



1
00:00:45,770 --> 00:00:43,700
for more than 20 centuries the moon has

2
00:00:48,410 --> 00:00:45,780
been studied and investigated by skilled

3
00:00:50,240 --> 00:00:48,420
and ingenious men they have come to

4
00:00:52,670 --> 00:00:50,250
realize that in comparing the moon with

5
00:00:55,700 --> 00:00:52,680
you we can learn more about the history

6
00:00:57,400 --> 00:00:55,710
of both and ultimately more about the

7
00:01:00,319 --> 00:00:57,410
history of the solar system as a whole

8
00:01:02,420 --> 00:01:00,329
in the process we would gain a new

9
00:01:12,440 --> 00:01:02,430
perspective about our own place and role

10
00:01:14,660 --> 00:01:12,450
on our small blue planet before a manned

11
00:01:17,539 --> 00:01:14,670
Apollo flights to the moon we could only

12
00:01:22,030 --> 00:01:17,549
study it remotely primarily by way of

13
00:01:25,219 --> 00:01:22,040

instruments such as the telescope and

14

00:01:32,140 --> 00:01:25,229

recently in history by way of automated

15

00:01:37,430 --> 00:01:35,480

early in the 17th century galileo

16

00:01:40,070 --> 00:01:37,440

galilei became the first of the great

17

00:01:42,440 --> 00:01:40,080

scientists to use the telescope a quite

18

00:01:47,660 --> 00:01:42,450

novel instrument at the time to study

19

00:01:50,270 --> 00:01:47,670

the moon I feel sure that the surface of

20

00:01:52,700 --> 00:01:50,280

the Moon is not perfectly smooth free

21

00:01:54,980 --> 00:01:52,710

from inequalities and exactly spherical

22

00:01:59,210 --> 00:01:54,990

as a large school of philosophers

23

00:02:02,510 --> 00:01:59,220

considers on the contrary it is full of

24

00:02:05,300 --> 00:02:02,520

inequalities uneven full of hollows and

25

00:02:08,719 --> 00:02:05,310

protuberances just like the surface of

26

00:02:10,850 --> 00:02:08,729

the earth itself his discoveries helped

27

00:02:13,910 --> 00:02:10,860

overturn erroneous beliefs popularly

28

00:02:18,310 --> 00:02:13,920

held and taught for 14 centuries and lay

29

00:02:22,970 --> 00:02:20,990

Galileo would be followed by a scream of

30

00:02:25,640 --> 00:02:22,980

other scientists and a mass of new

31

00:02:27,590 --> 00:02:25,650

information and knowledge the centuries

32

00:02:33,110 --> 00:02:27,600

of investigations produced a great deal

33

00:02:35,780 --> 00:02:33,120

of information about the moon for

34

00:02:38,449 --> 00:02:35,790

instance the moon orbiting once about

35

00:02:41,210 --> 00:02:38,459

every four weeks always keeping the same

36

00:02:43,250 --> 00:02:41,220

face toward Earth is far larger and more

37

00:02:44,810 --> 00:02:43,260

distant compared with its planet then

38

00:02:46,580 --> 00:02:44,820

are any of the other moons of our solar

39

00:02:49,280 --> 00:02:46,590

system compared with their planets in

40

00:02:51,310 --> 00:02:49,290

fact the moon is often considered a

41

00:02:54,290 --> 00:02:51,320

planet in its own right

42

00:02:56,060 --> 00:02:54,300

further some scientists believe that the

43

00:02:58,610 --> 00:02:56,070

moon is gradually pulling away from the

44

00:03:01,449 --> 00:02:58,620

earth which in turn is gradually

45

00:03:03,949 --> 00:03:01,459

revolving slower and slower on its axis

46

00:03:05,840 --> 00:03:03,959

there is at least some evidence that the

47

00:03:08,390 --> 00:03:05,850

moon was much nearer Earth in the past

48

00:03:13,520 --> 00:03:08,400

although no one knows just how near it

49

00:03:18,600 --> 00:03:16,380

the surface of the Moon has aptly been

50

00:03:21,270 --> 00:03:18,610

described as a cosmic battlefield a

51

00:03:24,300 --> 00:03:21,280

place terribly hostile to life

52

00:03:26,850 --> 00:03:24,310

it is alternately baked and frozen in

53

00:03:29,160 --> 00:03:26,860

temperatures ranging from some 250

54

00:03:32,339 --> 00:03:29,170

degrees Fahrenheit above zero to some

55

00:03:37,860 --> 00:03:32,349

250 degrees below zero and it is seared

56

00:03:39,660 --> 00:03:37,870

by radiation from the Sun as a whole the

57

00:03:41,940 --> 00:03:39,670

surface of the Moon may be divided into

58

