:38,549 --> 00:55:36,720
other priorities take precedence and so

1482
00:55:40,630 --> 00:55:38,559
i don't i don't see i don't have any

1483
00:55:42,630 --> 00:55:40,640
solutions to how you solve that i think

1484
00:55:43,990 --> 00:55:42,640
what the nrc is doing and what some in

1485
00:55:45,589 --> 00:55:44,000
the community are doing i'm saying you

1486
00:55:47,190 --> 00:55:45,599
know sub-kilometer impact we need to

1487
00:55:50,309 --> 00:55:47,200
survey those we need to fund what

1488
00:55:53,750 --> 00:55:50,319

congress asked for in 2005 um to to

1489
00:55:55,829 --> 00:55:53,760
survey those those objects is is good

1490
00:55:57,990 --> 00:55:55,839
but i think that

1491
00:55:59,829 --> 00:55:58,000
bearing that very present and clear

1492
00:56:01,190 --> 00:55:59,839
thread

1493
00:56:03,190 --> 00:56:01,200
there's not going to be that much

1494
00:56:04,870 --> 00:56:03,200
attention given to it

1495
00:56:06,549 --> 00:56:04,880
we'll have time for questions later so

1496
00:56:08,549 --> 00:56:06,559
flindley and you can save your questions

1497
00:56:10,470 --> 00:56:08,559
for the for the panel we will we'll

1498
00:56:11,430 --> 00:56:10,480
certainly have time for that but we do

1499
00:56:14,150 --> 00:56:11,440
want to make sure we get all our

1500
00:56:15,829 --> 00:56:14,160
presentations in i just have a question

1501
00:56:16,950 --> 00:56:15,839
i want to take it not for you but you

1502
00:56:18,390 --> 00:56:16,960
can answer it too

1503
00:56:20,230 --> 00:56:18,400
a survey

1504
00:56:22,870 --> 00:56:20,240
how many of you have ever seen a

1505
00:56:25,829 --> 00:56:22,880
shooting star

1506
00:56:28,309 --> 00:56:25,839
all right so you have seen

1507
00:56:30,630 --> 00:56:28,319
an asteroid impact the earth

1508
00:56:32,309 --> 00:56:30,640
you already have so the statistics about

1509
00:56:34,710 --> 00:56:32,319
62 of the people don't think it's like

1510
00:56:36,470 --> 00:56:34,720
gonna happen but it happens all the time

1511
00:56:39,190 --> 00:56:36,480
every night it's just a question of

1512
00:56:41,750 --> 00:56:39,200
whether it's a really big one or not all

1513
00:56:44,870 --> 00:56:43,510

i know and that's the point she says

1514
00:56:46,549 --> 00:56:44,880
people think of them as shooting stars

1515
00:56:48,390 --> 00:56:46,559
they don't understand what an asteroid

1516
00:56:50,390 --> 00:56:48,400
impact really is because they have a

1517
00:56:53,030 --> 00:56:50,400
hollywood impression and they don't

1518
00:56:55,990 --> 00:56:53,040
realize that asteroid and comet impacts

1519
00:56:58,150 --> 00:56:56,000
happen every single day

1520
00:57:00,150 --> 00:56:58,160
and it's just a question of degree all

1521
00:57:02,309 --> 00:57:00,160
right so that's something that we need

1522
00:57:04,630 --> 00:57:02,319
to communicate a little bit better i

1523
00:57:07,670 --> 00:57:04,640
think uh that we aren't just talking

1524
00:57:10,230 --> 00:57:07,680
about a one-off dinosaur killer the

1525
00:57:13,750 --> 00:57:10,240
tunguska event i like to show

1526
00:57:15,910 --> 00:57:13,760
super posed on washington dc

1527
00:57:19,030 --> 00:57:15,920
because it encompasses the tree fall

1528
00:57:21,510 --> 00:57:19,040
pattern tunguska encompasses all

1529
00:57:23,109 --> 00:57:21,520
of metro washington dc

1530
00:57:27,030 --> 00:57:23,119
so it's just something to keep in mind