1
00:01:26,480 --> 00:01:23,630
ever since even the fourth century BC

2
00:01:27,800 --> 00:01:26,490
and beyond I imagine there's been an

3
00:01:29,899 --> 00:01:27,810
interest in the possibility of life

4
00:01:31,910 --> 00:01:29,909
elsewhere and the Greek philosopher

5
00:01:34,040 --> 00:01:31,920
metrodorus of Chios was very much

6
00:01:36,890 --> 00:01:34,050
interested and thought that it would be

7
00:01:38,930 --> 00:01:36,900
very foolish to think that with all the

8
00:01:41,480 --> 00:01:38,940
many possible worlds in the universe

9
00:01:45,590 --> 00:01:41,490
that there would be only life on this

10
00:01:48,170 --> 00:01:45,600
planet Lucretia Slater on 1st century BC

11
00:01:52,370 --> 00:01:48,180
yet was of a similar opinion it was only

12
00:01:54,680 --> 00:01:52,380
with the rise of Ptolemaic understanding

13
00:01:56,150 --> 00:01:54,690

of the universe that people started to

14
00:01:58,150 --> 00:01:56,160
think of the universe it's earth

15
00:02:01,070 --> 00:01:58,160
centered and that was a later on

16
00:02:04,190 --> 00:02:01,080
phenomena and not necessarily prevalent

17
00:02:06,830 --> 00:02:04,200
in early Greece as a result though of

18
00:02:09,199 --> 00:02:06,840
Ptolemies ideas in the Dark Ages in

19
00:02:10,729 --> 00:02:09,209
Western civilization it was considered

20
00:02:12,199 --> 00:02:10,739
that earth was the center of the

21
00:02:14,270 --> 00:02:12,209
universe and it was the only place that

22
00:02:15,740 --> 00:02:14,280
life existed the later on that was

23
00:02:19,100 --> 00:02:15,750
overturned by the ideas of Copernicus

24
00:02:21,500 --> 00:02:19,110
and Kepler and those that followed since

25
00:02:23,840 --> 00:02:21,510
the earliest of times man has been

26
00:02:25,910 --> 00:02:23,850
interested in the heavens having been

27
00:02:27,890 --> 00:02:25,920
fascinated by the countless points of

28
00:02:30,590 --> 00:02:27,900
light that sparkled in the darkness of

29
00:02:31,880 --> 00:02:30,600
the evening skies one of these had a

30
00:02:34,370 --> 00:02:31,890
reddish hue to it

31
00:02:37,250 --> 00:02:34,380
and was known by several names depending

32
00:02:39,199 --> 00:02:37,260
on where one was many of the ancients

33
00:02:41,330 --> 00:02:39,209
named the planet we call Mars after

34
00:02:43,880 --> 00:02:41,340
their God of War due to the planets

35
00:02:47,090 --> 00:02:43,890
reddish hue which reminded them of blood

36
00:02:49,670 --> 00:02:47,100
in fact the nickname the red planet

37
00:03:19,060 --> 00:02:49,680
comes from this as does the notion that

38
00:03:25,070 --> 00:03:21,590

with Galileo's invention of the

39
00:03:26,900 --> 00:03:25,080
telescope in 1609 the first clear look

40
00:03:30,050 --> 00:03:26,910
at this the fourth planet became

41
00:03:31,730 --> 00:03:30,060
possible early astronomers believed that

42
00:03:35,180 --> 00:03:31,740
the Martian surface was similar to

43
00:03:37,460 --> 00:03:35,190
Earth's the first telescopic drawings of

44
00:03:39,350 --> 00:03:37,470
Mars showing distinct changes in surface

45
00:03:43,010 --> 00:03:39,360
appearance were made by Christian

46
00:03:45,980 --> 00:03:43,020
Huygens in 1659 he observed that the

47
00:03:48,470 --> 00:03:45,990
Martian polar icecap seemed to wax and

48
00:03:51,080 --> 00:03:48,480
wane and dark patches seemed to appear

49
00:03:53,270 --> 00:03:51,090
on the surface of Mars these

50
00:03:55,910 --> 00:03:53,280
observations led to the idea that Mars

51
00:04:10,760 --> 00:03:55,920
was indeed a habitable world similar to

52
00:04:12,980 --> 00:04:10,770
our own it had a time of day was very

53
00:04:16,840 --> 00:04:12,990
similar to the earth and so people

54
00:04:29,270 --> 00:04:16,850
imagined it to be like this and so they

55
00:04:49,940 --> 00:04:29,280
and this the prospect reinforced by

56
00:04:53,080 --> 00:04:49,950
these observations however in 1877 an

57
00:04:55,310 --> 00:04:53,090
Italian astronomer Giovanni Schiaparelli

58
00:04:58,610 --> 00:04:55,320
observed lines on the Martian surface

59
00:05:01,370 --> 00:04:58,620
and called them Canali the English

60
00:05:04,190 --> 00:05:01,380
translation of Canali is channels or

61
00:05:06,560 --> 00:05:04,200
grooves these channels were mistakenly

62
00:05:10,100 --> 00:05:06,570
called canals in English and the name

63
00:05:12,170 --> 00:05:10,110

stuck of course canals would infer that

64
00:05:14,060 --> 00:05:12,180
some type of intelligent life form on

65
00:05:15,360 --> 00:05:14,070
Mars was capable of building these

66
00:05:20,050 --> 00:05:15,370
structures

67
00:05:22,780 --> 00:05:20,060
in 1879 caparelli reported seeing double

68
00:05:25,180 --> 00:05:22,790
lines of Canali he came to believe that

69
00:05:28,540 --> 00:05:25,190
these finale were rivers on the surface

70
00:05:30,430 --> 00:05:28,550
of Mars a natural phenomenon others

71
00:05:33,340 --> 00:05:30,440
continue to think that the Canali were

72
00:05:36,700 --> 00:05:33,350
artificial that is to say constructed by

73
00:05:39,760 --> 00:05:36,710
some life-form later on shepper le the

74
00:05:42,820 --> 00:05:39,770
Italian astronomer made observations of

75
00:05:45,700 --> 00:05:42,830
Mars and in trying to make sense out of

76
00:05:50,170 --> 00:05:45,710
the visual image he saw of Mars on one

77
00:05:52,120 --> 00:05:50,180
of the closer opposition's the word

78
00:05:53,800 --> 00:05:52,130
Canali came into use because he thought

79
00:05:56,890 --> 00:05:53,810
