1
00:00:41,950 --> 00:00:39,259
on the surface of an average planet

2
00:00:44,810 --> 00:00:41,960
circling an ordinary yellow star an

3
00:00:52,520 --> 00:00:44,820
advanced intelligence searches the skies

4
00:00:55,039 --> 00:00:52,530
for evidence of life directed by even

5
00:00:58,009 --> 00:00:55,049
higher intelligence machines with brains

6
00:01:00,049 --> 00:00:58,019
of silicon patiently sift through faith

7
00:01:02,090 --> 00:01:00,059
shards of radio data for the

8
00:01:09,580 --> 00:01:02,100
unmistakable signal that will indicate

9
00:01:12,320 --> 00:01:09,590
the first sign of life beyond Earth in

10
00:01:14,480 --> 00:01:12,330
1959 physicist Philip Morrison was

11
00:01:17,770 --> 00:01:14,490
co-author of the first scientific paper

12
00:01:20,029 --> 00:01:17,780
to suggest a strategy for such a search

13
00:01:22,190 --> 00:01:20,039

no is an answer to a very simple

14
00:01:25,580 --> 00:01:22,200
question are we alone as conscious

15
00:01:28,999 --> 00:01:25,590
beings in this entire buzzing four

16
00:01:31,580 --> 00:01:29,009
hundred billion star galaxy one of ten

17
00:01:34,940 --> 00:01:31,590
to the tenth other galaxies it seems

18
00:01:37,060 --> 00:01:34,950
pretty implausible it's an enormous task

19
00:01:39,859 --> 00:01:37,070
to search the skies for intelligent life

20
00:01:42,709 --> 00:01:39,869
looking for a golden needle in a huge

21
00:01:44,660 --> 00:01:42,719
cosmic haystack but steady the search

22
00:01:47,060 --> 00:01:44,670
for extraterrestrial intelligence has

23
00:01:50,149 --> 00:01:47,070
come a long way since early experiments

24
00:01:52,760 --> 00:01:50,159
by young radio astronomer Frank Drake in

25
00:01:55,789 --> 00:01:52,770
1960 Drake made the first radio search

26
00:01:58,130 --> 00:01:55,799
from Green Bank West Virginia he called

27
00:02:02,779 --> 00:01:58,140
it Ozma after a princess from the

28
00:02:04,700 --> 00:02:02,789
fictional Land of Oz now plans for the

29
00:02:07,069 --> 00:02:04,710
most sophisticated SETI search ever

30
00:02:09,289 --> 00:02:07,079
focus on the goldstone deep space

31
00:02:12,349 --> 00:02:09,299
communication complex in California's

32
00:02:15,080 --> 00:02:12,359
Mojave Desert it is the site of tests

33
00:02:17,780 --> 00:02:15,090
for a possible future NASA project one

34
00:02:20,000 --> 00:02:17,790
not yet funded the full-scale NASA

35
00:02:22,130 --> 00:02:20,010
system when operational in the next

36
00:02:24,319 --> 00:02:22,140
decade would be billions of times more

37
00:02:26,250 --> 00:02:24,329
powerful than the sum of all previous

38
00:02:29,230 --> 00:02:26,260

searches

39
00:02:31,630 --> 00:02:29,240
for carl sagan a proponent of Seti for

40
00:02:34,000 --> 00:02:31,640
many years this technical progress has

41
00:02:36,900 --> 00:02:34,010
made the present unique for the first

42
00:02:40,450 --> 00:02:36,910
time we're mustering substantial

43
00:02:42,910 --> 00:02:40,460
sophisticated serious scientific

44
00:02:44,350 --> 00:02:42,920
searches for for extraterrestrial

45
00:02:47,350 --> 00:02:44,360
intelligence has never been a time like

46
00:02:49,390 --> 00:02:47,360
that perform so there is some chance

47
00:02:53,500 --> 00:02:49,400
that in the next few decades we will get

48
00:02:56,190 --> 00:02:53,510
a signal from some spectacularly distant

49
00:02:58,330 --> 00:02:56,200
spectacularly exotic civilization and

50
00:03:26,780 --> 00:02:58,340
everything on earth will as a

51
00:03:32,509 --> 00:03:30,380
how why when and whether to search for

52
00:03:35,449 --> 00:03:32,519
life beyond Earth has been debated for

53
00:03:39,339 --> 00:03:35,459
centuries deciding what sort of signal

54
00:03:42,110 --> 00:03:39,349
to look for in the skies is no easy task

55
00:03:43,640 --> 00:03:42,120
NASA's proposed search focuses on radio

56
00:03:46,309 --> 00:03:43,650
a portion of the electromagnetic

57
00:03:48,670 --> 00:03:46,319
spectrum where nature produces the least

58
00:03:51,679 --> 00:03:48,680
interference for any intelligent signal

59
00:03:54,050 --> 00:03:51,689
the plan is to use existing radio

60
00:03:55,449 --> 00:03:54,060
antennas and combine them with advanced

61
00:03:58,420 --> 00:03:55,459
computer hardware and software

62
00:04:01,129 --> 00:03:58,430
specifically designed for the task

63
00:04:03,229 --> 00:04:01,139

signal processing equipment suitable for

64
00:04:05,360 --> 00:04:03,239
SETI is constantly becoming more

65
00:04:08,800 --> 00:04:05,370
powerful and more efficient but also

66
00:04:12,140 --> 00:04:08,810
cheaper and smaller than ever before in

67
00:04:14,449 --> 00:04:12,150
the mid 1990s NASA hopes to deploy it

68
00:04:16,580 --> 00:04:14,459
systems in a relatively low cost ten

69
00:04:18,979 --> 00:04:16,590
years search that will for the first

70
00:04:20,810 --> 00:04:18,989
time systematically explore all the

71
00:04:23,210 --> 00:04:20,820
radio frequencies and directions on the

72
00:04:30,950 --> 00:04:23,220
sky that researchers think might reveal

73
00:04:32,300 --> 00:04:30,960
a signal my name is Jill tarter I'm an

74
00:04:34,370 --> 00:04:32,310
astronomer from the University of

75
00:04:35,960 --> 00:04:34,380
California at Berkeley and I work with

76
00:04:38,689 --> 00:04:35,970
colleagues from NASA's Ames Research

77
00:04:40,790 --> 00:04:38,699
Center the Jet Propulsion Laboratory and

78
00:04:43,010 --> 00:04:40,800
the SETI Institute to help design the

79
00:04:47,390 --> 00:04:43,020
special purpose tools needed to do SETI

80
00:04:49,550 --> 00:04:47,400
properly over the years I've worked at

81
00:04:51,980 --> 00:04:49,560
many radio telescopes like this one at

82
00:04:53,870 --> 00:04:51,990
knole say in france trying to adapt

83
00:04:57,110 --> 00:04:53,880
existing equipment to this difficult

84
00:05:00,110 --> 00:04:57,120
task these efforts I hope will soon be

85
00:05:02,060 --> 00:05:00,120
eclipsed by the planned NASA system some

86
00:05:05,980 --> 00:05:02,070
parts of which may eventually be placed

87
00:05:10,730 --> 00:05:08,290