00:03:43,860 --> 00:03:41,950

the heavily cratered Highlands which

59

00:03:46,650 --> 00:03:43,870

Galileo called the brighter parts and

60

00:03:51,660 --> 00:03:46,660

the Maurya which Galileo called the

61

00:03:54,449 --> 00:03:51,670

darker parts the highlands are far more

62

00:03:59,339 --> 00:03:54,459

rugged having 20 to 30 times more

63

00:04:01,229 --> 00:03:59,349

craters than the Maurya this means that

64

00:04:03,030 --> 00:04:01,239

the formation of craters had slowed

65

00:04:10,440 --> 00:04:03,040

drastically by the time the Maurya

66

00:04:12,119 --> 00:04:10,450

basins were filled in essence the

67

00:04:15,599 --> 00:04:12,129

Highlands were formed when the moon was

68

00:04:21,569 --> 00:04:15,609

a growing dynamic body the Maurya when

69

00:04:24,029 --> 00:04:21,579

the moon was far less active in contrast

70

00:04:25,800 --> 00:04:24,039

with the moon's face the far side is

71

00:04:30,320 --> 00:04:25,810

almost totally covered with Highlands

72

00:04:34,440 --> 00:04:32,760

telescopes and automated satellites

73

00:04:37,800 --> 00:04:34,450

brought us close-up looks at many

74

00:04:40,680 --> 00:04:37,810

individual features for instance in the

75

00:04:46,330 --> 00:04:40,690

highlands craters which look much like

76

00:04:51,340 --> 00:04:48,700

other craters which look like impact

77

00:04:53,260 --> 00:04:51,350

sites sometimes with streaks of debris

78

00:04:57,640 --> 00:04:53,270

radiating hundreds of miles away from

79

00:04:59,620 --> 00:04:57,650

their centers mountain ranges which

80

00:05:05,080 --> 00:04:59,630

tower thousands of feet above the

81

00:05:10,450 --> 00:05:05,090

surrounding Plains symmetrical Hills

82

00:05:16,150 --> 00:05:10,460

known as domes apparent red glows first

83

00:05:18,310 --> 00:05:16,160

seen in the 1950s where the Highlands

84

00:05:20,500 --> 00:05:18,320

and Mario meet there are features which

85

00:05:25,660 --> 00:05:20,510

look much like ocean waves approaching a

86

00:05:28,570 --> 00:05:25,670

rugged shoreline the Maurya basins are

87

00:05:31,090 --> 00:05:28,580

comparatively smooth and flat likened to

88

00:05:33,580 --> 00:05:31,100

a frozen sea by the first meander orbit

89

00:05:36,310 --> 00:05:33,590

the moon and they are marked by

90

00:05:42,340 --> 00:05:36,320

so-called wrinkled ridges which had the

91

00:05:45,190 --> 00:05:42,350

appearance of frozen waves phantom

92

00:05:50,440 --> 00:05:45,200

craters evidently real craters virtually

93

00:05:52,720 --> 00:05:50,450

inundated by Mario materials then there

94

00:05:58,360 --> 00:05:52,730

are valleys which wander for hundreds of

95

00:06:00,640 --> 00:05:58,370

miles across the surface great fractures

96

00:06:05,620 --> 00:06:00,650

or faults which may slice across the

97

00:06:07,050 --> 00:06:05,630

moon's face for a hundred miles there

98

00:06:10,570 --> 00:06:07,060

are the newly discovered mass

99

00:06:13,090 --> 00:06:10,580

concentrations or mass cones buried

100

00:06:14,950 --> 00:06:13,100

beneath the circular Marya and their

101

00:06:16,750 --> 00:06:14,960

gravitational attraction actually

102

00:06:21,210 --> 00:06:16,760

distorts the flight paths of space

103

00:06:25,980 --> 00:06:24,120

from surveyor spacecraft there was even

104

00:06:34,620 --> 00:06:25,990

some knowledge of the nature of the soil

105

00:06:37,340 --> 00:06:34,630

and a chemistry of materials yet for all

106

00:06:40,320 --> 00:06:37,350

we had learned for all we had discovered

107

00:06:42,690 --> 00:06:40,330

even with unmanned space vehicles which

108

00:06:44,940 --> 00:06:42,700

landed on the surface and manned Apollo

109

00:06:48,690 --> 00:06:44,950

vehicles which orbited above the surface

110

00:07:00,200 --> 00:06:48,700

the moon still somehow seemed remote and

111

00:07:08,640 --> 00:07:05,280

putting feet down to a nap any feet two

112

00:07:11,520 --> 00:07:08,650

and a half down take that out for

113

00:07:16,860 --> 00:07:11,530

forward forward drift into the right

114

00:07:22,110 --> 00:07:16,870

little shiny second or weakest I kept

