1
00:00:27,300 --> 00:00:24,990
there is a small planet so near the Sun

2
00:00:31,410 --> 00:00:27,310
that it is scarcely visited in the

3
00:00:33,990 --> 00:00:31,420
bright glare of our star like an elusive

4
00:00:36,420 --> 00:00:34,000
ghost it is best observed from Earth in

5
00:00:37,460 --> 00:00:36,430
the Twilight hours when the Sun is gone

6
00:00:44,760 --> 00:00:37,470
from the sky

7
00:00:46,920 --> 00:00:44,770
the ancient Romans gave it its name so

8
00:00:48,840 --> 00:00:46,930
little was known about the planet but

9
00:00:54,689 --> 00:00:48,850
scientists could only guess at its

10
00:01:00,500 --> 00:00:54,699
origin and evolution like the planet

11
00:01:00,510 --> 00:01:07,130
deep canyons scarred by violent winds

12
00:01:12,960 --> 00:01:10,289
more like our own moon its surface might

13
00:01:14,789 --> 00:01:12,970

be pitted with craters a record of

14
00:01:19,469 --> 00:01:14,799
ancient events written on a planet's

15
00:01:22,920 --> 00:01:19,479
surface the best photographs of mercury

16
00:01:25,350 --> 00:01:22,930
added little to our knowledge but when

17
00:01:27,209 --> 00:01:25,360
man learned to travel in space the

18
00:01:30,840 --> 00:01:27,219
electronic cameras of a spacecraft

19
00:01:49,709 --> 00:01:30,850
called Mariner 10 revealed the planet in

20
00:01:55,959 --> 00:01:54,010
in June of 1975 scientists from five

21
00:01:58,870 --> 00:01:55,969
nations assembled at the California

22
00:02:00,459 --> 00:01:58,880
Institute of Technology to exchange the

23
00:02:02,649 --> 00:02:00,469
information they had gained from the

24
00:02:06,819 --> 00:02:02,659
exploration of the planet Mercury by the

25
00:02:08,770 --> 00:02:06,829
spacecraft Mariner 10 included in the

26
00:02:11,559 --> 00:02:08,780
group for scientists representing many

27
00:02:13,420 --> 00:02:11,569
techniques of exploration including the

28
00:02:16,089 --> 00:02:13,430
detection of various forms of radiation

29
00:02:18,789 --> 00:02:16,099
a study of gases in a planet's

30
00:02:21,940 --> 00:02:18,799
atmosphere and the powerful scientific

31
00:02:25,490 --> 00:02:21,950
tool photography of the surface of a

32
00:02:34,559 --> 00:02:32,369
welcome to Pasadena we are convened the

33
00:02:36,540 --> 00:02:34,569
photographic exploration of mercury was

34
00:02:40,910 --> 00:02:36,550
led by dr. Bruce Murray of the

35
00:02:44,210 --> 00:02:40,920
California Institute of Technology the

36
00:02:46,949 --> 00:02:44,220
objective I have is to present a

37
00:02:49,650 --> 00:02:46,959
relatively simple interpretation of

38
00:02:51,539 --> 00:02:49,660

history of mercury and to draw some

39
00:02:55,020 --> 00:02:51,549
conclusions about the other terrestrial

40
00:02:57,360 --> 00:02:55,030
planets the work that dr. Murray and his

41
00:02:59,160 --> 00:02:57,370
colleagues are engrossed in goes beyond

42
00:03:03,630 --> 00:02:59,170
the exploration of a single planet

43
00:03:05,759 --> 00:03:03,640
mercury they are seeking insights into

44
00:03:09,900 --> 00:03:05,769
the history of our entire inner solar

45
00:03:26,010 --> 00:03:09,910
system the search for new information

46
00:03:31,090 --> 00:03:29,200
these photographs appear were taken to

47
00:03:33,220 --> 00:03:31,100
test the cameras that were to photograph

48