contemporary city is a science a

88
00:05:13,160 --> 00:05:10,740

discipline which transforms humanity's

89
00:05:15,610 --> 00:05:13,170
age-old speculations about life and

90
00:05:18,230 --> 00:05:15,620
universe into experimental reality

91
00:05:19,760 --> 00:05:18,240
steady pioneer Frank Drake came up with

92
00:05:22,400 --> 00:05:19,770
a way to organize our developing

93
00:05:24,200 --> 00:05:22,410
knowledge and current ignorance SETI

94
00:05:26,270 --> 00:05:24,210
scientists often use what's called the

95
00:05:28,820 --> 00:05:26,280
Drake Equation to illuminate the

96
00:05:30,470 --> 00:05:28,830
necessary conditions for contact and to

97
00:05:34,160 --> 00:05:30,480
provide a rough estimate of the number

98
00:05:37,070 --> 00:05:34,170
of other civilizations the existence of

99
00:05:43,180 --> 00:05:37,080
other technical civilizations depends

100
00:05:53,350 --> 00:05:49,760
comparative planetology biochemistry the

101
00:05:56,870 --> 00:05:53,360
role of intelligence in evolution

102
00:05:59,900 --> 00:05:56,880
technology and the fate of technical

103
00:06:01,700 --> 00:05:59,910
civilizations so SETI becomes a way to

104
00:06:03,650 --> 00:06:01,710
test our theories of the origin and

105
00:06:07,250 --> 00:06:03,660
evolution of the universe and the place

106
00:06:08,840 --> 00:06:07,260
of life within it some factors in the

107
00:06:12,230 --> 00:06:08,850
Drake Equation are well determined

108
00:06:14,750 --> 00:06:12,240
others are not we're pretty sure our

109
00:06:16,820 --> 00:06:14,760
galaxy has about 400 billion stars and

110
00:06:19,370 --> 00:06:16,830
maybe ten percent of them will shine

111
00:06:21,110 --> 00:06:19,380
long enough for life to evolve and we

112
00:06:24,530 --> 00:06:21,120
understand something of a life cycle of

113
00:06:27,260 --> 00:06:24,540

those stars we know that it required

114
00:06:28,970 --> 00:06:27,270
colossal supernova explosions to

115
00:06:31,460 --> 00:06:28,980
transform the simple elements produced

116
00:06:35,830 --> 00:06:31,470
in the Big Bang into the heavy elements

117
00:06:38,530 --> 00:06:35,840
that form rocky planets and we ourselves

118
00:06:40,570 --> 00:06:38,540
and we have taken the first steps in

119
00:06:43,659 --> 00:06:40,580
understanding the chemical origin of

120
00:06:45,879 --> 00:06:43,669
life and the principles of evolution but

121
00:06:48,219 --> 00:06:45,889
as yet we found no definitive proof of

122
00:06:50,200 --> 00:06:48,229
solar systems beyond our own though

123
00:06:51,939 --> 00:06:50,210
recent observations of the disk of

124
00:06:54,250 --> 00:06:51,949
matter around the nearby star beta

125
00:06:57,310 --> 00:06:54,260
Pictoris suggests the planets they

126
00:06:59,770 --> 00:06:57,320
become in our own solar system we have

127
00:07:02,290 --> 00:06:59,780
found no signs of advanced life though

128
00:07:04,870 --> 00:07:02,300
planets like Mars from the large moons

129
00:07:06,730 --> 00:07:04,880
like Europa and Titan may have provided

130
00:07:09,430 --> 00:07:06,740
suitable environments for life in the

131
00:07:14,140 --> 00:07:09,440
past or may do in the future and seem

132
00:07:16,120 --> 00:07:14,150
worth further exploratory missions so

133
00:07:18,150 --> 00:07:16,130
far we have detected no signals from

134
00:07:20,800 --> 00:07:18,160
other civilizations around other stars

135
00:07:23,560 --> 00:07:20,810
using technologies which could make them

136
00:07:25,719 --> 00:07:23,570
visible across the light-years and we

137
00:07:27,909 --> 00:07:25,729
cannot predict whether civilizations

138
00:07:30,310 --> 00:07:27,919

with advanced technology will perish

139
00:07:32,500 --> 00:07:30,320
quickly or learn to use it to explore

140
00:07:35,500 --> 00:07:32,510
the universe and thrive for the lifetime

141
00:07:37,659 --> 00:07:35,510
of their star some people look at the

142
00:07:39,900 --> 00:07:37,669
seven conditions Drake proposed and see

143
00:07:42,550 --> 00:07:39,910
a weak chain that could easily be broken

144
00:07:45,250 --> 00:07:42,560
Drake himself thinks there could be many

145
00:07:47,409 --> 00:07:45,260
thousands of civilizations with whom we

146
00:07:49,900 --> 00:07:47,419
could communicate in the Milky Way alone

147
00:07:51,690 --> 00:07:49,910
we take the solar system which we know

148
00:07:54,640 --> 00:07:51,700
has happened and the life on Earth is

149
00:07:56,800 --> 00:07:54,650
typical and as far as we know it is

150
00:07:59,800 --> 00:07:56,810
typical we know of nothing no freakish

151
00:08:01,750 --> 00:07:59,810
event that was required for us with our

152
00:08:04,870 --> 00:08:01,760
motorcycles and our video tape recorders

153
00:08:07,089 --> 00:08:04,880
to exist SETI researchers such as

154
00:08:08,529 --> 00:08:07,099
Harvard's Paul Horowitz doubt that the

155
00:08:10,920 --> 00:08:08,539
question of other life in the universe

156
00:08:12,850 --> 00:08:10,930
will ever be answered in the abstract

157
00:08:14,560 --> 00:08:12,860
people have argued for a long time about

158
00:08:16,029 --> 00:08:14,570
the odds what are the probabilities that

159
00:08:19,029 --> 00:08:16,039
there's life elsewhere in the universe

160
00:08:21,129 --> 00:08:19,039
and lacking any data they're nothing but

161
00:08:22,659 --> 00:08:21,139
arguments and you can argue yourself

162
00:08:24,940 --> 00:08:22,669
blue in the face but if you want to

163
00:08:27,790 --> 00:08:24,950

answer this question you're gonna have

164
00:08:29,469 --> 00:08:27,800
to do the experiment but how can you do

165
00:08:32,170 --> 00:08:29,479
the experiment what is the right

166
00:08:35,140 --> 00:08:32,180
experiment over interstellar distances

167
00:08:37,269 --> 00:08:35,150
there's little sign of Earth the Sun

168
00:08:38,660 --> 00:08:37,279
outshines the planet by more than a

169
00:08:40,370 --> 00:08:38,670
billion to one

170
00:08:42,590 --> 00:08:40,380
that's one reason we've not yet seen

171
00:08:45,200 --> 00:08:42,600
planets around other stars with even the

172
00:08:47,240 --> 00:08:45,210