115

00:07:22,120 --> 00:07:29,490

at the battle out there contact light

116

00:07:39,630 --> 00:07:34,580

okay engine stop we copy it down eagle

117

00:07:43,230 --> 00:07:39,640

and Gordie babe here we go out landed in

118

00:07:44,580 --> 00:07:43,240

a sense from this moment on the old moon

119

00:07:47,430 --> 00:07:44,590

that had once been the stuff of

120

00:07:50,700 --> 00:07:47,440

impossible dreams completely disappeared

121

00:07:53,520 --> 00:07:50,710

and a new moon of mountains and valleys

122

00:07:57,600 --> 00:07:53,530

and stone and dirt and possible dreams

123

00:08:01,050 --> 00:07:57,610

took its place I will get to the details

124

00:08:04,380 --> 00:08:01,060

of what's around here but it looked like

125

00:08:08,960 --> 00:08:04,390

a collection of just about every variety

126

00:08:12,860 --> 00:08:08,970

of shaped angularity granularity that

127

00:08:16,280 --> 00:08:12,870

every variety of rock you could find

128

00:08:22,340 --> 00:08:16,290

fairly large number of craters of the

129

00:08:27,840 --> 00:08:22,350

five 250-foot variety and some reaches

130

00:08:30,650 --> 00:08:27,850

for 2013 Iowa death and literally

131

00:08:34,500 --> 00:08:30,660

thousands of little one and stupid

132

00:08:39,230 --> 00:08:34,510

craters around the area there is a hill

133

00:08:42,480 --> 00:08:39,240

and you just about on the ground track

134

00:08:47,010 --> 00:08:42,490

ahead of it difficult to estimate but

135

00:08:49,770 --> 00:08:47,020

might be a half a mile and throughout

136

00:08:52,860 --> 00:08:49,780

the world there was renewed belief not

137

00:08:57,120 --> 00:08:52,870

just in American technology but in human

138

00:08:59,640 --> 00:08:57,130

abilities thus in the Moon Sea of

139

00:09:04,980 --> 00:08:59,650

Tranquility a new chapter in the history

140

00:09:07,380 --> 00:09:04,990

of science was begun simultaneously a

141

00:09:09,720 --> 00:09:07,390

carefully developed and planned program

142

00:09:14,670 --> 00:09:09,730

of scientific investigation was set in

143

00:09:17,579 --> 00:09:14,680

motion there would be new information

144

00:09:20,070 --> 00:09:17,589

about the internal structure of the moon

145

00:09:23,610 --> 00:09:20,080

the chemical composition of the rocks

146

00:09:28,380 --> 00:09:23,620

and soil the dynamic processes at work

147

00:09:31,330 --> 00:09:28,390

and the ages of materials scientists

148

00:09:34,010 --> 00:09:31,340

shared a great sense of excitement

149

00:09:36,380 --> 00:09:34,020

in the highest-priority scientific

150

00:09:38,090 --> 00:09:36,390

undertaking the astronauts collected a

151
00:09:40,600 --> 00:09:38,100
selection of samples of the lunar

152
00:09:43,010 --> 00:09:40,610
surface the first extraterrestrial

153
00:09:47,240 --> 00:09:43,020
materials ever to be brought to earth

154
00:09:49,970 --> 00:09:47,250
from a known context in an experience so

155
00:10:28,010 --> 00:09:49,980
new every fragment of information was of

156
00:10:30,500 --> 00:10:28,020
intense scientific interest in the

157
00:10:32,900 --> 00:10:30,510
centres of small craters the astronauts

158
00:10:37,580 --> 00:10:32,910
discovered strange features which looked

159
00:10:39,440 --> 00:10:37,590
much like splattered solder or glass the

160
00:10:41,900 --> 00:10:39,450
astronauts discovered rocks which had

161
00:10:44,180 --> 00:10:41,910
been hurled from neighboring craters yet

162
00:10:46,940 --> 00:10:44,190
they saw no impact scars in the powdery

163
00:10:48,560 --> 00:10:46,950

surface with a rock struck the scars had

164

00:10:52,130 --> 00:10:48,570

apparently been eroded away by an

165

00:10:54,260 --> 00:10:52,140

unknown process the astronauts set up an

166

00:10:56,660 --> 00:10:54,270

array of instruments in effect a

167

00:10:58,490 --> 00:10:56,670

miniature scientific station to return

168

00:11:02,750 --> 00:10:58,500

data to earth long after the men

169

00:11:04,900 --> 00:11:02,760

themselves had left one of the

170

00:11:07,250 --> 00:11:04,910

instruments relatively simple in concept

171

00:11:09,200 --> 00:11:07,260