00:03:40,210 --> 00:03:33,230
both venus and mercury for the first

49
00:03:43,090 --> 00:03:40,220
time after leaving the gravitational

50
00:03:47,230 --> 00:03:43,100
field of Earth Mariner 10 began its long

51
00:03:49,750 --> 00:03:47,240
voyage to mercury the spacecraft's

52
00:03:51,940 --> 00:03:49,760
flight path was carefully chosen to skim

53
00:03:55,990 --> 00:03:51,950
past the planet orbiting between Earth

54
00:03:58,330 --> 00:03:56,000
and Mercury cloud-covered Venus the

55
00:04:01,320 --> 00:03:58,340
Mariner 10 cameras at close range

56
00:04:05,680 --> 00:04:01,330
were to show us a startling new Venus a

57
00:04:07,990 --> 00:04:05,690
Venus we couldn't see from Earth Venus

58
00:04:10,690 --> 00:04:08,000
has been a real frustration to

59
00:04:12,360 --> 00:04:10,700
photograph from the ground because in

60
00:04:14,830 --> 00:04:12,370
the visible it's perfectly featureless

61
00:04:17,220 --> 00:04:14,840
there is occasionally a little bit of

62
00:04:20,229 --> 00:04:17,230
indentation along the Terminator and

63
00:04:22,660 --> 00:04:20,239

occasionally one can see a little

64
00:04:25,450 --> 00:04:22,670
structure around the limb but basically

65
00:04:29,500 --> 00:04:25,460
appears from the earth to be obscured by

66
00:04:32,050 --> 00:04:29,510
an incredible haze and the ultraviolet

67
00:04:34,780 --> 00:04:32,060
however that's the wavelengths beyond

68
00:04:37,990 --> 00:04:34,790
the blue that the eye cannot see but

69
00:04:41,440 --> 00:04:38,000
photographic film can respond to very

70
00:04:42,760 --> 00:04:41,450
faint markings have been observed and it

71
00:04:45,130 --> 00:04:42,770
was those faint markings in the

72
00:04:47,320 --> 00:04:45,140
ultraviolet that persuaded us to make a

73
00:04:50,790 --> 00:04:47,330
maximum effort to photograph Venus in

74
00:04:53,249 --> 00:04:50,800
the ultraviolet up close

75
00:04:56,810 --> 00:04:53,259
the Mariner 10 cameras photographed

76
00:04:59,270 --> 00:04:56,820
Venus in high-resolution sections

77
00:05:04,700 --> 00:04:59,280
each photograph covering only a small

78
00:05:06,890 --> 00:05:04,710
portion of the planet the frames were

79
00:05:09,020 --> 00:05:06,900
then pieced together into mosaics to

80
00:05:19,100 --> 00:05:09,030
give a detailed picture of the entire

81
00:05:21,500 --> 00:05:19,110
planet the results of the Mariner 10

82
00:05:23,270 --> 00:05:21,510
photography in the ultraviolet are

83
00:05:26,390 --> 00:05:23,280
really good in fact much much better

84
00:05:28,940 --> 00:05:26,400
than we had hoped because as you can see

85
00:05:31,600 --> 00:05:28,950
looking at first a picture of Venus in

86
00:05:34,310 --> 00:05:31,610
the visible that was taken by Mariner 10

87
00:05:36,560 --> 00:05:34,320
and then when we switched to one that

88
00:05:38,600 --> 00:05:36,570

was taken in the ultraviolet and has

89
00:05:41,300 --> 00:05:38,610
been enhanced for the computer to bring

90
00:05:43,510 --> 00:05:41,310
up the details there's a tremendous

91
00:05:45,530 --> 00:05:43,520
pattern of organization of markings

92
00:05:50,120 --> 00:05:45,540
let's take a look at what's in these

93
00:05:53,690 --> 00:05:50,130
pictures the most prominent thing that

94
00:05:57,980 --> 00:05:53,700
one can see is a very bright south polar