largest optical telescopes it's rather

173
00:08:50,690 --> 00:08:47,250
like trying to see a firefly perched on

174
00:08:53,150 --> 00:08:50,700
the rim of a searchlight but at radio

175
00:08:55,940 --> 00:08:53,160
wavelengths at certain times and certain

176
00:08:58,370 --> 00:08:55,950
frequencies Earth's technology outshines

177
00:09:01,610 --> 00:08:58,380
all other sources in the solar system by

178
00:09:03,580 --> 00:09:01,620
nearly a million to one the carrier

179
00:09:05,960 --> 00:09:03,590
waves of Earth's radio and television

180
00:09:09,260 --> 00:09:05,970
broadcasts leak outward in a spherical

181
00:09:13,220 --> 00:09:09,270
shell and could be detected by distant

182
00:09:15,470 --> 00:09:13,230
civilizations radio signals travel at

183
00:09:18,830 --> 00:09:15,480
the speed of light the fastest velocity

184
00:09:21,710 --> 00:09:18,840
possible in contrast pioneer 10 has been

185
00:09:24,050 --> 00:09:21,720
traveling for nine years to cover some 4

186
00:09:26,200 --> 00:09:24,060
billion miles but its signal arrives

187
00:09:29,120 --> 00:09:26,210
back here on earth in just five hours

188
00:09:32,030 --> 00:09:29,130

that's one reason NASA researchers think

189
00:09:34,160 --> 00:09:32,040
it is communication not physical travel

190
00:09:37,100 --> 00:09:34,170
that makes most sense for all species

191
00:09:39,440 --> 00:09:37,110
everywhere in the universe earth's most

192
00:09:44,680 --> 00:09:39,450
sensitive antennas could detect strong

193
00:09:50,420 --> 00:09:47,260
traveling for just five light-hours

194
00:09:52,820 --> 00:09:50,430
pioneer tens very weak signal is being

195
00:09:55,760 --> 00:09:52,830
used to test NASA's prototype detectors

196
00:09:58,400 --> 00:09:55,770
back here on earth Barney Oliver chief

197
00:09:59,930 --> 00:09:58,410
up NASA's SETI office looking for a

198
00:10:03,050 --> 00:09:59,940
signal now it's coming from the Pioneer

199
00:10:04,730 --> 00:10:03,060
spacecraft which is now outside the

200
00:10:09,700 --> 00:10:04,740
solar system that's beyond the orbit of

201
00:10:13,070 --> 00:10:09,710
Neptune its carrier is a 1 watt signal

202
00:10:15,650 --> 00:10:13,080
and that is about the fun what one

203
00:10:18,020 --> 00:10:15,660
twentieth of the energy of a candle

204
00:10:21,890 --> 00:10:18,030
burning so we're picking up a really

205
00:10:24,050 --> 00:10:21,900
small signal indeed we succeed the Naza

206
00:10:26,870 --> 00:10:24,060
effort has united Barney Oliver and

207
00:10:28,910 --> 00:10:26,880
other longtime City proponents with the

208
00:10:31,550 --> 00:10:28,920
younger generation of computer builders

209
00:10:34,940 --> 00:10:31,560
and programmers including Kent colors

210
00:10:37,150 --> 00:10:34,950
who despite being blind has worked on

211
00:10:40,580 --> 00:10:37,160
the statistics of pattern recognition

212
00:10:42,680 --> 00:10:40,590
pioneer 10 is simply a very good example

213
00:10:45,410 --> 00:10:42,690

of the kind of signal that we might

214
00:10:47,540 --> 00:10:45,420
detect first of all although it's kind

215
00:10:49,430 --> 00:10:47,550
of close in interstellar terms it's a

216
00:10:52,079 --> 00:10:49,440
very weak one would expect that a

217
00:10:53,970 --> 00:10:52,089
civilization would be farther away and

218
00:10:57,119 --> 00:10:53,980
hunger it's near the limit of our

219
00:11:01,619 --> 00:10:57,129
detection it's also a good example of a

220
00:11:05,340 --> 00:11:01,629
signal that might be used as beacon I'm

221
00:11:07,519 --> 00:11:05,350
gonna go upper hurts just let's see what

222
00:11:09,540 --> 00:11:07,529
happens here the test was successful

223
00:11:11,249 --> 00:11:09,550
even though the rotation of the earth

224
00:11:13,259 --> 00:11:11,259
and its motion through the galaxy

225
00:11:15,150 --> 00:11:13,269
continuously changes the frequency of

226
00:11:19,019 --> 00:11:15,160
Pioneer signal over time there's a

227
00:11:21,119 --> 00:11:19,029
promising candidate right here laughs a

228
00:11:26,220 --> 00:11:21,129
wait for a few more spectra to see if it

229
00:11:29,340 --> 00:11:26,230
does yes I think that's it this right

230
00:11:32,160 --> 00:11:29,350
line do you see going slanting down the

231
00:11:37,650 --> 00:11:32,170
screen is the signal from the pioneer 10

232
00:11:40,259 --> 00:11:37,660
spacecraft now if you look at other

233
00:11:43,199 --> 00:11:40,269
means of communication or making contact

234
00:11:45,569 --> 00:11:43,209
you have to send something you can't

235
00:11:47,999 --> 00:11:45,579
just think about it you have to send

236
00:11:49,829 --> 00:11:48,009
something and we've investigated all the

237
00:11:51,989 --> 00:11:49,839
known particles and it's certainly true

238
00:11:56,280 --> 00:11:51,999

that electromagnetic waves or photons

239
00:11:57,780 --> 00:11:56,290
are hands down the best medium to use so

240
00:11:59,850 --> 00:11:57,790
it might seem that we have solved the

241
00:12:02,220 --> 00:11:59,860
problem of how to do the SETI experiment

242
00:12:04,650 --> 00:12:02,230
look for artificial signals at radio

243
00:12:08,189 --> 00:12:04,660
frequencies unfortunately it's not that

244
00:12:12,059 --> 00:12:08,199
simple consider a terrestrial FM radio

245
00:12:14,220 --> 00:12:12,069
dial on earth we recognize the channels

246
00:12:16,439 --> 00:12:14,230
of our favorite radio stations defined

247
00:12:18,689 --> 00:12:16,449
in mega birds and can tone from one to

248
00:12:21,329 --> 00:12:18,699
the other each station has an assigned

249
00:12:23,220 --> 00:12:21,339
place on the dial there it broadcasts a

250
00:12:25,199 --> 00:12:23,230
carrier wave that's always present you

251
00:12:26,910 --> 00:12:25,209
no matter the program content the

252
00:12:31,079 --> 00:12:26,920
stations are separated from each other

253
00:12:33,600 --> 00:12:31,089
so that they do not interfere on the

254
00:12:35,669 --> 00:12:33,610
cosmic radio dial we're also looking for

255
00:12:38,220 --> 00:12:35,679
signals artificially concentrated in

256
00:12:39,960 --> 00:12:38,230