was a reflecting device which would

172

00:11:14,030 --> 00:11:09,210

intercept a laser beam from earth and

173

00:11:17,760 --> 00:11:16,200

measuring the time it took the beam to

174

00:11:18,240 --> 00:11:17,770

travel from the earth to the moon and

175

00:11:20,340 --> 00:11:18,250

back

176
00:11:23,400 --> 00:11:20,350
scientists could calculate the distance

177
00:11:25,080 --> 00:11:23,410
to the moon within a few inches they

178
00:11:27,510 --> 00:11:25,090
will be able to use such precise

179
00:11:29,670 --> 00:11:27,520
measurements in studying the earth for

180
00:11:33,480 --> 00:11:29,680
instance the variations in its rotation

181
00:11:38,550 --> 00:11:33,490
rate the wobble of its axis the drift of

182
00:11:41,100 --> 00:11:38,560
its continents another of the devices

183
00:11:43,220 --> 00:11:41,110
was a seismometer an instrument which

184
00:11:45,870 --> 00:11:43,230
detects vibrations of the lunar surface

185
00:11:47,340 --> 00:11:45,880
the vibrations reflect something of the

186
00:11:53,130 --> 00:11:47,350
nature of the internal structure and

187
00:11:55,620 --> 00:11:53,140
energy release of the moon a few months

188
00:11:58,440 --> 00:11:55,630

later when Apollo 12 landed in the ocean

189

00:12:00,660 --> 00:11:58,450

of storms the astronauts given more time

190

00:12:02,820 --> 00:12:00,670

for scientific work on the surface were

191

00:12:05,640 --> 00:12:02,830

able to enlarge on all that the Apollo

192

00:12:08,130 --> 00:12:05,650

11 astronauts had accomplished they were

193

00:12:10,680 --> 00:12:08,140

able to range farther collect more and

194

00:12:14,370 --> 00:12:10,690

better documented samples and set up a

195

00:12:16,380 --> 00:12:14,380

larger scientific station the scientific

196

00:12:22,110 --> 00:12:16,390

exploration of the moon was now well

197

00:12:24,930 --> 00:12:22,120

underway the lunar materials returned to

198

00:12:27,480 --> 00:12:24,940

Earth were met with high excitement more

199

00:12:29,760 --> 00:12:27,490

than 140 scientists from this country

200

00:12:33,210 --> 00:12:29,770

and abroad understand two painstaking

201
00:12:35,340 --> 00:12:33,220
and intensive investigations we're

202
00:12:38,340 --> 00:12:35,350
broadening our horizon we were never

203
00:12:40,140 --> 00:12:38,350
able to do that while the intense

204
00:12:41,910 --> 00:12:40,150
activity that took place on the surface

205
00:12:44,640 --> 00:12:41,920
of the earth when it was a young planet

206
00:12:46,710 --> 00:12:44,650
had wiped out the record of the first

207
00:12:49,710 --> 00:12:46,720
million years in his history the moon

208
00:12:51,680 --> 00:12:49,720
has now restored that missing record in

209
00:12:54,360 --> 00:12:51,690
so far as we can related to the earth I

210
00:12:56,160 --> 00:12:54,370
think it's contact with the feelings of

211
00:12:58,020 --> 00:12:56,170
every person not merely with the

212
00:13:02,700 --> 00:12:58,030
specialists regarding what he's doing

213
00:13:04,500 --> 00:13:02,710

here on the face of this planet typical

214

00:13:07,170 --> 00:13:04,510

of the detailed efforts were studies

215

00:13:09,810 --> 00:13:07,180

with electron microscopes which produced

216

00:13:17,950 --> 00:13:09,820

magnifications up to 1 million times and

217

00:13:22,730 --> 00:13:21,140

for some of these studies samples were

218

00:13:25,640 --> 00:13:22,740

sectioned with a knife which has the

219

00:13:33,710 --> 00:13:25,650

sharpest edge known it can split a hair

220

00:13:35,810 --> 00:13:33,720

into ten thousand sections the

221

00:13:40,280 --> 00:13:35,820

scientists often felt a sense of wonder

222

00:13:42,130 --> 00:13:40,290

what they saw dot which looks like gray

223

00:13:44,720 --> 00:13:42,140

material without interest has

224

00:13:46,790 --> 00:13:44,730

exceedingly beautiful and varied forms

225

00:13:48,170 --> 00:13:46,800

just from an aesthetic standpoint as

226

00:13:49,610 --> 00:13:48,180

well of course from a scientific

227

00:13:51,470 --> 00:13:49,620

standpoint when you put it under the

228

00:13:53,660 --> 00:13:51,480