95
00:06:01,490 --> 00:05:57,990
cap probably a great vortex almost like

96
00:06:03,740 --> 00:06:01,500
a huge cyclone and there are dark

97
00:06:07,550 --> 00:06:03,750
streaks that come into this as though

98
00:06:10,640 --> 00:06:07,560
they're winding up like taffy so the

99
00:06:14,030 --> 00:06:10,650
whole series of mosaics is like a series

100
00:06:17,270 --> 00:06:14,040
of snapshots of Venus in time and from

101
00:06:20,660 --> 00:06:17,280
those mosaics it was possible to create

102
00:06:23,150 --> 00:06:20,670
a time-lapse movie of the rotation of

103
00:06:26,180 --> 00:06:23,160
the Venus atmosphere during the period

104
00:06:29,780 --> 00:06:26,190
of time mirror ten flew by and flew away

105
00:06:32,120 --> 00:06:29,790
from the front so the pattern of

106
00:06:34,190 --> 00:06:32,130
rotation of features on Venus and the

107
00:06:38,750 --> 00:06:34,200
upper atmosphere way up high by our

108
00:06:42,710 --> 00:06:38,760
standards is remarkable in that the

109
00:06:45,470 --> 00:06:42,720
atmosphere on Venus rotates faster than

110
00:06:47,090 --> 00:06:45,480
the surface in the case of the earth the

111
00:06:49,490 --> 00:06:47,100
atmosphere tends to drag behind a little

112
00:06:51,470 --> 00:06:49,500
bit as one might imagine case of Venus

113
00:06:53,950 --> 00:06:51,480

the atmosphere rotates all the way

114
00:06:58,780 --> 00:06:53,960
around the planet once every four days

115
00:07:01,940 --> 00:06:58,790
the surface rotates once every 243 days

116
00:07:05,240 --> 00:07:01,950
so the atmosphere is rotating almost 60

117
00:07:10,030 --> 00:07:05,250
times as fast at the top anyway as a

118
00:07:14,990 --> 00:07:12,950
the gravitational field of Venus was

119
00:07:18,260 --> 00:07:15,000
used to bend the flight path of Mariner

120
00:07:20,120 --> 00:07:18,270
10 inwards towards mercury then the

121
00:07:21,740 --> 00:07:20,130
gravity of the Sun pulled Mariner

122
00:07:25,250 --> 00:07:21,750
towards its first encounter with the

123
00:07:32,810 --> 00:07:29,210
in March of 1974 Mariner 10 flew past

124
00:07:36,380 --> 00:07:32,820
mercury during the next year it would

125
00:07:38,900 --> 00:07:36,390
perform two more flyby Mariner 10

126
00:07:43,790 --> 00:07:38,910
returned almost 3,000 pictures of the

127
00:07:46,700 --> 00:07:43,800
surface of mercury these pictures reveal

128
00:07:49,010 --> 00:07:46,710
craters and other features which were

129
00:07:51,830 --> 00:07:49,020
formed very early in the history of

130
00:07:53,900 --> 00:07:51,840
mercury and may refer to events that

131
00:07:57,860 --> 00:07:53,910
affected the entire inner solar system

132
00:08:06,500 --> 00:07:57,870
Mars Earth Moon and Venus as well as

133
00:08:09,650 --> 00:08:06,510
mercury the pictures of mercury revealed

134
00:08:12,410 --> 00:08:09,660
craters and many other features and to

135
00:08:14,960 --> 00:08:12,420
the geologist these features and these

136
00:08:19,550 --> 00:08:14,970
pictures are like the pages of a history

137
00:08:23,600 --> 00:08:19,560
book and the entry book for mercury may

138
00:08:30,310 --> 00:08:23,610

go back almost to the formation of the

139
00:08:37,310 --> 00:08:34,460
five million years ago a vast cloud of

140
00:08:40,640 --> 00:08:37,320
gas and dust floated through the galaxy