he saw straight lines on the surface

80
00:06:01,060 --> 00:05:56,900
this was seized upon by Percival Lowell

81
00:06:04,390 --> 00:06:01,070
and he wrote a book in the 1890s that

82
00:06:07,780 --> 00:06:04,400
described the possibility of a Mars that

83
00:06:09,790 --> 00:06:07,790
would have intelligent life water but a

84
00:06:14,970 --> 00:06:09,800
dry planet in general so I need to get

85
00:06:17,410 --> 00:06:14,980
the water down to the presumably more

86
00:06:19,540 --> 00:06:17,420
agriculturally inclined central parts of

87
00:06:21,670 --> 00:06:19,550
the planet first of all while will

88
00:06:24,700 --> 00:06:21,680

maintain this interest in a living and

89
00:06:26,710 --> 00:06:24,710
civilized Mars until his death in 1916

90
00:06:28,450 --> 00:06:26,720
and of course his ideas were seized upon

91
00:06:30,700 --> 00:06:28,460
and made popular for a lot of us by

92
00:06:33,490 --> 00:06:30,710
Edgar Rice Burroughs who's Barsoom

93
00:06:35,950 --> 00:06:33,500
series that was fascinating and a lot of

94
00:06:40,120 --> 00:06:35,960
fun in a potboiler sort of way

95
00:06:42,070 --> 00:06:40,130
and I got people's imaginations turned

96
00:06:45,220 --> 00:06:42,080
up about the ideas of civilizations on

97
00:06:46,780 --> 00:06:45,230
Mars dying civilizations and recurrent

98
00:06:48,550 --> 00:06:46,790
civilizations and I think that a lot of

99
00:06:50,280 --> 00:06:48,560
that stayed in the public mind certainly

100
00:06:53,140 --> 00:06:50,290
was something that I found of interest

101
00:06:54,790 --> 00:06:53,150
later on we found that Mars was a much

102
00:06:57,610 --> 00:06:54,800
different place than chaparral II and

103
00:06:59,950 --> 00:06:57,620
Percival Lowell had imagined the

104
00:07:02,170 --> 00:06:59,960
American astronomer Percival Lowell was

105
00:07:04,870 --> 00:07:02,180
another who saw the Canali and believed

106
00:07:06,790 --> 00:07:04,880
them to be artificially created he made

107
00:07:08,650 --> 00:07:06,800
his observations with a variety of

108
00:07:12,610 --> 00:07:08,660
telescopes in different parts of the

109
00:07:14,790 --> 00:07:12,620
world starting in 1896 Lowell wrote the

110
00:07:16,990 --> 00:07:14,800
first of his three books about Mars

111
00:07:19,780 --> 00:07:17,000
there's been a long-standing interest

112
00:07:21,940 --> 00:07:19,790
with Mars and with life on Mars and I

113
00:07:24,280 --> 00:07:21,950

think it traces back to the early

114
00:07:26,380 --> 00:07:24,290
telescope observations when people

115
00:07:28,540 --> 00:07:26,390
finally started pointing telescopes at

116
00:07:30,340 --> 00:07:28,550
the planets they notice them are

117
00:07:33,130 --> 00:07:30,350
unlike all the other planets had

118
00:07:35,620 --> 00:07:33,140
distinct seasonal cycles very similar to

119
00:07:37,810 --> 00:07:35,630
Earth's it had white polar caps which

120
00:07:39,550 --> 00:07:37,820
shrank and grew with the seasons it had

121
00:07:41,320 --> 00:07:39,560
dark spots on the surface which seemed

122
00:07:43,900 --> 00:07:41,330
to come and go with the seasons like

123
00:07:47,590 --> 00:07:43,910
vegetation and it was this similarity

124
00:07:50,200 --> 00:07:47,600
between Earth and Mars this superficial

125
00:07:52,390 --> 00:07:50,210
similarity but I think was the spark

126
00:07:54,480 --> 00:07:52,400
that first started this interest in life

127
00:07:57,190 --> 00:07:54,490
on Mars and the notion that there was

128
00:07:59,650 --> 00:07:57,200
civilizations on Mars as well and then I

129
00:08:02,170 --> 00:07:59,660
think all the subsequent observations in

130
00:08:04,930 --> 00:08:02,180
some sense culminating with Percival

131
00:08:06,880 --> 00:08:04,940
Lowell's work looking for canals on Mars

132
00:08:09,880 --> 00:08:06,890
and the perception that there were

133
00:08:13,180 --> 00:08:09,890
canals and that was an evidence of human

134
00:08:15,040 --> 00:08:13,190
civilization like civilizations all of

135
00:08:16,720 --> 00:08:15,050
that has tended to reinforce the notion

136
00:08:19,000 --> 00:08:16,730
that Mars was the planet that was the

137
00:08:21,130 --> 00:08:19,010
most like earth better information about

138
00:08:23,830 --> 00:08:21,140

Mars and its surface came with the

139
00:08:27,100 --> 00:08:23,840
development of new technology the first

140
00:08:29,920 --> 00:08:27,110
breakthrough came in 1964 when NASA's

141
00:08:31,840 --> 00:08:29,930
Mariner 4 spacecraft flew by Mars at a

142
00:08:35,470 --> 00:08:31,850
distance of nine thousand eight hundred

143
00:08:38,590 --> 00:08:35,480
forty-four kilometers Mariner four

144
00:08:40,810 --> 00:08:38,600
returned 22 images of Mars including

145
00:08:43,150 --> 00:08:40,820
some which showed impact craters on the

146
00:08:46,240 --> 00:08:43,160
surface and caused much comment among

147
00:08:48,700 --> 00:08:46,250
planetary scientists of the time the

148
00:08:50,920 --> 00:08:48,710
images Mariner 4 returned gave us an

149
00:08:54,850 --> 00:08:50,930
image of Mars that was totally different

150
00:08:57,790 --> 00:08:54,860
than expected it wasn't until late 1969

151
00:08:59,910 --> 00:08:57,800
with Mariner six and seven that we got a

152
00:09:02,770 --> 00:08:59,920
clearer look at the martian surface

153
00:09:05,110 --> 00:09:02,780
these two flybys gave scientists

154
00:09:06,940 --> 00:09:05,120
hundreds of images and showed many

155
00:09:08,980 --> 00:09:06,950
details of the surface that were once

156