microscope the material is just

229

00:13:54,730 --> 00:13:53,670

beautiful aesthetically and of course

230

00:13:59,330 --> 00:13:54,740

it's beautiful

231

00:14:01,370 --> 00:13:59,340

scientifically among the materials there

232

00:14:03,890 --> 00:14:01,380

are crystalline rocks clearly marked as

233

00:14:06,410 --> 00:14:03,900

igneous by bubble-like cavities and by

234

00:14:09,260 --> 00:14:06,420

their chemistry they were crystallized

235

00:14:11,030 --> 00:14:09,270

from molten silicon material in a lunar

236

00:14:17,600 --> 00:14:11,040

inferno with temperatures well over

237

00:14:19,550 --> 00:14:17,610

2,000 degrees Fahrenheit there are other

238

00:14:21,580 --> 00:14:19,560

rocks which consist of fragments of the

239

00:14:24,800 --> 00:14:21,590

igneous rocks embedded in lunar soil

240

00:14:26,710 --> 00:14:24,810

call Breck Sia's they were formed when

241

00:14:29,360 --> 00:14:26,720

meteorites impacted on the surface

242

00:14:31,760 --> 00:14:29,370

producing such tremendous pressures that

243

00:14:36,610 --> 00:14:31,770

rubble and soil were welded into solid

244

00:14:40,880 --> 00:14:39,170

both the igneous rocks and the breck

245

00:14:43,550 --> 00:14:40,890

Sia's they are clear witness to

246

00:14:45,410 --> 00:14:43,560

prolonged meteorite bombardment they

247

00:14:49,070 --> 00:14:45,420

have been rounded as if they had been

248

00:14:50,480 --> 00:14:49,080

severely sandblasted pitted where they

249

00:14:58,700 --> 00:14:50,490

have been struck by micrometeorites

250

00:15:01,700 --> 00:14:58,710

traveling at high velocity and some

251
00:15:03,440 --> 00:15:01,710
coated with glass a material which had

252
00:15:11,360 --> 00:15:03,450
been melted and splashed by a meteorite

253
00:15:16,980 --> 00:15:14,610
rocks from Apollo 11 and Apollo 12 are

254
00:15:18,750 --> 00:15:16,990
in some ways similar but there were

255
00:15:22,230 --> 00:15:18,760
important differences in chemistry

256
00:15:24,840 --> 00:15:22,240
mineral composition and texture further

257
00:15:27,330 --> 00:15:24,850
the minerals of the Apollo 11 marks took

258
00:15:30,090 --> 00:15:27,340
on their present arrangement about 3.7

259
00:15:34,320 --> 00:15:30,100
billion years ago the minerals of the

260
00:15:37,170 --> 00:15:34,330
Apollo 12 rocks about 3.3 or 3.4 billion

261
00:15:39,390 --> 00:15:37,180
years ago an indication of two different

262
00:15:42,360 --> 00:15:39,400
events separated by several hundred

263
00:15:45,210 --> 00:15:42,370

million years the ages were far greater

264

00:15:47,250 --> 00:15:45,220

than many expected it was probably

265

00:15:49,530 --> 00:15:47,260

during this time more than three billion

266

00:15:53,160 --> 00:15:49,540

years ago that the Maurya basins were

267

00:15:55,290 --> 00:15:53,170

filled while the opponent well rocks

268

00:15:57,300 --> 00:15:55,300

were generally somewhat younger the

269

00:16:00,840 --> 00:15:57,310

collection did yield one unique and

270

00:16:03,990 --> 00:16:00,850

quite complicated Rock number 13 now

271

00:16:07,410 --> 00:16:04,000

famous in lunar science portions of rock

272

00:16:09,930 --> 00:16:07,420

13 proved to be some 4.6 billion years

273

00:16:12,660 --> 00:16:09,940

old very merely the age of the solar

274

00:16:14,460 --> 00:16:12,670

system itself this may be some

275

00:16:18,870 --> 00:16:14,470

indication of what to expect from the

276

00:16:21,540 --> 00:16:18,880

lunar Highlands another type of material

277

00:16:24,260 --> 00:16:21,550

is the lunar soil created apparently as

278

00:16:27,240 --> 00:16:24,270

rocks had been pulverized by bombardment

279

00:16:29,550 --> 00:16:27,250

one core tube sample from the Apollo 12

280

00:16:31,740 --> 00:16:29,560

landing site showed the soil was

281

00:16:34,500 --> 00:16:31,750

stratified or layered with lighter

282

00:16:35,790 --> 00:16:34,510

darker bands of material they even

283

00:16:40,350 --> 00:16:35,800

seemed that one layer might have a

284

00:16:42,510 --> 00:16:40,360

mixture of volcanic ash under the

285

00:16:44,870 --> 00:16:42,520