frequency but we don't know what

257
00:12:43,619 --> 00:12:39,970
frequencies the extraterrestrials may be

258
00:12:46,139 --> 00:12:43,629
using on earth between 90 and 92

259
00:12:49,590 --> 00:12:46,149
megahertz there are just ten frequencies

260
00:12:52,710 --> 00:12:49,600
in use on the cosmic dial there are 20

261
00:12:55,750 --> 00:12:52,720
million potentially usable frequencies

262
00:12:57,960 --> 00:12:55,760
in space the entire electromagnetic

263
00:13:00,790 --> 00:12:57,970

spectrum could be used for communication

264
00:13:03,030 --> 00:13:00,800
but in practice some portions of the

265
00:13:06,790 --> 00:13:03,040
cosmic radio dial are harder to use

266
00:13:09,430 --> 00:13:06,800
lower frequencies that we use for FM and

267
00:13:11,560 --> 00:13:09,440
TV broadcasts are overwhelmed by

268
00:13:14,500 --> 00:13:11,570
interference from natural sources in our

269
00:13:16,720 --> 00:13:14,510
galaxy so we think it makes sense to

270
00:13:20,200 --> 00:13:16,730
listen in the microwave region between

271
00:13:22,060 --> 00:13:20,210
1,000 and 100,000 megahertz there is a

272
00:13:24,310 --> 00:13:22,070
preferred region in the electromagnetic

273
00:13:27,160 --> 00:13:24,320
spectrum we believe to minimize as the

274
00:13:29,050 --> 00:13:27,170
energy required to make contact and that

275
00:13:31,600 --> 00:13:29,060
is the microwave region and the reason

276
00:13:33,250 --> 00:13:31,610
for that is that the noise that would

277
00:13:36,550 --> 00:13:33,260
interfere with our transmissions or

278
00:13:39,100 --> 00:13:36,560
theirs is lowest there if you know lower

279
00:13:41,830 --> 00:13:39,110
in frequency the noise increases noises

280
00:13:43,540 --> 00:13:41,840
of the galaxy produces you go higher in

281
00:13:46,360 --> 00:13:43,550
frequency quantum effects come in and

282
00:13:49,330 --> 00:13:46,370
create noise and in this silent valley

283
00:13:50,650 --> 00:13:49,340
between those two walls communication

284
00:13:53,650 --> 00:13:50,660
can be accomplished with the least

285
00:13:55,450 --> 00:13:53,660
energy of any region of the spectrum but

286
00:13:57,760 --> 00:13:55,460
even if there are clues about frequency

287
00:14:00,160 --> 00:13:57,770
you still must choose where when and

288
00:14:01,780 --> 00:14:00,170

exactly how to listen it's really more

289
00:14:04,480 --> 00:14:01,790
like looking for a needle inside a

290
00:14:06,400 --> 00:14:04,490
haystack inside a haystack for

291
00:14:08,130 --> 00:14:06,410
simplicity SETI researchers compared

292
00:14:10,780 --> 00:14:08,140
their experiments using three parameters

293
00:14:13,120 --> 00:14:10,790
in addition to frequency you have to

294
00:14:15,840 --> 00:14:13,130
choose directions to survey the whole

295
00:14:18,160 --> 00:14:15,850
sky or to target individual stars and

296
00:14:20,560 --> 00:14:18,170
all experiments will have different

297
00:14:23,410 --> 00:14:20,570
sensitivities determined primarily by

298
00:14:27,220 --> 00:14:23,420
the size of the radio antenna and by how

299
00:14:29,080 --> 00:14:27,230
long they listen are there any further

300
00:14:31,270 --> 00:14:29,090
clues which can help limit places to

301
00:14:33,220 --> 00:14:31,280
look for the needle many study

302
00:14:35,680 --> 00:14:33,230
researchers think there may be at least

303
00:14:37,570 --> 00:14:35,690
in the frequency dimension since

304
00:14:39,370 --> 00:14:37,580
hydrogen is the most abundant element in

305
00:14:41,380 --> 00:14:39,380
the universe they argue that all

306
00:14:43,390 --> 00:14:41,390
intelligent species would think of

307
00:14:44,980 --> 00:14:43,400
transmitting their signals close to the

308
00:14:47,610 --> 00:14:44,990
frequency at which hydrogen atoms

309
00:14:50,290 --> 00:14:47,620
naturally emit radio waves

310
00:14:53,410 --> 00:14:50,300
1420 megahertz was the first so-called

311
00:14:56,110 --> 00:14:53,420
magic frequency to be tried it was at

312
00:15:00,250 --> 00:14:56,120
1420 megahertz that Frank trach searched

313
00:15:02,350 --> 00:15:00,260

in 1960 the first targeted search he

314
00:15:04,390 --> 00:15:02,360
looked at just two stars at this one

315
00:15:08,320 --> 00:15:04,400
frequency in a search of moderate

316
00:15:10,510 --> 00:15:08,330
sensitivity in 1973 Ohio State

317
00:15:13,810 --> 00:15:10,520
University with its unusual antenna

318
00:15:16,090 --> 00:15:13,820
began a continuing sky servic it listens

319
00:15:18,580 --> 00:15:16,100
not to single stars but to the sky

320
00:15:22,630 --> 00:15:18,590
passing overhead it covers 50 channels

321
00:15:25,150 --> 00:15:22,640
but is low in sensitivity searches over

322
00:15:27,130 --> 00:15:25,160
the last six years by myself and French

323
00:15:30,310 --> 00:15:27,140
radio astronomer Francois Bureau at mal

324
00:15:32,890 --> 00:15:30,320
say have looked at 350 stars in the

325
00:15:34,930 --> 00:15:32,900
latest targeted search there has been

326
00:15:36,760 --> 00:15:34,940
significant international interest in

327
00:15:39,400 --> 00:15:36,770
setting with searches mounted in the

328
00:15:41,290 --> 00:15:39,410
USSR Canada Holland Germany and

329
00:15:41,710 --> 00:15:41,300
Australia as well as those in the United

330
00:15:46,749 --> 00:15:41,720
States

331
00:15:49,269 --> 00:15:46,759
friends I'd not say by adapting existing

332
00:15:51,040 --> 00:15:49,279
radio astronomical equipment we've been

333
00:15:53,679 --> 00:15:51,050
able to listen to thousands of channels

334
00:15:55,929 --> 00:15:53,689
simultaneously we've achieved improved

335
00:16:00,970 --> 00:15:55,939
frequency coverage and a modest gain in

336
00:16:02,889 --> 00:16:00,980
sensitivity as computers advanced it

337
00:16:04,600 --> 00:16:02,899
became possible to construct detectors

338
00:16:07,449 --> 00:16:04,610

that were specially adapted to the needs

339
00:16:09,309 --> 00:16:07,459
of Seti one of the first researchers to

340
00:16:11,619 --> 00:16:09,319
take advantage of this capability was

341
00:16:13,929 --> 00:16:11,629
Paul harvest a professor of physics at