00:09:12,010 --> 00:09:08,990
again totally unexpected

157
00:09:14,140 --> 00:09:12,020
the imaging showed a planet start and

158
00:09:17,920 --> 00:09:14,150
lunar like in appearance with craters

159
00:09:20,500 --> 00:09:17,930
and vast featureless areas also seen was

160
00:09:23,650 --> 00:09:20,510
chaotic terrain unlike anything seen

161
00:09:27,160 --> 00:09:23,660
here on earth or on the moon craters

162
00:09:29,560 --> 00:09:27,170
ranging in size from 500 meters to 500

163
00:09:32,050 --> 00:09:29,570

kilometers in diameter were seen after

164
00:09:34,210 --> 00:09:32,060
we started to fly by Mars with

165
00:09:37,639 --> 00:09:34,220
spacecraft we found that Mars was a much

166
00:09:40,249 --> 00:09:37,649
drier place than

167
00:09:42,139 --> 00:09:40,259
had been conceived before and also one

168
00:09:44,869 --> 00:09:42,149
where a very low atmospheric pressure

169
00:09:47,030 --> 00:09:44,879
less than 1% of that of the year total

170
00:09:49,730 --> 00:09:47,040
surface area of Mars is approximately

171
00:09:51,769 --> 00:09:49,740
that of the earth dry land surface so

172
00:09:55,579 --> 00:09:51,779
it's a fairly large planet in terms of

173
00:09:57,439 --> 00:09:55,589
possibilities and as a separate world

174
00:10:01,009 --> 00:09:57,449
anything you say about any particular

175
00:10:03,919 --> 00:10:01,019
place on Mars may not pertain everywhere

176
00:10:06,549 --> 00:10:03,929
on Mars 1/4 Mariner mission Mariner 9

177
00:10:10,489 --> 00:10:06,559
was successfully launched on May 30th

178
00:10:13,759 --> 00:10:10,499
1971 the spacecraft was inserted into

179
00:10:17,329 --> 00:10:13,769
Mars orbit in November of 1971 and

180
00:10:21,679 --> 00:10:17,339
functioned for 349 days returning almost

181
00:10:24,889 --> 00:10:21,689
7,000 images what Mariner 9 first

182
00:10:27,559 --> 00:10:24,899
reached Mars an intense dust storm had

183
00:10:29,540 --> 00:10:27,569
obscured most of the Martian surface so

184
00:10:33,069 --> 00:10:29,550
scientists used the opportunity to study

185
00:10:36,949 --> 00:10:33,079
the Martian moons Deimos and Phobos

186
00:10:39,139 --> 00:10:36,959
Mariner 9 eventually mapped over 85% of

187
00:10:40,910 --> 00:10:39,149
the Martian surface with images having a

188
00:10:43,910 --> 00:10:40,920

resolution of approximately one

189
00:10:46,129 --> 00:10:43,920
kilometer imaging returned from this

190
00:10:48,639 --> 00:10:46,139
mission gave scientists the first really

191
00:10:51,590 --> 00:10:48,649
comprehensive look at the red planet

192
00:10:53,900 --> 00:10:51,600
other experiments on board Mariner 9

193
00:10:56,150 --> 00:10:53,910
told scientists that Mars was a very

194
00:10:58,610 --> 00:10:56,160
cold planet and that the Martian

195
00:11:01,509 --> 00:10:58,620
atmosphere was about 1% as dense as the

196
00:11:11,480 --> 00:11:01,519
Earth's atmosphere at sea level

197
00:11:13,549 --> 00:11:11,490
dramatic change came in 1971 and it just

198
00:11:17,269 --> 00:11:13,559
revealed a fascinating place with huge

199
00:11:21,980 --> 00:11:17,279
volcanoes vast canyons enormous dry

200
00:11:25,579 --> 00:11:21,990
riverbeds sand dunes just an incredibly

201
00:11:28,280 --> 00:11:25,589
very variable planet and particularly

202
00:11:30,439 --> 00:11:28,290
fascinated with all these indications

203
00:11:33,470 --> 00:11:30,449
that water had flowed across the surface

204
00:11:35,710 --> 00:11:33,480
and some of that some of the features

205
00:11:39,499 --> 00:11:35,720
really quite startling because they were

206
00:11:41,960 --> 00:11:39,509
not dry riverbeds suggestive of large

207
00:11:46,009 --> 00:11:41,970
floods and these floods were an enormous

208
00:11:48,290 --> 00:11:46,019
magnitude they would have had discharges

209
00:11:50,679 --> 00:11:48,300
a hundred times a dischargeable present

210
00:11:55,189 --> 00:11:50,689
Mississippi was just lasted a short time

211
00:12:07,460 --> 00:11:55,199
but as a consequence people began to

212
00:12:10,249 --> 00:12:07,470
rethink how many other features on Mars

213
00:12:12,919 --> 00:12:10,259

were seen for the first time in addition

214
00:12:15,499 --> 00:12:12,929
to Olympus Mars one of the largest known

215
00:12:17,929 --> 00:12:15,509
volcanoes in the solar system there were

216
00:12:20,329 --> 00:12:17,939
vast valleys on the surface of Mars as

217
00:12:22,160 --> 00:12:20,339
well as canyons one of which is much

218
00:12:25,369 --> 00:12:22,170
longer and deeper than the Grand Canyon

219
00:12:28,429 --> 00:12:25,379
in the United States this Martian of

220
00:12:31,879 --> 00:12:28,439
this Valles Marineris extends over two

221
00:12:33,619 --> 00:12:31,889
thousand kilometres other formations and

222
00:12:35,929 --> 00:12:33,629
deposits seem to indicate that the

223
00:12:37,999 --> 00:12:35,939
long-ago and Martian history there were

224
00:12:42,439 --> 00:12:38,009
large amounts of water present on the

225
00:12:44,569 --> 00:12:42,449
surface of Mars Mars was still an enigma

226
00:12:47,629 --> 00:12:44,579
to scientists and researchers after

227
00:12:50,480 --> 00:12:47,639
Mariner 9 they wanted and needed to know

228
00:12:52,970 --> 00:12:50,490
much more about Mars specifically

229
00:12:55,970 --> 00:12:52,980
whether or not there was or had been

230
00:13:00,169 --> 00:12:55,980
life there so another unmanned mission

231
00:13:02,239 --> 00:13:00,179
to Mars was in the works viking vikings

232
00:13:05,449 --> 00:13:02,249
1 and 2 were launched from Cape Kennedy