microscope it can be seen that the soil

286

00:16:47,280 --> 00:16:44,880

consists of tiny fragments of rocks

287

00:16:49,890 --> 00:16:47,290

particles of glass and bits of

288

00:16:52,770 --> 00:16:49,900

meteorites even the soil shows evidence

289

00:16:55,170 --> 00:16:52,780

of bombardment some of the individual

290

00:16:57,150 --> 00:16:55,180

brains have been so pitted in fact that

291

00:17:02,560 --> 00:16:57,160

they look almost like tiny replicas of

292

00:17:07,420 --> 00:17:04,870

in examining the lunar soils and Breck

293

00:17:09,430 --> 00:17:07,430

sees scientists have found an abundance

294

00:17:15,540 --> 00:17:09,440

of products of the solar wind the

295

00:17:20,980 --> 00:17:18,520

they have found in fact that if an ounce

296

00:17:22,960 --> 00:17:20,990

of lunar soil is heated to about 1,800

297

00:17:24,700 --> 00:17:22,970

degrees Fahrenheit at an atmospheric

298

00:17:27,340 --> 00:17:24,710

pressure equal to that at sea level

299

00:17:29,730 --> 00:17:27,350

about 12 cubic inches of gas will be

300

00:17:33,520 --> 00:17:29,740

produced primarily hydrogen and helium

301
00:17:36,100 --> 00:17:33,530
directly from the Sun it is possible

302
00:17:39,430 --> 00:17:36,110
using the moon materials to go back and

303
00:17:40,750 --> 00:17:39,440
trace the behavior of the Sun almost

304
00:17:41,590 --> 00:17:40,760
back to the beginning of the solar

305
00:17:43,450 --> 00:17:41,600
system

306
00:17:45,490 --> 00:17:43,460
the interesting part about the solar

307
00:17:48,370 --> 00:17:45,500
wind is that it represents the actual

308
00:17:50,740 --> 00:17:48,380
stuff of the Sun if you had in Turkey

309
00:17:53,320 --> 00:17:50,750
Hamzah maybe the dippy end of the Sun

310
00:17:56,860 --> 00:17:53,330
and reach out and take this material and

311
00:17:58,660 --> 00:17:56,870
bring it back to your laboratory the

312
00:18:01,390 --> 00:17:58,670
lunar materials have also been closely

313
00:18:03,520 --> 00:18:01,400

searched for any trace of life or even

314

00:18:05,470 --> 00:18:03,530

for any materials with organic contents

315

00:18:07,210 --> 00:18:05,480

it has been a search which the

316

00:18:12,019 --> 00:18:07,220

scientists have so far found to be

317

00:18:12,029 --> 00:18:14,520

you

318

00:18:18,480 --> 00:18:16,470

scientists have found the results more

319

00:18:22,590 --> 00:18:18,490

interesting however when earth organisms

320

00:18:25,860 --> 00:18:22,600

have been exposed to lunar materials of

321

00:18:28,890 --> 00:18:25,870

the variety of biological systems that

322

00:18:31,500 --> 00:18:28,900

we tested with the lunar material the

323

00:18:34,920 --> 00:18:31,510

plants were most unique in their

324

00:18:37,560 --> 00:18:34,930

response for example the five jars of

325

00:18:41,040 --> 00:18:37,570

liverworts you see illustrated on the

326

00:18:43,740 --> 00:18:41,050

top gave much increased growth in the

327

00:18:46,530 --> 00:18:43,750

presence of lunar material this effect

328

00:18:48,990 --> 00:18:46,540

was noted for ferns a number of tissue

329

00:18:51,630 --> 00:18:49,000

cultures such as tobacco and corn and

330

00:18:54,840 --> 00:18:51,640

certain higher plant species such as

331

00:18:57,480 --> 00:18:54,850

lettuce now the exact reasons for this

332

00:19:01,140 --> 00:18:57,490

beneficial response are unknown at the

333

00:19:05,670 --> 00:19:01,150

present however it is likely that some

334

00:19:07,790 --> 00:19:05,680

trace mineral or perhaps even a physical

335

00:19:10,290 --> 00:19:07,800

property of the lunar material is

336

00:19:13,170 --> 00:19:10,300

interacting with the minerals we furnish

337

00:19:16,320 --> 00:19:13,180

to give a more desirable medium for

338

00:19:18,690 --> 00:19:16,330

plant growth this is a very exciting

339

00:19:21,840 --> 00:19:18,700

discovery and one that was totally

340

00:19:27,090 --> 00:19:21,850

unexpected in the tests conducted in the

341

00:19:29,190 --> 00:19:27,100

lunar receiving laboratory the flooded

342

00:19:29,760 --> 00:19:29,200

information derived lunar materials

343