141
00:08:43,040 --> 00:08:40,650
we call the Milky Way the ghostly

142
00:08:47,810 --> 00:08:43,050
remains of a great star that had died in

143
00:08:50,410 --> 00:08:47,820
a gigantic explosion the gas and dust is

144
00:08:53,210 --> 00:08:50,420
twisted and shaped by magnetic forces

145
00:08:58,430 --> 00:08:53,220
electrical currents and the subtle pull

146
00:09:01,700 --> 00:08:58,440
of gravity as it swirls around a

147
00:09:08,000 --> 00:09:01,710
thickening core the huge cloud gradually

148
00:09:11,210 --> 00:09:08,010
flattens into a disk dust and gas

149
00:09:20,080 --> 00:09:11,220
gravitates slowly inwards and Eddie's

150
00:09:38,579 --> 00:09:22,570
particles of matter clustering two solid

151
00:09:43,840 --> 00:09:41,259
the larger bodies continue to grow

152
00:09:45,790 --> 00:09:43,850
sweeping up particles and dust as they

153
00:09:48,460 --> 00:09:45,800
orbit the condensing core of the disk

154
00:09:54,639 --> 00:09:48,470
and begin to heat under the increasing

155
00:09:57,280 --> 00:09:54,649
gravitational pressures in the central

156
00:09:59,949 --> 00:09:57,290
core of the disk incredible heat is

157
00:10:03,310 --> 00:09:59,959
being generated hotter and hotter until

158
00:10:07,210 --> 00:10:03,320
it reaches critical temperatures and

159
00:10:09,730 --> 00:10:07,220
then billions of years ago a nuclear

160
00:10:17,690 --> 00:10:09,740
reaction occurred and our Sun was

161
00:10:24,410 --> 00:10:20,150
it's intense radiation repels the

162
00:10:26,570 --> 00:10:24,420
surrounding gas and dust the increasing

163
00:10:30,440 --> 00:10:26,580

heat of the inner planets has formed

164
00:10:33,230 --> 00:10:30,450
them into molten spheres mercury like

165
00:10:36,260 --> 00:10:33,240
the other inner planets is continuously

166
00:10:40,970 --> 00:10:36,270
bombarded by debris that form craters on

167
00:10:44,180 --> 00:10:40,980
its surface in the final stages of its

168
00:10:48,620 --> 00:10:44,190
formation mercury flowed from internal

169
00:10:51,440 --> 00:10:48,630
heat hot lava was forced to a surface

170
00:10:56,000 --> 00:10:51,450
being torn by collisions with masses of

171
00:10:58,030 --> 00:10:56,010
rock that were shaping the planet the

172
00:11:00,800 --> 00:10:58,040
same heat that triggered the lava flows

173
00:11:05,560 --> 00:11:00,810
also melted rock and metals in the

174
00:11:07,970 --> 00:11:05,570
interior of Mercury heavy iron

175
00:11:10,880 --> 00:11:07,980
concentrated at Mercury's center to form

176
00:11:13,130 --> 00:11:10,890
a dense core which was overlain by a

177
00:11:17,870 --> 00:11:13,140
thin shell of lighter material brought

178
00:11:20,150 --> 00:11:17,880
to the surface by lava flows again the

179
00:11:23,120 --> 00:11:20,160
surface was gouged and pitted by a great

180
00:11:27,140 --> 00:11:23,130
series of impacts leaving huge craters

181
00:11:29,480 --> 00:11:27,150
on the surface the Mariner 10

182
00:11:46,310 --> 00:11:29,490
photographs have revealed these early

183
00:11:52,170 --> 00:11:49,170
one of these craters was formed by a

184
00:11:56,730 --> 00:11:52,180
massive rock perhaps a small planet that

185
00:11:59,430 --> 00:11:56,740
crashed into mercury in the Mariner 10

186
00:12:03,410 --> 00:11:59,440
photographs half of this huge crater was