233
00:13:08,900 --> 00:13:05,459
in the summer of 1975 and reached Mars

234
00:13:11,179 --> 00:13:08,910
in the summer of 1976 the primary

235
00:13:13,460 --> 00:13:11,189
objectives of the spacecraft were to

236
00:13:15,259 --> 00:13:13,470
safely land on the surface of Mars and

237
00:13:18,019 --> 00:13:15,269
to attempt to determine if there was

238
00:13:21,319 --> 00:13:18,029

some type of life on Mars either now or

239
00:13:23,030 --> 00:13:21,329
in the past the Mariner missions did not

240
00:13:23,749 --> 00:13:23,040
tell scientists if there was life on

241
00:13:26,210 --> 00:13:23,759
Mars

242
00:13:28,780 --> 00:13:26,220
and in the end Viking did not

243
00:13:32,059 --> 00:13:28,790
conclusively answer this question either

244
00:13:34,909 --> 00:13:32,069
the Viking spacecraft each consisted of

245
00:13:36,889 --> 00:13:34,919
two separate spacecraft there was an

246
00:13:39,230 --> 00:13:36,899
instrumented orbiter section which

247
00:13:40,700 --> 00:13:39,240
remained in orbit above Mars taking

248
00:13:43,310 --> 00:13:40,710
readings and measurements

249
00:13:46,100 --> 00:13:43,320
taking pictures and acting as a relay

250
00:13:49,400 --> 00:13:46,110
satellite for the Viking landers these

251
00:13:51,050 --> 00:13:49,410
Landers were miniature laboratories the

252
00:13:53,180 --> 00:13:51,060
goal of the Viking project was the

253
00:13:55,550 --> 00:13:53,190
exploration of Mars and we had had

254
00:13:57,769 --> 00:13:55,560
missions that went to Mars before but

255
00:13:59,780 --> 00:13:57,779
the goal of the Viking was to land

256
00:14:03,110 --> 00:13:59,790
spacecraft on the surface and actually

257
00:14:06,130 --> 00:14:03,120
explore in situ what Mars was like it

258
00:14:08,810 --> 00:14:06,140
was like being on Mars we actually had

259
00:14:10,490 --> 00:14:08,820
experiments that one would do if one of

260
00:14:12,860 --> 00:14:10,500
us were lucky enough to be landed on on

261
00:14:14,780 --> 00:14:12,870
the planet and dug up handfuls of Mars

262
00:14:16,460 --> 00:14:14,790
and had a little laboratory there it was

263
00:14:19,310 --> 00:14:16,470

fundamentally with what Viking was all

264
00:14:20,870 --> 00:14:19,320
about we used two spacecraft to do that

265
00:14:23,630 --> 00:14:20,880
we had a spacecraft that was a lander

266
00:14:25,699 --> 00:14:23,640
this base craft was in orbit it was kind

267
00:14:27,110 --> 00:14:25,709
of like a mother and a daughter the

268
00:14:28,370 --> 00:14:27,120
mother was the one that received the

269
00:14:30,470 --> 00:14:28,380
information and did a little

270
00:14:33,650 --> 00:14:30,480
investigation on its own and the ladder

271
00:14:35,150 --> 00:14:33,660
was primarily used to to do the kinds of

272
00:14:37,340 --> 00:14:35,160
things that if we were having a field

273
00:14:39,440 --> 00:14:37,350
trip on Mars we would have sent an

274
00:14:41,120 --> 00:14:39,450
exploration party up to Mars to do that

275
00:14:43,250 --> 00:14:41,130
kind of experiment they involved

276
00:14:46,490 --> 00:14:43,260
meteorology they involve biology they

277
00:14:49,130 --> 00:14:46,500
involve chemistry they involved geology

278
00:14:51,110 --> 00:14:49,140
of course the biology was a predominant

279
00:14:53,120 --> 00:14:51,120
predominant question we had because that

280
00:14:55,280 --> 00:14:53,130
was a kind of a bell ringer but

281
00:14:57,920 --> 00:14:55,290
nevertheless did the whole point of the

282
00:15:00,140 --> 00:14:57,930
Viking was to explore in breadth what

283
00:15:03,380 --> 00:15:00,150
Mars was was like and how summer how

284
00:15:06,230 --> 00:15:03,390
different it is from the earth the

285
00:15:08,750 --> 00:15:06,240
Viking spacecraft consisted of two parts

286
00:15:11,180 --> 00:15:08,760
an orbiter that was placed into orbit

287
00:15:13,160 --> 00:15:11,190
around Mars it carried the daughter ship

288
00:15:14,630 --> 00:15:13,170

that was then allowed to descend to the

289
00:15:17,690 --> 00:15:14,640
surface of the planet

290
00:15:21,110 --> 00:15:17,700
the orbiter consisted of a large

291
00:15:23,150 --> 00:15:21,120
spacecraft with very large solar panels

292
00:15:25,760 --> 00:15:23,160
so that it could absorb the sun's energy

293
00:15:28,699 --> 00:15:25,770
to burn to electrical power and be run

294
00:15:31,490 --> 00:15:28,709
the orbiter was placed into elliptical

295
00:15:33,829 --> 00:15:31,500
orbit around Mars the periapsis of the

296
00:15:36,410 --> 00:15:33,839
planet this was about 1500 kilometers

297
00:15:37,940 --> 00:15:36,420
the opposite entered orbit was trimming

298
00:15:40,699 --> 00:15:37,950
about 30,000 kilometers

299
00:15:42,829 --> 00:15:40,709
imagine this orbital passing over a

300
00:15:44,960 --> 00:15:42,839
landing site and it's a distance of

301
00:15:47,480 --> 00:15:44,970
about 15 kilometers trying to take

302
00:15:49,430 --> 00:15:47,490
pictures of a landing site that we know

303
00:15:52,460 --> 00:15:49,440
later going to be going to be used for

304
00:15:54,080 --> 00:15:52,470
the daughter ship the lander which was

305
00:15:57,170 --> 00:15:54,090
folded up like a Chris

306
00:15:59,930 --> 00:15:57,180
of a butterfly would be later landed by

307
00:16:01,730 --> 00:15:59,940
descending to the surface the descent of

308
00:16:04,490 --> 00:16:01,740
the surface was tricky because the Mars

309
00:16:06,770 --> 00:16:04,500
atmosphere was just thin enough to bring

310
00:16:08,930 --> 00:16:06,780