00:19:34,340 --> 00:19:29,770

alone

344

00:19:38,970 --> 00:19:37,320

in the mean time however still more

345

00:19:40,650 --> 00:19:38,980

information is flowing in from the

346

00:19:43,320 --> 00:19:40,660

scientific instruments set up by the

347

00:19:45,240 --> 00:19:43,330

astronauts scientists received one of

348

00:19:47,580 --> 00:19:45,250

their biggest surprises when the Apollo

349

00:19:49,800 --> 00:19:47,590

12 seismometer told the story of how the

350

00:19:53,460 --> 00:19:49,810

moon vibrated when it was struck by the

351
00:19:57,510 --> 00:19:53,470
astronauts abandoned lunar module it is

352
00:20:00,750 --> 00:19:57,520
as though one had struck a belt in the

353
00:20:03,210 --> 00:20:00,760
belfry of the church a single blow and

354
00:20:06,510 --> 00:20:03,220
found that the reverberation from it

355
00:20:08,370 --> 00:20:06,520
continued for 30 minutes the signal

356
00:20:09,030 --> 00:20:08,380
seemed to indicate that the energy the

357
00:20:11,520 --> 00:20:09,040
impact

358
00:20:14,190 --> 00:20:11,530
scattered greatly on one hand but had a

359
00:20:16,170 --> 00:20:14,200
prolonged duration on the other such a

360
00:20:19,320 --> 00:20:16,180
combination of characteristics simply

361
00:20:21,750 --> 00:20:19,330
does not occur on earth subsequently

362
00:20:24,030 --> 00:20:21,760
signals of a similar nature will receive

363
00:20:27,560 --> 00:20:24,040

from other impacts both natural and

364

00:20:32,460 --> 00:20:30,450

after analyzing signals recorded over

365

00:20:35,130 --> 00:20:32,470

several months scientists also

366

00:20:36,840 --> 00:20:35,140

discovered evidence of moon quakes these

367

00:20:38,460 --> 00:20:36,850

occurred each time the moon passed

368

00:20:40,350 --> 00:20:38,470

through the point of its orbit closest

369

00:20:42,120 --> 00:20:40,360

to Earth when there was maximum

370

00:20:44,970 --> 00:20:42,130

gravitational attraction between the two

371

00:20:46,380 --> 00:20:44,980

bodies apparently the attraction

372

00:20:50,190 --> 00:20:46,390

triggered the quakes and they were

373

00:20:52,950 --> 00:20:50,200

possibly a volcanic origin so far

374

00:20:54,630 --> 00:20:52,960

however the seismometer detected those

375

00:20:57,480 --> 00:20:54,640

signals that would indicate events

376

00:21:02,549 --> 00:20:57,490

originating deep within the moon such

377

00:21:04,350 --> 00:21:02,559

events occur frequently under the upshot

378

00:21:07,320 --> 00:21:04,360

is that the meaning of the signals is

379

00:21:09,720 --> 00:21:07,330

far from understood from other

380

00:21:12,870 --> 00:21:09,730

instruments scientists are harvesting

381

00:21:15,870 --> 00:21:12,880

rich new information on the magnetic

382

00:21:18,500 --> 00:21:15,880

fields of the moon and of the earth the

383

00:21:21,210 --> 00:21:18,510

extremely thin atmosphere of the moon

384

00:21:25,440 --> 00:21:21,220

the rate at which particles stream away

385

00:21:27,330 --> 00:21:25,450

from the Sun for a long time to come

386

00:21:29,370 --> 00:21:27,340

scientists will be putting bits and

387

00:21:32,220 --> 00:21:29,380

pieces together searching out the

388

00:21:34,169 --> 00:21:32,230

answers to a long list of questions but

389

00:21:37,460 --> 00:21:34,179

already certain parts of the whole

390

00:21:40,590 --> 00:21:37,470

picture are beginning to take shape and

391

00:21:45,830 --> 00:21:40,600

the moon is by far our more interesting

392

00:21:51,480 --> 00:21:48,480

although every current theory about the

393

00:21:53,460 --> 00:21:51,490

moon's origin has major flaws it does

394

00:21:55,289 --> 00:21:53,470

seem probable that the major events in

395

00:21:58,049 --> 00:21:55,299

the formation and evolution of the moon

396

00:21:59,549 --> 00:21:58,059

occurred early in its history and that

397

00:22:02,669 --> 00:21:59,559

relatively little has happened since

398

00:22:04,409 --> 00:22:02,679

then one indication of this is the far

399

00:22:06,600 --> 00:22:04,419

greater frequency of craters in the

400

00:22:09,390 --> 00:22:06,610

highlands than in the Maurya which are