187
00:12:11,830 --> 00:12:09,250
today this huge crater is called Caloris

188
00:12:13,620 --> 00:12:11,840

the impact spewed millions of tons of

189
00:12:16,180 --> 00:12:13,630
debris across the surface of mercury

190
00:12:21,460 --> 00:12:16,190
creating a ring of mountain ranges over

191
00:12:25,450 --> 00:12:21,470
a mile high the floor of this basement

192
00:12:31,120 --> 00:12:25,460
was split by great surface cracks wide

193
00:12:34,690 --> 00:12:31,130
and deep as the surface continued to

194
00:12:38,950 --> 00:12:34,700
form deep inside mercury it's heavy iron

195
00:12:42,580 --> 00:12:38,960
core began to contract the surface

196
00:12:45,120 --> 00:12:42,590
buckled cracked and great sections

197
00:12:48,310 --> 00:12:45,130
hundreds of miles wide were split open

198
00:12:55,990 --> 00:12:48,320
leaving immense mile-high walls of rock

199
00:12:58,330 --> 00:12:56,000
called scarps again there was a great

200
00:13:04,230 --> 00:12:58,340
flow of lava covering many of the large

201
00:13:07,060 --> 00:13:04,240
craters and leaving smooth flat plains

202
00:13:10,120 --> 00:13:07,070
this set the stage for the final episode

203
00:13:16,590 --> 00:13:10,130
in the history of mercury a period of

204
00:13:24,809 --> 00:13:23,009
in this time mercury died the internal

205
00:13:29,999 --> 00:13:24,819
heat that triggered many of the events

206
00:13:32,389 --> 00:13:30,009
in the planet's history turned off and

207
00:13:46,020 --> 00:13:32,399
for three and a half billion years

208
00:13:52,300 --> 00:13:49,600
before Mariner 10 there were a multitude

209
00:13:55,240 --> 00:13:52,310
of possible Mercury's now there's only

210
00:13:58,330 --> 00:13:55,250
one the mercury of craters and basins

211
00:14:01,150 --> 00:13:58,340
and planes this illustrates how

212
00:14:04,870 --> 00:14:01,160
photography can be an exploratory tool

213
00:14:07,270 --> 00:14:04,880

it displays features which were perhaps

214
00:14:10,210 --> 00:14:07,280
never even anticipated and and sometimes

215
00:14:12,790 --> 00:14:10,220
could not even be imagined before the

216
00:14:14,590 --> 00:14:12,800
experiment was flown in a sense it

217
00:14:18,220 --> 00:14:14,600
provides answers to questions that were

218
00:14:20,620 --> 00:14:18,230
not even asked this was true at Mars

219
00:14:23,770 --> 00:14:20,630
when Mariner 4 returned pictures of what

220
00:14:25,420 --> 00:14:23,780
appeared to be a a moon like surface it

221
00:14:27,520 --> 00:14:25,430
had been expected that Mars might be

222
00:14:29,320 --> 00:14:27,530
very much like the earth the folded

223
00:14:31,750 --> 00:14:29,330
mountain ranges and many other

224
00:14:34,950 --> 00:14:31,760
earth-like features instead it looked

225
00:14:37,210 --> 00:14:34,960
like the moon and that was a big shock

226
00:14:41,410 --> 00:14:37,220
and it was even bigger shock when

227
00:14:44,890 --> 00:14:41,420
Mariner 9 in 1971 visited Mars again and

228
00:14:48,130 --> 00:14:44,900
found huge volcanoes and even some

229
00:14:49,360 --> 00:14:48,140
peculiar sinuous channels that looked

230
00:14:51,040 --> 00:14:49,370
like they might have been formed by

231
00:14:55,720 --> 00:14:51,050
flowing water at some point in Mars

232
00:14:59,800 --> 00:14:55,730