up the not sick enough to to slow you

311
00:16:11,510 --> 00:16:08,940
down and so there was this unique

312
00:16:15,710 --> 00:16:11,520
problem of a landing system that wasn't

313
00:16:19,190 --> 00:16:15,720

just a parachute in fact we had three

314
00:16:21,860 --> 00:16:19,200
braking systems online or once down into

315
00:16:23,390 --> 00:16:21,870
the Mars atmosphere a person is this was

316
00:16:25,700 --> 00:16:23,400
no ordinary parachute this was a

317
00:16:28,760 --> 00:16:25,710
parachute the head there slowed the

318
00:16:31,670 --> 00:16:28,770
spacecraft down at Mach and about box

319
00:16:34,490 --> 00:16:31,680
for parachute got us down to within

320
00:16:37,310 --> 00:16:34,500
about a hundred kilometers and then a

321
00:16:39,560 --> 00:16:37,320
retro rocket system was used retro

322
00:16:42,080 --> 00:16:39,570
rockets were firing the Rockets down

323
00:16:44,570 --> 00:16:42,090
against the mild surface to slowly slow

324
00:16:46,640 --> 00:16:44,580
the spacecraft found in combination with

325
00:16:49,280 --> 00:16:46,650
the radar data tell us how far we

326
00:16:51,710 --> 00:16:49,290
working surface and allow the spacecraft

327
00:16:53,270 --> 00:16:51,720
to descend to the surface the very last

328
00:16:55,790 --> 00:16:53,280
moments that be like jumping off the

329
00:16:57,710 --> 00:16:55,800
small table to eat settled on up to the

330
00:16:59,960 --> 00:16:57,720
Mars atmosphere and protect those

331
00:17:03,570 --> 00:16:59,970
valuable scientific instruments from

332
00:17:08,140 --> 00:17:06,070
the first Lander was originally

333
00:17:11,620 --> 00:17:08,150
scheduled to set down on the surface on

334
00:17:15,070 --> 00:17:11,630
July 4th 1976 in honor of America's

335
00:17:17,470 --> 00:17:15,080
Bicentennial however when the spacecraft

336
00:17:19,990 --> 00:17:17,480
reached Mars and began imaging the

337
00:17:22,210 --> 00:17:20,000
proposed landing sites the scientists

338
00:17:25,360 --> 00:17:22,220

saw a younger and more dynamic planet

339
00:17:27,460 --> 00:17:25,370
than they had expected after two weeks

340
00:17:30,130 --> 00:17:27,470
of studying the images returned from

341
00:17:32,470 --> 00:17:30,140
Mars a new landing site was selected and

342
00:17:37,240 --> 00:17:32,480
the Viking one lander set down on the

343
00:17:39,760 --> 00:17:37,250
cry see plenty show on July 20 1976 the

344
00:17:42,690 --> 00:17:39,770
Viking two Landers safely soft landed on

345
00:17:46,840 --> 00:17:42,700
the Utopia Planitia on September 3rd

346
00:17:48,910 --> 00:17:46,850
1976 the selection of the landing sites

347
00:17:51,580 --> 00:17:48,920
was one of the more controversial issues

348
00:17:53,170 --> 00:17:51,590
of the Viking missions the biologists

349
00:17:55,780 --> 00:17:53,180
wanted an area that would be the most

350
00:17:58,120 --> 00:17:55,790
hospitable to life and the landing team

351
00:18:00,580 --> 00:17:58,130
wanted the site was conducive to a safe

352
00:18:03,070 --> 00:18:00,590
landing as soon as the lander was down

353
00:18:04,870 --> 00:18:03,080
onto the surface there were two things

354
00:18:07,150 --> 00:18:04,880
done one the well-being of the

355
00:18:09,430 --> 00:18:07,160
spacecraft think about you're trying to

356
00:18:11,170 --> 00:18:09,440
land some kind of an instrument anywhere

357
00:18:13,780 --> 00:18:11,180
first thing to do is to make sure that

358
00:18:15,660 --> 00:18:13,790
the system is working elevates the the

359
00:18:17,920 --> 00:18:15,670
antenna that talked back to the earth

360
00:18:19,300 --> 00:18:17,930
takes measurement temperature

361
00:18:21,010 --> 00:18:19,310
measurements to make sure that the

362
00:18:23,710 --> 00:18:21,020
spacecraft is all right a kind of

363
00:18:25,390 --> 00:18:23,720

housekeeping maneuver there most of the

364
00:18:27,070 --> 00:18:25,400
most important piece of scientific data

365
00:18:29,830 --> 00:18:27,080
to come back would be the first picture

366
00:18:33,070 --> 00:18:29,840
and the very first picture pointed down

367
00:18:35,170 --> 00:18:33,080
to the foot pad to make sure that the

368
00:18:37,390 --> 00:18:35,180
instruments were stable with the

369
00:18:39,670 --> 00:18:37,400
spacecraft was stable and also to see

370
00:18:41,590 --> 00:18:39,680
what the Martian surface was like I will

371
00:18:43,930 --> 00:18:41,600
never forget that first evening when we

372
00:18:47,620 --> 00:18:43,940
first saw the first pictures coming back

373
00:18:49,660 --> 00:18:47,630
did 5-bit line-by-line sweeping across

374
00:18:52,060 --> 00:18:49,670
the Barros surface and seeing for the

375
00:18:53,770 --> 00:18:52,070
first time that it was a surface that

376
00:18:55,570 --> 00:18:53,780
was per measure from the young a sense

377
00:18:58,060 --> 00:18:55,580
that looked a little bit like like some

378
00:18:59,320 --> 00:18:58,070
pictures we've seen of the earth and

379
00:19:01,060 --> 00:18:59,330
that it wasn't like the moon at all

380
00:19:03,820 --> 00:19:01,070
there were rocks in the surface that

381
00:19:05,500 --> 00:19:03,830
were features to the surface you didn't

382
00:19:06,250 --> 00:19:05,510
get a horizon until the second picture

383
00:19:08,560 --> 00:19:06,260
first

384
00:19:10,960 --> 00:19:08,570
she was just to say it's sort of like

385
00:19:13,330 --> 00:19:10,970
looking down at your own foot if you

386
00:19:16,600 --> 00:19:13,340
stepped onto a brand new planet and said

387
00:19:18,640 --> 00:19:16,610