342
00:16:16,059 --> 00:16:13,939
Harvard University the key breakthrough

343
00:16:20,829 --> 00:16:16,069
was the ability to scan many channels

344
00:16:22,090 --> 00:16:20,839
and frequencies simultaneously the heart

345
00:16:25,119 --> 00:16:22,100
of the system is a so-called

346
00:16:27,579 --> 00:16:25,129
multi-channel spectrum analyzer or mcsa

347
00:16:29,259 --> 00:16:27,589
the one Horowitz uses in his latest

348
00:16:31,449 --> 00:16:29,269
system was designed in collaboration

349
00:16:33,879 --> 00:16:31,459
with ivan lins gotten colleagues at

350
00:16:37,210 --> 00:16:33,889
Stanford University as part of the R&D

351
00:16:39,340 --> 00:16:37,220
for NASA's plan city systems Horowitz

352
00:16:42,790 --> 00:16:39,350
puts this equipment to practical test in

353
00:16:45,939 --> 00:16:42,800
a Sky Survey known as meta the mega

354
00:16:48,369 --> 00:16:45,949
channel extraterrestrial asset Drake's

355
00:16:51,970 --> 00:16:48,379
experiment could scan only one frequency

356
00:16:53,230 --> 00:16:51,980
channel at a time meta can listen to 8.4

357
00:16:55,929 --> 00:16:53,240
million frequency channels

358
00:17:00,189 --> 00:16:55,939
simultaneously it can do in one second

359
00:17:02,530 --> 00:17:00,199
which took Drake five years meta funded

360
00:17:05,500 --> 00:17:02,540
by the Planetary Society is perhaps the

361
00:17:07,569 --> 00:17:05,510
ultimate magic frequency machine but if

362
00:17:09,069 --> 00:17:07,579
Horowitz has guessed wrong he may be

363
00:17:11,409 --> 00:17:09,079

looking in the right direction with

364
00:17:14,340 --> 00:17:11,419
excellent sensitivity but just the wrong

365
00:17:20,529 --> 00:17:17,139
no search to date has found any evidence

366
00:17:22,569 --> 00:17:20,539
of intelligent life but SETI researchers

367
00:17:26,980 --> 00:17:22,579
feel that their equipment has not been

368
00:17:28,870 --> 00:17:26,990
equal to the task NASA's goal is to

369
00:17:31,930 --> 00:17:28,880
extend these previous efforts into a

370
00:17:33,669 --> 00:17:31,940
truly comprehensive search successful

371
00:17:35,529 --> 00:17:33,679
tests of hardware and software in

372
00:17:38,169 --> 00:17:35,539
detecting signals like those coming back

373
00:17:40,600 --> 00:17:38,179
from pioneer are but the first steps in

374
00:17:42,700 --> 00:17:40,610
a planned 10-year project that will

375
00:17:45,759 --> 00:17:42,710
combine the most promising strategies

376
00:17:47,259 --> 00:17:45,769
from these earlier searches the NASA

377
00:17:49,000 --> 00:17:47,269
approach that we're that we're

378
00:17:51,759 --> 00:17:49,010
developing right now has two different

379
00:17:54,310 --> 00:17:51,769
approaches to the search and they're

380
00:17:55,990 --> 00:17:54,320
complementary one of them is called the

381
00:17:57,940 --> 00:17:56,000
sky survey and another is called the

382
00:18:00,129 --> 00:17:57,950
target search and the objective of the

383
00:18:02,259 --> 00:18:00,139
sky survey is to search the entire sky

384
00:18:04,480 --> 00:18:02,269
having making no guesses as to what are

385
00:18:06,730 --> 00:18:04,490
the best directions to carry out that

386
00:18:08,169 --> 00:18:06,740
search in a reasonable length of time we

387
00:18:11,110 --> 00:18:08,179
have to do it quickly which means we

388
00:18:12,580 --> 00:18:11,120

sacrifice sensitivity to signals we only

389
00:18:15,190 --> 00:18:12,590
detect may be the strongest of the

390
00:18:17,350 --> 00:18:15,200
signals it might be there to cover this

391
00:18:19,960 --> 00:18:17,360
guy quickly the radio telescopes will be

392
00:18:22,810 --> 00:18:19,970
driven very rapidly eventually scanning

393
00:18:24,909 --> 00:18:22,820
each patch of the sky 30 times but it is

394
00:18:27,159 --> 00:18:24,919
in frequency sampled rather than

395
00:18:30,610 --> 00:18:27,169
directions covered that NASA's project

396
00:18:33,310 --> 00:18:30,620
will dwarf all previous searches Drake's

397
00:18:35,409 --> 00:18:33,320
loan frequency is gossamer thin in

398
00:18:37,450 --> 00:18:35,419
comparison to the tens of billions of

399
00:18:40,750 --> 00:18:37,460
usable frequencies in the naturally

400
00:18:43,000 --> 00:18:40,760
quiet microwave window and even though

401
00:18:45,490 --> 00:18:43,010
the ohio state survey covers lots of

402
00:18:48,129 --> 00:18:45,500
directions and stars about sixty percent

403
00:18:51,519 --> 00:18:48,139
of the sky overall its frequency range

404
00:18:54,490 --> 00:18:51,529
is also limited mehta also scans the

405
00:18:56,500 --> 00:18:54,500
northern skies but all of its 8.4

406
00:18:59,080 --> 00:18:56,510
million channels cluster around a single

407
00:19:02,740 --> 00:18:59,090
magic frequency though it will be tuned

408
00:19:05,350 --> 00:19:02,750
to others in contrast on the frequency

409
00:19:07,269 --> 00:19:05,360
dimension NASA Sky Survey will cover the

410
00:19:10,159 --> 00:19:07,279
whole one to ten gigahertz window and

411
00:19:12,259 --> 00:19:10,169
the entire sky

412
00:19:15,109 --> 00:19:12,269
to achieve this comprehensive coverage

413
00:19:17,029 --> 00:19:15,119

of directions and stars NASA plans to

414
00:19:18,739 --> 00:19:17,039
use several telescopes around the world

415
00:19:21,499 --> 00:19:18,749
which are part of its spacecraft

416
00:19:23,659 --> 00:19:21,509
tracking system each of these telescopes

417
00:19:25,519 --> 00:19:23,669
can see two-thirds of the sky and NASA

418
00:19:27,859 --> 00:19:25,529
will move its sky survey system between

419
00:19:31,639 --> 00:19:27,869
them the complementary approach is to

420
00:19:33,229 --> 00:19:31,649
say let's concentrate on detecting with

421
00:19:35,299 --> 00:19:33,239
more sensitivity to be able to tech

422
00:19:37,399 --> 00:19:35,309
weaker signals and to do that we look

423
00:19:39,229 --> 00:19:37,409
and wonder in a few directions for

424
00:19:42,289 --> 00:19:39,239
longer periods of time that's called the

425
00:19:45,259 --> 00:19:42,299
targeted search and we pre select a set

426
00:19:47,299 --> 00:19:45,269