history now Viking has transported man's

233
00:15:02,200 --> 00:14:59,810
vision to the actual surface the fantasy

234
00:15:04,930 --> 00:15:02,210
of science fiction has been replaced by

235
00:15:09,730 --> 00:15:04,940
the strange lonely reality of the

236
00:15:13,420 --> 00:15:09,740
Martian landscape when Mariner 10 flew

237
00:15:17,980 --> 00:15:13,430
by Venus it discovered an unexpectedly

238
00:15:20,470 --> 00:15:17,990

well-organized set of cloud motions and

239
00:15:23,410 --> 00:15:20,480
the unexpected was certainly encountered

240
00:15:25,870 --> 00:15:23,420
in case of mercury which turned out to

241
00:15:28,390 --> 00:15:25,880
exhibit not only moonlight features on

242
00:15:30,820 --> 00:15:28,400
its surface but a sequence of events

243
00:15:33,550 --> 00:15:30,830
there that seemed to be very similar to

244
00:15:34,390 --> 00:15:33,560
those of the moon and that's

245
00:15:37,720 --> 00:15:34,400
extraordinary

246
00:15:40,840 --> 00:15:37,730
because mercury is very different inside

247
00:15:43,350 --> 00:15:40,850
compared to the moon and that means it

248
00:15:46,510 --> 00:15:43,360
must have had a different history of

249
00:15:49,960 --> 00:15:46,520
heating and modification the surface

250
00:15:51,160 --> 00:15:49,970
from the inside and furthermore it lives

251
00:15:52,950 --> 00:15:51,170
in a very different part of the solar

252
00:15:55,510 --> 00:15:52,960
system much closer to the Sun and

253
00:15:59,370 --> 00:15:55,520
therefore it must have experienced a

254
00:16:01,810 --> 00:15:59,380
for exterior history as well and yet a

255
00:16:04,390 --> 00:16:01,820
picture show that we're Creek has a

256
00:16:06,460 --> 00:16:04,400
surface history very similar to that of

257
00:16:10,740 --> 00:16:06,470
the moon and to me that's extraordinary

258
00:16:14,110 --> 00:16:10,750
a comparison of the craters on the moon

259
00:16:16,150 --> 00:16:14,120
Mercury and Mars shows that these inner

260
00:16:20,080 --> 00:16:16,160
planets were subjected to cratering at

261
00:16:21,820 --> 00:16:20,090
the same time before Mariner 10 it was

262
00:16:24,460 --> 00:16:21,830
believed that the source of cratering of

263
00:16:28,510 --> 00:16:24,470

the inner solar system was the asteroid

264
00:16:30,670 --> 00:16:28,520
belt orbiting beyond Mars because of the

265
00:16:32,740 --> 00:16:30,680
difference in distance from the belt it

266
00:16:36,520 --> 00:16:32,750
was assumed that no two planets would be

267
00:16:38,500 --> 00:16:36,530
cratered the same those planets farther

268
00:16:42,580 --> 00:16:38,510
from the asteroid belt like mercury

269
00:16:44,950 --> 00:16:42,590
would have fewer craters but a careful

270
00:16:46,420 --> 00:16:44,960
count of the craters on mercury and a

271
00:16:50,700 --> 00:16:46,430
comparison with those on the Moon and

272
00:16:53,920 --> 00:16:50,710
Mars showed them all to be roughly equal

273
00:16:55,720 --> 00:16:53,930
if the crater count is equal then the

274
00:16:58,150 --> 00:16:55,730
source could not be the asteroid belt

275
00:17:00,090 --> 00:16:58,160
but must have come from elsewhere in the

276
00:17:03,070 --> 00:17:00,100
solar system

277
00:17:04,960 --> 00:17:03,080
one strong possibility is the planet

278
00:17:09,010 --> 00:17:04,970
Jupiter with a gravitational attraction