what is it like on this planet in time

388
00:19:21,100 --> 00:19:18,650

the other experiments were successfully

389
00:19:23,920 --> 00:19:21,110
activated and the results were anxiously

390
00:19:26,560 --> 00:19:23,930
awaited here on earth scientists were

391
00:19:29,010 --> 00:19:26,570
elated at this the first opportunity to

392
00:19:31,600 --> 00:19:29,020
look for life on another planet in situ

393
00:19:33,900 --> 00:19:31,610
but data from the experiments on the

394
00:19:37,000 --> 00:19:33,910
surface of Mars was inconclusive

395
00:19:39,520 --> 00:19:37,010
additionally the meteorology packages

396
00:19:41,920 --> 00:19:39,530
showed Mars to have an extremely cold

397
00:19:45,310 --> 00:19:41,930
and hostile environment to life as we

398
00:19:47,050 --> 00:19:45,320
know it here on earth the three biology

399
00:19:49,600 --> 00:19:47,060
experiments were designed to detect

400
00:19:51,460 --> 00:19:49,610
activity of microorganisms as we

401
00:19:53,620 --> 00:19:51,470
understand them if there were any

402
00:19:56,440 --> 00:19:53,630
present in the Martian soil that Viking

403
00:19:58,900 --> 00:19:56,450
gathered for testing these experiment

404
00:20:00,760 --> 00:19:58,910
packages measured a gas exchange with

405
00:20:03,280 --> 00:20:00,770
the surface sample for both the

406
00:20:06,940 --> 00:20:03,290
incorporation and release of radioactive

407
00:20:09,760 --> 00:20:06,950
carbon-14 in one experiment immediately

408
00:20:12,640 --> 00:20:09,770
after heating and humidifying a soil

409
00:20:15,880 --> 00:20:12,650
sample with a complex nutrient oxygen

410
00:20:18,100 --> 00:20:15,890
was detected about 15 times as much

411
00:20:21,190 --> 00:20:18,110
oxygen as is known to be present in the

412
00:20:22,840 --> 00:20:21,200
Martian atmosphere was released this

413
00:20:25,090 --> 00:20:22,850

result is now thought to have been

414
00:20:27,100 --> 00:20:25,100
caused by a chemical reaction between

415
00:20:29,530 --> 00:20:27,110
the soil sample and the nutrient

416
00:20:32,860 --> 00:20:29,540
solution as opposed to an indication of

417
00:20:34,600 --> 00:20:32,870
life but at the time and until all the

418
00:20:35,230 --> 00:20:34,610
data returned had a chance to be where

419
00:20:38,470 --> 00:20:35,240
you

420
00:20:42,700 --> 00:20:38,480
analyzed and reanalyzed no one could say

421
00:20:44,260 --> 00:20:42,710
for certain what this reaction meant in

422
00:20:46,029 --> 00:20:44,270
a third experiment that we kind of

423
00:20:48,610 --> 00:20:46,039
laughingly called the chicken soup

424
00:20:51,630 --> 00:20:48,620
experiment we actually tried to grow

425
00:20:54,580 --> 00:20:51,640
some organisms we took a mixture of

426
00:20:56,430 --> 00:20:54,590
delicious terrestrial ingredients are

427
00:20:59,080 --> 00:20:56,440
all sorts of vitamins and minerals

428
00:21:01,090 --> 00:20:59,090
extracts amino acids and sugars all the

429
00:21:03,970 --> 00:21:01,100
goodies that you would use if you were

430
00:21:07,000 --> 00:21:03,980
going to grow up some organisms and the

431
00:21:11,919 --> 00:21:07,010
idea was to inoculate the sample with

432
00:21:14,680 --> 00:21:11,929
these goodies now in the experiment we

433
00:21:17,440 --> 00:21:14,690
had a novel of first stage before we

434
00:21:22,990 --> 00:21:17,450
actually inoculated the sample we wanted

435
00:21:26,649 --> 00:21:23,000
to humidify some terrestrial organisms

436
00:21:29,049 --> 00:21:26,659
that form spores are known to die as a

437
00:21:32,260 --> 00:21:29,059
result of the ingestion of water so the

438
00:21:35,110 --> 00:21:32,270

idea is do we do with spore formers on

439
00:21:38,289 --> 00:21:35,120
the earth we first humidified just

440
00:21:43,390 --> 00:21:38,299
expose it to water and then finally grow

441
00:21:45,330 --> 00:21:43,400
up the offices in the case of that

442
00:21:48,190 --> 00:21:45,340
experiment we had a great surprise

443
00:21:50,919 --> 00:21:48,200
instead of the first humidification

444
00:21:54,159 --> 00:21:50,929
having no result which was what we would

445
00:21:55,810 --> 00:21:54,169
see here on earth we saw enormous

446
00:21:58,120 --> 00:21:55,820
quantities of oxygen that came out of

447
00:22:00,190 --> 00:21:58,130
the sample for reasons that at the time

448
00:22:02,799 --> 00:22:00,200
were very confusing to us we saw this

449
00:22:05,320 --> 00:22:02,809
release of oxygen not at all which we

450
00:22:07,810 --> 00:22:05,330
find here on the on the earth finally

451
00:22:10,120 --> 00:22:07,820
after some thought we figured out what

452
00:22:12,820 --> 00:22:10,130
that oxygen was we finally figured out

453
00:22:15,490 --> 00:22:12,830
that Mars surface of Mars has some

454
00:22:16,960 --> 00:22:15,500
peroxide as though there were kind of

455
00:22:19,779 --> 00:22:16,970
bleach or something spilled on the

456
00:22:21,850 --> 00:22:19,789
surface these were a little like

457
00:22:24,370 --> 00:22:21,860
hydrogen peroxide although there's no

458
00:22:27,789 --> 00:22:24,380
hydrogen peroxide in ours it's proudly

459
00:22:30,070 --> 00:22:27,799
iron peroxide a peroxide is something

460
00:22:32,020 --> 00:22:30,080
that's known to give up oxygen

461
00:22:34,740 --> 00:22:32,030
and when you add water to a peroxide

462
00:22:38,200 --> 00:22:34,750
this oxygen is released a kind of

463
00:22:39,640 --> 00:22:38,210

self-sterilizing surface in a way we

464
00:22:42,130 --> 00:22:39,650
don't know that that's the fact on Mars