of stars that we know Apriori are more

427
00:19:49,039 --> 00:19:47,309
or less similar to our own Sun in age

428
00:19:51,859 --> 00:19:49,049
and size and look in those directions

429
00:19:54,739 --> 00:19:51,869
with more sensitivity and the ability to

430
00:19:56,659 --> 00:19:54,749
tech many more complex signals the

431
00:19:58,759 --> 00:19:56,669
targeted search will look repeatedly and

432
00:20:02,899 --> 00:19:58,769
at different frequencies at nearly 800

433
00:20:05,419 --> 00:20:02,909
year by stars like mal say NASA's

434
00:20:08,720 --> 00:20:05,429
targeted search may start around 1420

435
00:20:09,979 --> 00:20:08,730
megahertz that is 1.4 2 gigahertz but

436
00:20:13,930 --> 00:20:09,989
then it will expand to cover all

437
00:20:16,639 --> 00:20:13,940
frequencies between one and three goods

438
00:20:20,330 --> 00:20:16,649

like the Sky Survey the targeted search

439
00:20:22,519 --> 00:20:20,340
requires antennas around the world the

440
00:20:24,769 --> 00:20:22,529
giant radio telescope at Arecibo is the

441
00:20:27,320 --> 00:20:24,779
largest on the planet and because of its

442
00:20:29,090 --> 00:20:27,330
unique size and sensitivity NASA hopes

443
00:20:31,940 --> 00:20:29,100
to share time to search for the very

444
00:20:34,249 --> 00:20:31,950
faintest signals the large dish can't be

445
00:20:38,960 --> 00:20:34,259
moved so it can only see stars which

446
00:20:41,269 --> 00:20:38,970
rotate overhead each day the antennas at

447
00:20:43,669 --> 00:20:41,279
either Ohio State or null say could be

448
00:20:47,560 --> 00:20:43,679
used to observe about 300 stars outside

449
00:20:52,070 --> 00:20:50,060
more of the target stars can be seen

450
00:20:54,109 --> 00:20:52,080
from the southern hemisphere so about

451
00:20:56,389 --> 00:20:54,119
200 of them could be observed from the

452
00:20:58,460 --> 00:20:56,399
large NASA antenna at Canberra or

453
00:21:03,830 --> 00:20:58,470
perhaps the astronomical facility at

454
00:21:05,840 --> 00:21:03,840
parks in Australia the last 50 or so

455
00:21:08,539 --> 00:21:05,850
stars must be searched from a telescope

456
00:21:11,180 --> 00:21:08,549
in the northern latitudes perhaps rather

457
00:21:15,519 --> 00:21:11,190
appropriately and green deck where Frank

458
00:21:20,269 --> 00:21:18,379
with this unparalleled combination of

459
00:21:22,940 --> 00:21:20,279
advanced hardware and sophisticated

460
00:21:27,379 --> 00:21:22,950
software NASA's project will have the

461
00:21:31,459 --> 00:21:29,509
the targeted search will look for faint

462
00:21:33,169 --> 00:21:31,469
signals from what according to the

463
00:21:35,149 --> 00:21:33,179

current understanding of cosmic

464
00:21:37,459 --> 00:21:35,159
evolution seem to be the most

465
00:21:40,879 --> 00:21:37,469
interesting sights and we'll look at

466
00:21:42,649 --> 00:21:40,889
billions of frequencies the sky survey

467
00:21:44,629 --> 00:21:42,659
will color an even wider range of

468
00:21:46,699 --> 00:21:44,639
frequencies yet with sufficient

469
00:21:50,239 --> 00:21:46,709
sensitivity to detect a very strong

470
00:21:52,099 --> 00:21:50,249
signal from clear across the galaxy in

471
00:21:53,959 --> 00:21:52,109
addition NASA system will have an

472
00:21:55,759 --> 00:21:53,969
unprecedented ability to look for

473
00:21:58,999 --> 00:21:55,769
different types of signals that vary

474
00:22:01,249 --> 00:21:59,009
over time not just a continuous carrier

475
00:22:04,789 --> 00:22:01,259
wave like that of pioneer 10 or Earth's

476
00:22:06,979 --> 00:22:04,799
radio broadcasts for the first time we

477
00:22:08,899 --> 00:22:06,989
will be able to detect regular pulses

478
00:22:10,699 --> 00:22:08,909
that some researchers say will save

479
00:22:12,769 --> 00:22:10,709
energy and so be the choice of the

480
00:22:15,469 --> 00:22:12,779
transmitting civilization the

481
00:22:18,079 --> 00:22:15,479
interesting thing about the citysearch

482
00:22:19,789 --> 00:22:18,089
is that although we claim that we're

483
00:22:23,539 --> 00:22:19,799
looking for extraterrestrial

484
00:22:27,049 --> 00:22:23,549
intelligence we can't actually define

485
00:22:29,299 --> 00:22:27,059
what an intelligent signal is and so a

486
00:22:32,899 --> 00:22:29,309
starting point is to say we look for a

487
00:22:35,749 --> 00:22:32,909
signal which nature will not produce by

488
00:22:37,669 --> 00:22:35,759

any mechanism that we understand where

489
00:22:39,649 --> 00:22:37,679
it becomes kent colors helped NASA

490
00:22:41,479 --> 00:22:39,659
design the smart computer algorithms

491
00:22:43,729 --> 00:22:41,489
needed to locate weak signals and in

492
00:22:45,199 --> 00:22:43,739
many channels of noise figure but there

493
00:22:48,199 --> 00:22:45,209
will be no human staring at

494
00:22:50,089 --> 00:22:48,209
sophisticated graphics display no human

495
00:22:52,159 --> 00:22:50,099
is any more cited than Kent when it

496
00:22:55,279 --> 00:22:52,169
comes to recognizing an extraterrestrial

497
00:22:58,789 --> 00:22:55,289
signal so the eye is not a good detector

498
00:23:00,739 --> 00:22:58,799
first of all in sensitivity a thing that

499
00:23:02,029 --> 00:23:00,749
you could look at virtually forever and

500
00:23:04,190 --> 00:23:02,039
you would never know whether you were

501
00:23:07,879 --> 00:23:04,200
seeing random noise or whether you were

502
00:23:11,239 --> 00:23:07,889
seeing a real signal the computer can

503
00:23:15,349 --> 00:23:11,249
find signals that are 10 times weaker

504
00:23:17,119 --> 00:23:15,359
than that the amount of data processed

505
00:23:19,159 --> 00:23:17,129
per second is the equivalent of the

506
00:23:21,289 --> 00:23:19,169
entire Encyclopedia Britannica per

507
00:23:24,919 --> 00:23:21,299
second of course that's filled with

508
00:23:27,379 --> 00:23:24,929
random letters if that's analogous to

509
00:23:30,739 --> 00:23:27,389
noise and what you have to do is find

510
00:23:32,779 --> 00:23:30,749
that one pattern that says hi there in

511
00:23:34,699 --> 00:23:32,789