279
00:17:11,949 --> 00:17:09,020
second only to the Sun it is possible

280
00:17:14,199 --> 00:17:11,959
that on two occasions Jupiter literally

281
00:17:17,110 --> 00:17:14,209
hurled millions of tons of rock inwards

282
00:17:20,310 --> 00:17:17,120
towards the Sun to impact the planets of

283
00:17:23,530 --> 00:17:20,320
the inner solar system including mercury

284
00:17:25,600 --> 00:17:23,540
this cratered record on Mercury was read

285
00:17:29,140 --> 00:17:25,610
three times because of a fortunate

286
00:17:33,790 --> 00:17:29,150
coincidence Mercury's orbit around the

287
00:17:35,440 --> 00:17:33,800
Sun is 88 Earth days Mariner tens orbit

288
00:17:38,740 --> 00:17:35,450

was twice as long or a hundred

289
00:17:41,680 --> 00:17:38,750
seventy-six days these synchronous

290
00:17:48,890 --> 00:17:41,690
orbits allowed Mariner 10 to fly past

291
00:17:59,340 --> 00:17:52,020
the path of the first flyby was on the

292
00:18:01,770 --> 00:17:59,350
dark side of mercury the second

293
00:18:03,690 --> 00:18:01,780
encounter sent the spacecraft past the

294
00:18:08,520 --> 00:18:03,700
light side of the planet specifically

295
00:18:11,130 --> 00:18:08,530
for photography after another six-month

296
00:18:13,470 --> 00:18:11,140
journey around the Sun Mariner 10 made

297
00:18:15,480 --> 00:18:13,480
its third and final encounter to look

298
00:18:18,330 --> 00:18:15,490
again at a major discovery made during

299
00:18:21,030 --> 00:18:18,340
the first flyby the presence of a

300
00:18:26,490 --> 00:18:21,040
magnetic field around mercury similar to

301
00:18:30,900 --> 00:18:26,500
earth a bow shock wave blocks the solar

302
00:18:32,910 --> 00:18:30,910
wind from the Sun and deflects it around

303
00:18:34,530 --> 00:18:32,920
the planet creating an environment

304
00:18:38,490 --> 00:18:34,540
similar to the magnetic field around

305
00:18:41,820 --> 00:18:38,500
Earth this discovery was a surprise

306
00:18:45,060 --> 00:18:41,830
because mercury slow rotation about once

307
00:18:46,560 --> 00:18:45,070
every 57 Earth days had led scientists

308
00:18:50,310 --> 00:18:46,570
to believe that the planet could not

309
00:18:52,290 --> 00:18:50,320
generate a magnetic field it is believed

310
00:18:54,870 --> 00:18:52,300
that Earth's magnetic field is generated

311
00:18:59,270 --> 00:18:54,880
by an interaction between the planets

312
00:19:02,040 --> 00:18:59,280
faster rotation and its molten core

313
00:19:04,440 --> 00:19:02,050

mariner tens discovery may change

314
00:19:07,470 --> 00:19:04,450
theories on how these fields are formed

315
00:19:09,960 --> 00:19:07,480
and has given scientists their first

316
00:19:15,090 --> 00:19:09,970
opportunity to compare two magnetic

317
00:19:16,919 --> 00:19:15,100
fields in the inner solar system there

318
00:19:21,540 --> 00:19:16,929
were other measurements made at Mercury

319
00:19:24,120 --> 00:19:21,550
by Mariner 10 infrared showed that

320
00:19:27,000 --> 00:19:24,130
mercury surface ranges in temperature

321
00:19:29,310 --> 00:19:27,010
from 700 degrees Fahrenheit to 300

322
00:19:33,330 --> 00:19:29,320
degrees below zero the widest

323
00:19:35,700 --> 00:19:33,340
temperature range of any planet the

324
00:19:37,890 --> 00:19:35,710
ultraviolet experiment revealed that