465
00:22:44,110 --> 00:22:42,140
but that's a possibility and in fact it

466
00:22:46,900 --> 00:22:44,120
explains what happened in the second

467
00:22:48,960 --> 00:22:46,910
experiment in the second experiment

468
00:22:52,150 --> 00:22:48,970
where we had added the growth media

469
00:22:54,910 --> 00:22:52,160
probably what happened is the peroxide

470
00:22:58,510 --> 00:22:54,920
on Mars reacted with the growth media

471
00:23:00,550 --> 00:22:58,520
and released some of the carbon dioxide

472
00:23:03,400 --> 00:23:00,560
as though it were being broken down by

473
00:23:06,280 --> 00:23:03,410
organisms a kind of chemical reaction so

474
00:23:08,860 --> 00:23:06,290
in fact the two experiments blended

475
00:23:11,500 --> 00:23:08,870
together simple results of the third gas

476
00:23:13,720 --> 00:23:11,510
exchange experiment told us something

477
00:23:16,780 --> 00:23:13,730
about the answer to the second the label

478
00:23:18,430 --> 00:23:16,790
release experiment some of the people

479
00:23:20,260 --> 00:23:18,440
who have been interested then on life on

480
00:23:24,780 --> 00:23:20,270
Mars participated in the Viking mission

481
00:23:28,780 --> 00:23:24,790
in 1975 launched 1976 landing where they

482
00:23:30,580 --> 00:23:28,790
sifted the very fine surface material

483
00:23:32,560 --> 00:23:30,590
and put it into what was called the

484
00:23:34,120 --> 00:23:32,570
Viking biology package and conducted a

485
00:23:36,730 --> 00:23:34,130
series of experiments looking for life

486
00:23:40,600 --> 00:23:36,740
on Mars the results of those experiments

487
00:23:42,070 --> 00:23:40,610
were equivocal there were some reactions

488
00:23:43,750 --> 00:23:42,080

in the experiments that were consistent

489
00:23:47,160 --> 00:23:43,760
with life some that were inconsistent

490
00:23:50,640 --> 00:23:47,170
with life and generally the tie vote got

491
00:23:54,520 --> 00:23:50,650
ascribed to a device called a gasp from

492
00:23:59,830 --> 00:23:54,530
a tog rafi mass spectroscopy device a

493
00:24:02,440 --> 00:23:59,840
the GCMs and the GCMs showed no evidence

494
00:24:05,020 --> 00:24:02,450
for organic material in the soil it

495
00:24:07,450 --> 00:24:05,030
wasn't able to get you know final

496
00:24:09,100 --> 00:24:07,460
evidence that none existed on Mars and

497
00:24:10,690 --> 00:24:09,110
it was only looking at material taking

498
00:24:13,660 --> 00:24:10,700
from about the first four inches of the

499
00:24:16,300 --> 00:24:13,670
surface but because there was no organic

500
00:24:19,360 --> 00:24:16,310
material detectable by the GCMs it was

501
00:24:21,430 --> 00:24:19,370
thought that the reactions that were

502
00:24:24,280 --> 00:24:21,440
seen in the Viking biology package were

503
00:24:26,890 --> 00:24:24,290
inconsistent with life as we know it at

504
00:24:29,020 --> 00:24:26,900
present most scientists and researchers

505
00:24:31,930 --> 00:24:29,030
discount the theory that intelligent

506
00:24:33,940 --> 00:24:31,940
life was ever present on Mars there are

507
00:24:36,160 --> 00:24:33,950
those however who believe that at some

508
00:24:38,259 --> 00:24:36,170
time in Martian history there was

509
00:24:41,049 --> 00:24:38,269
intelligent life on the planet

510
00:24:43,509 --> 00:24:41,059
this minority claims that teachers seen

511
00:24:45,909 --> 00:24:43,519
in certain images returned by the Viking

512
00:24:48,119 --> 00:24:45,919
orbiters of the Martian surface show

513
00:24:50,769 --> 00:24:48,129

signs of past intelligent life there

514
00:24:53,469 --> 00:24:50,779
they feel that some of the features seen

515
00:24:55,839 --> 00:24:53,479
in certain images are actually monuments

516
00:24:58,810 --> 00:24:55,849
left behind by a past Martian base

517
00:25:02,349 --> 00:24:58,820
civilization for us to find and use as a

518
00:25:03,759 --> 00:25:02,359
beacon a beacon to a home in on to find

519
00:25:07,180 --> 00:25:03,769
the remnants of this proposed

520
00:25:10,449 --> 00:25:07,190
civilization although not endorsed by

521
00:25:12,699 --> 00:25:10,459
NASA Richard Hoagland space author and

522
00:25:14,919 --> 00:25:12,709
lecturer because of some of the Viking

523
00:25:17,769 --> 00:25:14,929
images suggest a past intelligent

524
00:25:20,589 --> 00:25:17,779
civilization on Mars set of photographs

525
00:25:22,299 --> 00:25:20,599
taken on the morning of July 25th 1976

526
00:25:25,089 --> 00:25:22,309
came in through the various channels

527
00:25:27,310 --> 00:25:25,099
back to the computers of JPL and then to

528
00:25:29,979 --> 00:25:27,320
those of us who were gathered at PPL to

529
00:25:33,009 --> 00:25:29,989
witness this historic first landing of

530
00:25:35,139 --> 00:25:33,019
spacecraft along another planet and one

531
00:25:37,719 --> 00:25:35,149
of those photographs showed a mile-long

532
00:25:40,659 --> 00:25:37,729
1500 foot high Mesa in the cydonia

533
00:25:43,149 --> 00:25:40,669
region the northern deserts that was

534
00:25:46,389 --> 00:25:43,159
literally out of place it did not belong

535
00:25:48,669 --> 00:25:46,399
he had cried out for explanation if only

536
00:25:51,609 --> 00:25:48,679
for reassurance that it could not be

537
00:25:54,399 --> 00:25:51,619
real because the object look like a

538
00:25:56,829 --> 00:25:54,409

human face it's highly speculative

539
00:26:02,139 --> 00:25:56,839
there's no question about it there's an

540
00:26:04,569 --> 00:26:02,149
interesting I think that this