401
00:22:11,100 --> 00:22:09,400
themselves very old and it means that

402
00:22:12,870 --> 00:22:11,110
the moon may hold records of events

403
00:22:18,000 --> 00:22:12,880
which have long since been obliterated

404
00:22:20,130 --> 00:22:18,010
from Earth by erosion structurally the

405
00:22:22,890 --> 00:22:20,140
moon compared with the earth is an

406
00:22:24,360 --> 00:22:22,900
extremely strong and rigid body as it

407
00:22:28,110 --> 00:22:24,370
would have to be to support the great

408
00:22:31,329 --> 00:22:28,120
mass concentrations mass comes so near

409
00:22:35,449 --> 00:22:33,560
scientists have seen that great heating

410
00:22:38,719 --> 00:22:35,459
has played a major role in shaping the

411
00:22:41,199 --> 00:22:38,729
moon's face in fact the Maurya basins

412
00:22:44,149 --> 00:22:41,209
were filled with lava flows

413
00:22:46,789 --> 00:22:44,159

they have also seen that impact has

414

00:22:53,499 --> 00:22:46,799

played a major role both on a gigantic

415

00:22:59,689 --> 00:22:56,359

contrary to what many expected there has

416

00:23:02,299 --> 00:22:59,699

been no evidence of water and as most

417

00:23:04,459 --> 00:23:02,309

expected there has been no trace of life

418

00:23:08,689 --> 00:23:04,469

and there seems little chance of finding

419

00:23:10,879 --> 00:23:08,699

any but as often happens in science the

420

00:23:12,139 --> 00:23:10,889

investigation so far have raised more

421

00:23:15,409 --> 00:23:12,149

questions than they have provided

422

00:23:18,259 --> 00:23:15,419

answers for instance what is the

423

00:23:19,699 --> 00:23:18,269

interior of the Moon like what is the

424

00:23:22,549 --> 00:23:19,709

source of the heat that produced the

425

00:23:25,339 --> 00:23:22,559

lava was it produced in some way and the

426
00:23:28,789 --> 00:23:25,349
interior of the Moon or was it generated

427
00:23:30,680 --> 00:23:28,799
by meteoroid impacts what lies behind

428
00:23:32,779 --> 00:23:30,690
the fact that it is the side of the moon

429
00:23:40,849 --> 00:23:32,789
with a Marya basis that faces us on

430
00:23:42,499 --> 00:23:40,859
earth what in the tail are the relative

431
00:23:45,589 --> 00:23:42,509
differences between the Highlands and

432
00:23:50,059 --> 00:23:45,599
the Maurya and the question one always

433
00:23:52,579 --> 00:23:50,069
returns to how was the moon related in

434
00:23:54,109 --> 00:23:52,589
essence the scientific investigation of

435
00:23:59,769 --> 00:23:54,119
the Moon is one of the great

436
00:24:02,599 --> 00:23:59,779
intellectual adventures of our time and

437
00:24:04,909 --> 00:24:02,609
a major chapter was written at the first

438
00:24:08,749 --> 00:24:04,919

conference for lunar science early in

439

00:24:09,949 --> 00:24:08,759

the year 1970 well we've come an awful

440

00:24:11,119 --> 00:24:09,959

long way and I think we've learned some

441

00:24:14,180 --> 00:24:11,129

very interesting things but there's

442

00:24:15,319 --> 00:24:14,190

still an enormous amount for us to learn

443

00:24:17,869 --> 00:24:15,329

about the moon before we fully

444

00:24:19,969 --> 00:24:17,879

understand it when we go to the

445

00:24:22,430 --> 00:24:19,979

highlands and we'll go to the patterns

446

00:24:24,529 --> 00:24:22,440

that they're going to be even more

447

00:24:26,089 --> 00:24:24,539

interesting from this point of view of

448

00:24:28,430 --> 00:24:26,099

the fundamental history of the solar

449

00:24:31,129 --> 00:24:28,440

system and then the parts that we have

450

00:24:32,899 --> 00:24:31,139

already visited it is only through the

451

00:24:35,329 --> 00:24:32,909

understanding of the interior of this

452

00:24:37,430 --> 00:24:35,339

planet that we begin to start to

453

00:24:39,419 --> 00:24:37,440

understand some of the processes that we

454

00:24:43,049 --> 00:24:39,429

see on the surface of the earth

455

00:24:44,879 --> 00:24:43,059

in fact we are taking a step in our

456

00:24:47,729 --> 00:24:44,889

understanding of the solar system and

457

00:24:50,279 --> 00:24:47,739

the earth that is comparable to the one