all of those random letters that come in

512
00:23:36,019 --> 00:23:34,709
every second and then decide whether

513
00:23:37,240 --> 00:23:36,029

that pattern could have happened at

514
00:23:39,400 --> 00:23:37,250
random because

515
00:23:42,220 --> 00:23:39,410
your statistics of your process or

516
00:23:45,310 --> 00:23:42,230
whether in fact that's the real thing

517
00:23:47,140 --> 00:23:45,320
and a human being even if he could

518
00:23:50,430 --> 00:23:47,150
perform the task as effectively as a

519
00:23:52,420 --> 00:23:50,440
computer couldn't do it for very long

520
00:23:54,040 --> 00:23:52,430
removing humans from the signal

521
00:23:56,200 --> 00:23:54,050
detection process requires a very

522
00:23:57,910 --> 00:23:56,210
special hardware which is what Ivan

523
00:24:00,210 --> 00:23:57,920
Linscott and his colleagues at Stanford

524
00:24:03,250 --> 00:24:00,220
University have been designing and

525
00:24:05,970 --> 00:24:03,260
that's like having 10 million ears each

526
00:24:08,200 --> 00:24:05,980
one listening to a particular tone and

527
00:24:10,210 --> 00:24:08,210
where all of those are listening

528
00:24:13,390 --> 00:24:10,220
simultaneously and so what we're doing

529
00:24:15,910 --> 00:24:13,400
now is taking the technology that exists

530
00:24:18,340 --> 00:24:15,920
in this prototype form and casting it in

531
00:24:21,040 --> 00:24:18,350
sand we're building silicon versions of

532
00:24:23,770 --> 00:24:21,050
our processors that that together with

533
00:24:27,010 --> 00:24:23,780
the way we know how to use them will

534
00:24:29,140 --> 00:24:27,020
convince both the scale and increase the

535
00:24:35,500 --> 00:24:29,150
performance the process of

536
00:24:38,080 --> 00:24:35,510
miniaturization is already underway 680

537
00:24:40,330 --> 00:24:38,090
of the older large boards will soon be

538
00:24:42,610 --> 00:24:40,340

replaced by just 24 smaller boards

539
00:24:44,740 --> 00:24:42,620
filled with new chips that are cheaper

540
00:24:47,230 --> 00:24:44,750
smarter and faster and can be more

541
00:24:50,290 --> 00:24:47,240
easily transported around the world no

542
00:24:52,540 --> 00:24:50,300
longer will require you to step in small

543
00:24:56,410 --> 00:24:52,550
chunks across the frequency band you can

544
00:24:58,510 --> 00:24:56,420
make a giant stride and and spend lots

545
00:25:01,520 --> 00:24:58,520
of time on particular sources or or

546
00:25:02,690 --> 00:25:01,530
sweep broad swath of the sky

547
00:25:05,540 --> 00:25:02,700
and I think there's where the

548
00:25:07,700 --> 00:25:05,550
opportunity lies because it's a

549
00:25:11,330 --> 00:25:07,710
prospectors art you know and you just

550
00:25:13,520 --> 00:25:11,340
have to look and take your best bet in

551
00:25:15,350 --> 00:25:13,530
normal operations the NASA systems will

552
00:25:17,270 --> 00:25:15,360
rely very heavily on silicon

553
00:25:20,240 --> 00:25:17,280
intelligence with limited human

554
00:25:22,520 --> 00:25:20,250
involvement the computers will have to

555
00:25:24,200 --> 00:25:22,530
have sufficient online intelligence to

556
00:25:26,870 --> 00:25:24,210
analyze the vast amounts of data

557
00:25:28,970 --> 00:25:26,880
arriving every second and weed out the

558
00:25:32,690 --> 00:25:28,980
inevitable false alarms before involving

559
00:25:35,120 --> 00:25:32,700
humans for the operational sky survey

560
00:25:37,130 --> 00:25:35,130
the sky will automatically be divided

561
00:25:40,520 --> 00:25:37,140
into blocks which will be searched in

562
00:25:42,830 --> 00:25:40,530
turn NASA expects many suspicious

563
00:25:45,260 --> 00:25:42,840

signals during each scan but they won't

564
00:25:47,390 --> 00:25:45,270
be from extraterrestrials these events

565
00:25:50,540 --> 00:25:47,400
will be compared to the online database

566
00:25:53,300 --> 00:25:50,550
of radio frequency interference RFI to

567
00:25:55,460 --> 00:25:53,310
identify man-made signals most of the

568
00:25:58,340 --> 00:25:55,470
signals will be explained away until

569
00:26:02,030 --> 00:25:58,350
someday maybe there might come something

570
00:26:04,070 --> 00:26:02,040
more significant the characteristics of

571
00:26:06,590 --> 00:26:04,080
the long hoped for signal will show some

572
00:26:12,200 --> 00:26:06,600
clear sign of intelligence and the

573
00:26:14,030 --> 00:26:12,210
computer will have made content then it

574
00:26:15,830 --> 00:26:14,040
will call humans to come look and we

575
00:26:20,150 --> 00:26:15,840
will know for sure about life elsewhere

576
00:26:22,400 --> 00:26:20,160
in space but before that increasing RFI

577
00:26:25,610 --> 00:26:22,410
poses the greatest obstacle to success

578
00:26:26,720 --> 00:26:25,620
think of the haystack principle we're

579
00:26:29,630 --> 00:26:26,730
looking for the needle in the haystack

580
00:26:32,150 --> 00:26:29,640
as a gold needle same color as the hay

581
00:26:33,800 --> 00:26:32,160
in the haystack but some Joker has

582
00:26:36,290 --> 00:26:33,810
thrown an awful lot of bras needles in

583
00:26:38,390 --> 00:26:36,300
the haystack too so not only do we have

584
00:26:39,890 --> 00:26:38,400
to pick up every little straw and sort

585
00:26:42,050 --> 00:26:39,900
of crinkle it our fingers to see if it

586
00:26:43,760 --> 00:26:42,060
sell it or not but we also have to test

587
00:26:46,640 --> 00:26:43,770
every solid one because it might be a

588
00:26:48,440 --> 00:26:46,650

bronze one since the first SETI

589
00:26:50,960 --> 00:26:48,450
experiments we have filled Earth's skies

590
00:26:53,810 --> 00:26:50,970
with all manner of satellites and we use

591
00:26:55,820 --> 00:26:53,820
them continuously for this reason said

592
00:26:57,920 --> 00:26:55,830
he must get started soon or it will

593
00:27:00,400 --> 00:26:57,930
become more and more difficult to sort

594
00:27:05,049 --> 00:27:00,410
out man-made signals from possible

595
00:27:09,380 --> 00:27:07,400
from the early theories of Philip

596
00:27:11,630 --> 00:27:09,390
morrison and the Ozma experiment of