541
00:26:07,060 --> 00:26:04,579
speculation is all very much interesting

542
00:26:09,599 --> 00:26:07,070
to sell newspapers but there's not a lot

543
00:26:11,949 --> 00:26:09,609
of scientific credibility in it

544
00:26:15,129 --> 00:26:11,959
unfortunately we don't have enough data

545
00:26:16,899 --> 00:26:15,139
to address the question of why this

546
00:26:19,569 --> 00:26:16,909
happens to look like a human face but I

547
00:26:21,430 --> 00:26:19,579
would suggest it most one of the most

548
00:26:23,949 --> 00:26:21,440
adaptive features that humans have is

549
00:26:26,560 --> 00:26:23,959
the ability to recognize human faces in

550
00:26:28,569 --> 00:26:26,570
order to envision that those monuments

551
00:26:29,919 --> 00:26:28,579
were created by a civilization and

552
00:26:32,379 --> 00:26:29,929
intelligent civilization

553
00:26:34,749 --> 00:26:32,389
you really need to extrapolate our

554
00:26:37,599 --> 00:26:34,759
knowledge of evolution and biological

555
00:26:40,719 --> 00:26:37,609
processes enormous ly somehow you have

556
00:26:43,359 --> 00:26:40,729
to envision that life started on Mars

557
00:26:46,329 --> 00:26:43,369
and it evolved very rapidly and

558
00:26:48,279 --> 00:26:46,339
persisted even in the face of adverse

559
00:26:49,950 --> 00:26:48,289
conditions if the planet got colder and

560
00:26:53,060 --> 00:26:49,960
drier it would have been

561
00:26:55,470 --> 00:26:53,070
call for life to have continued somehow

562
00:26:57,289 --> 00:26:55,480
to imagine a civilization there would

563
00:27:00,870 --> 00:26:57,299

have required that it did so the

564
00:27:02,760 --> 00:27:00,880
evidence of the monuments and the faces

565
00:27:05,220 --> 00:27:02,770
is very interesting I think they are

566
00:27:07,169 --> 00:27:05,230
interesting geological features some of

567
00:27:09,720 --> 00:27:07,179
the people who claim that the monuments

568
00:27:12,299 --> 00:27:09,730
on Mars and the face on Mars are indeed

569
00:27:15,120 --> 00:27:12,309
artifacts from an extinct civilization

570
00:27:17,100 --> 00:27:15,130
do not claim that intelligent life or

571
00:27:19,639 --> 00:27:17,110
the life ones that may have constructed

572
00:27:22,500 --> 00:27:19,649
these alleged structures evolved on Mars

573
00:27:24,750 --> 00:27:22,510
rather they say that the beings may have

574
00:27:29,370 --> 00:27:24,760
come from another planet another solar

575
00:27:31,769 --> 00:27:29,380
system or another galaxy the idea that

576
00:27:34,260 --> 00:27:31,779
this supposin complex of structures on

577
00:27:37,639 --> 00:27:34,270
Mars are a construct stems from their

578
00:27:39,990 --> 00:27:37,649
geometric alignment we have found

579
00:27:42,180 --> 00:27:40,000
provocative sets of objects and the

580
00:27:44,279 --> 00:27:42,190
important thing is sets because of the

581
00:27:47,389 --> 00:27:44,289
resolution we're looking at 15 meters

582
00:27:50,010 --> 00:27:47,399
hundred meters you're not going to see

583
00:27:51,960 --> 00:27:50,020
structures of comparable size to those

584
00:27:54,870 --> 00:27:51,970
on earth you're seeing much larger

585
00:27:57,120 --> 00:27:54,880
objects and the only indicator that they

586
00:27:59,399 --> 00:27:57,130
are made by intelligence is their

587
00:28:01,740 --> 00:27:59,409
relative geometric placement well as

588
00:28:04,919 --> 00:28:01,750

other objects Carl Sagan who had some

589
00:28:07,409 --> 00:28:04,929
credentials for for pronouncements in

590
00:28:09,810 --> 00:28:07,419
this area has said that on earth the

591
00:28:11,789 --> 00:28:09,820
first indicator of intelligent design is

592
00:28:14,220 --> 00:28:11,799
the geometric regularity of our

593
00:28:15,570 --> 00:28:14,230
constructions taking that rule of thumb

594
00:28:18,120 --> 00:28:15,580
and applying it to another planet like

595
00:28:20,279 --> 00:28:18,130
Mars if we see a set of objects in a

596
00:28:22,799 --> 00:28:20,289
very particular geometric configuration

597
00:28:25,370 --> 00:28:22,809
the suspicion is raised just the

598
00:28:28,200 --> 00:28:25,380
suspicion maybe we should look closer

599
00:28:30,360 --> 00:28:28,210
unfortunately we only have really good

600
00:28:32,159 --> 00:28:30,370
coverage from Cydonia we do not have

601
00:28:33,840 --> 00:28:32,169
dual sets of pictures taken to two

602
00:28:36,539 --> 00:28:33,850
different Sun angles like we do with

603
00:28:39,570 --> 00:28:36,549
Cydonia in other places both sides do

604
00:28:42,360 --> 00:28:39,580
agree on two points first the face is

605
00:28:44,490 --> 00:28:42,370
indeed a very fascinating image but what

606
00:28:47,669 --> 00:28:44,500
it is or means is still open for

607
00:28:50,190 --> 00:28:47,679
speculation and second that the Mars

608
00:28:52,799 --> 00:28:50,200
Observer spacecraft should definitely be

609
00:28:54,870 --> 00:28:52,809
used return higher resolution images and

610
00:28:58,169 --> 00:28:54,880
more complete imaging than anything

611
00:28:59,560 --> 00:28:58,179
Viking sent back the ultimate answer to

612
00:29:02,170 --> 00:28:59,570
the question of

613
00:29:04,720 --> 00:29:02,180

or these features made by some life-form

614
00:29:08,200 --> 00:29:04,730
were caused by natural processes on the

615
00:29:10,510 --> 00:29:08,210
Martian surface awaits us but until a

616
00:29:13,170 --> 00:29:10,520
human sets foot on the surface of Mars

617
00:29:16,030 --> 00:29:13,180
and can examine the evidence firsthand