325
00:19:42,870 --> 00:19:37,900
mercury has a very thin atmosphere of

326
00:19:45,270 --> 00:19:42,880
helium sensors measured the invisible

327
00:19:47,790 --> 00:19:45,280
cosmic rays which flood our solar system

328
00:19:50,100 --> 00:19:47,800
at tremendous speeds penetrate any

329
00:19:53,190 --> 00:19:50,110
surface and are unaffected by

330
00:19:58,290 --> 00:19:53,200
gravitational forces their source is

331
00:20:00,650 --> 00:19:58,300
unknown exploration is an adaptive

332
00:20:03,270 --> 00:20:00,660
process each new piece of information

333
00:20:06,810 --> 00:20:03,280
adds the value of others that were

334
00:20:08,970 --> 00:20:06,820
accumulated earlier we had the results

335
00:20:11,760 --> 00:20:08,980
of the Apollo program on the moon to

336
00:20:13,680 --> 00:20:11,770
help us understand the timescales and a

337
00:20:19,340 --> 00:20:13,690
some extent the processes we were seeing

338
00:20:24,060 --> 00:20:21,600

now that Mariner 10 has looked at

339
00:20:27,090 --> 00:20:24,070
mercury we can begin to compare it with

340
00:20:29,010 --> 00:20:27,100
the Moon and Mars and begin to realize

341
00:20:31,320 --> 00:20:29,020
that there is a common solar system

342
00:20:33,960 --> 00:20:31,330
history which has been recorded on these

343
00:20:35,850 --> 00:20:33,970
planets whose early services have not

344
00:20:40,710 --> 00:20:35,860
been erased by erosion and other

345
00:20:43,620 --> 00:20:40,720
atmospheric processes that same common

346
00:20:46,500 --> 00:20:43,630
history affected the earth too and so by

347
00:20:49,200 --> 00:20:46,510
looking at these services reading those

348
00:20:51,470 --> 00:20:49,210
records we're in fact looking back into

349
00:20:54,630 --> 00:20:51,480
the Earth's history into a heretofore

350
00:20:57,750 --> 00:20:54,640
unexplored domain of time our own

351
00:21:00,510 --> 00:20:57,760
history on the earth now we can begin to

352
00:21:04,020 --> 00:21:00,520
compare and contrast to look for

353
00:21:07,500 --> 00:21:04,030
similarities and differences and try to

354
00:21:10,770 --> 00:21:07,510
recognize our family relationships among

355
00:21:14,340 --> 00:21:10,780
the terrestrial planets are we cousins

356
00:21:16,350 --> 00:21:14,350
or brothers or all of us bizarre

357
00:21:20,100 --> 00:21:16,360
strangers it happened inhabit the same

358
00:21:22,470 --> 00:21:20,110
portion of the solar system that's the

359
00:21:29,090 --> 00:21:22,480
task of comparative planetology

360
00:21:38,139 --> 00:21:32,730
in future planetary flights Venus will

361
00:21:43,139 --> 00:21:40,959
the probes of one pioneer spacecraft

362
00:21:53,909 --> 00:21:43,149
will penetrate its thick atmosphere

363
00:22:03,880 --> 00:21:57,130

- Mariner class spacecraft will explore

364
00:22:08,710 --> 00:22:03,890
the planet Jupiter and then fly upward

365
00:22:11,409 --> 00:22:08,720
to reach Saturn one of the Mariners may

366
00:22:14,789 --> 00:22:11,419
be sent on to the planet Uranus over a

367
00:22:19,570 --> 00:22:14,799
billion and a half miles from the Sun

368
00:22:23,260 --> 00:22:19,580
and someday in our future we will send

369
00:22:27,240 --> 00:22:23,270
intelligent machines robots to explore

370
00:22:30,539 --> 00:22:27,250
the hostile surface of Mars and perhaps