597
00:27:14,870 --> 00:27:11,640
Frank Drake past searches have

598
00:27:17,600 --> 00:27:14,880
tantalized as much as resolved now in

599
00:27:20,480 --> 00:27:17,610
the proposed NASA search technology and

600
00:27:22,190 --> 00:27:20,490
task are beginning to converge millions

601
00:27:24,230 --> 00:27:22,200
of times we've in fact even billions of

602
00:27:26,630 --> 00:27:24,240
times more comprehensive than the sum of

603
00:27:28,190 --> 00:27:26,640
all previous searches but fall short by

604
00:27:31,039 --> 00:27:28,200
about a million fold from what could be

605
00:27:33,260 --> 00:27:31,049
done so we're kind of nicely positioned

606
00:27:35,690 --> 00:27:33,270
in the middle and if we succeed we will

607
00:27:37,490 --> 00:27:35,700
succeed with the cheap play searching

608
00:27:39,980 --> 00:27:37,500
the cosmic haystack with the full NASA

609
00:27:43,180 --> 00:27:39,990
system would cost just a few pennies per

610
00:27:46,460 --> 00:27:43,190
american per year is it worth that price

611
00:27:48,650 --> 00:27:46,470
when I take my paycheck home I certainly

612
00:27:51,110 --> 00:27:48,660
pay my house bill and my medical bills

613
00:27:53,419 --> 00:27:51,120

and I insurance premiums first and that

614
00:27:56,270 --> 00:27:53,429
takes up most of my income but I always

615
00:27:58,430 --> 00:27:56,280
save a little bit to buy a book or go to

616
00:28:00,500 --> 00:27:58,440
a good movie or go to the Art Museum or

617
00:28:02,870 --> 00:28:00,510
go to a football game and I think it's

618
00:28:05,750 --> 00:28:02,880
that kind of activity that's necessary

619
00:28:07,250 --> 00:28:05,760
for us as human beings to keep us human

620
00:28:09,640 --> 00:28:07,260
I mean that's what that's what keeps our

621
00:28:11,690 --> 00:28:09,650
curiosity stimulated our our our

622
00:28:14,570 --> 00:28:11,700
intellect moving and I think we

623
00:28:16,810 --> 00:28:14,580
collectively as a human race also need

624
00:28:19,610 --> 00:28:16,820
to invest some of our resources into

625
00:28:22,130 --> 00:28:19,620
exploration into trying to understand

626
00:28:25,669 --> 00:28:22,140
nature as it is around us nature as it

627
00:28:27,650 --> 00:28:25,679
is out there and the cosmos trying to

628
00:28:29,900 --> 00:28:27,660
learn who we are and what we're like I

629
00:28:31,190 --> 00:28:29,910
think we always need to climb that extra

630
00:28:33,830 --> 00:28:31,200
mountain somehow I think that's very

631
00:28:35,120 --> 00:28:33,840
important to us collectively I think

632
00:28:38,120 --> 00:28:35,130
even if there's a plausible argument for

633
00:28:39,980 --> 00:28:38,130
a few we got to keep looking I even go

634
00:28:41,450 --> 00:28:39,990
further than that if there's a plausible

635
00:28:43,610 --> 00:28:41,460
argument that there isn't anybody out

636
00:28:45,470 --> 00:28:43,620
there bearing in mind that we can be

637
00:28:48,380 --> 00:28:45,480
wrong we ought to keep looking because

638
00:28:51,260 --> 00:28:48,390

the question is of the most supreme

639
00:28:54,100 --> 00:28:51,270
importance it calibrates our place in

640
00:28:57,740 --> 00:28:54,110
the universe it tells us who we are and

641
00:29:00,409 --> 00:28:57,750
so it is worthwhile trying to find other

642
00:29:02,930 --> 00:29:00,419
civilizations I would say no matter what

643
00:29:05,000 --> 00:29:02,940
we've hardly searched all the various

644
00:29:06,860 --> 00:29:05,010
frequencies the forms of signal the

645
00:29:10,010 --> 00:29:06,870
places in the sky from which signals

646
00:29:12,169 --> 00:29:10,020
might come and so the fact that we so

647
00:29:13,850 --> 00:29:12,179
far have no evidence of extraterrestrial

648
00:29:15,470 --> 00:29:13,860
life is not at all discouraging we

649
00:29:18,320 --> 00:29:15,480
shouldn't have found it yet

650
00:29:20,570 --> 00:29:18,330
we have hardly begun but i think this

651
00:29:22,850 --> 00:29:20,580
enterprise can best be understood as a

652
00:29:25,100 --> 00:29:22,860
kind of exercise in the archaeology of

653
00:29:28,430 --> 00:29:25,110
the future we're well aware of the

654
00:29:31,760 --> 00:29:28,440
archaeology of the past we find a site a

655
00:29:33,740 --> 00:29:31,770
tumulus or a ruin and we take a spade

656
00:29:36,590 --> 00:29:33,750
and we dig into the ground and if you're

657
00:29:39,350 --> 00:29:36,600
lucky you discover or of the kaldi's or

658
00:29:41,210 --> 00:29:39,360
something marvelous now we ever thought

659
00:29:43,490 --> 00:29:41,220
that we could examine the same thing in

660
00:29:46,040 --> 00:29:43,500
reverse time but in fact in a way we can

661
00:29:48,230 --> 00:29:46,050
we know that it's possible that somebody

662
00:29:52,010 --> 00:29:48,240
who wants to do it will bring us in of

663
00:29:53,660 --> 00:29:52,020

course it is their past but our future

664
00:29:55,460 --> 00:29:53,670
which we are investigating to some

665
00:29:56,690 --> 00:29:55,470
degree even though they're made of

666
00:29:58,640 --> 00:29:56,700
different chemistry even though they've

667
00:30:02,180 --> 00:29:58,650
never seen our star even though they

668
00:30:04,340 --> 00:30:02,190
have nothing biological in common with

669
00:30:05,330 --> 00:30:04,350
us they have if they have got radio

670
00:30:07,280 --> 00:30:05,340
astronomy if they have the Conn

671
00:30:09,080 --> 00:30:07,290
technology were imagining have very much

672
00:30:10,760 --> 00:30:09,090
income with us the manufacturer of a

673
00:30:13,430 --> 00:30:10,770
culture the development of a culture

674
00:30:16,040 --> 00:30:13,440
which is unmatched among in all the ten

675
00:30:17,870 --> 00:30:16,050
billion species or more that have come

676
00:30:19,790 --> 00:30:17,880
to the face of the earth so that's the

677
00:30:22,220 --> 00:30:19,800
story and maybe the spag will turn up

678
00:30:23,960 --> 00:30:22,230
luckily a good site one day we hope it

679
00:30:25,970 --> 00:30:23,970
will it's just a question being patient

680
00:30:29,090 --> 00:30:25,980
when you got the Spade and you know the