



24 Dec 1968 16:38:42 UT

1
00:00:10,629 --> 00:00:08,230
hello and welcome to this nasa goddard

2
00:00:12,870 --> 00:00:10,639
google plus hangout on earthrise one of

3
00:00:15,350 --> 00:00:12,880
the most iconic photographs ever taken

4
00:00:17,269 --> 00:00:15,360
by humans now thanks to new data

5
00:00:19,670 --> 00:00:17,279
acquired by a nasa satellite that is

6
00:00:21,990 --> 00:00:19,680
orbiting the moon right now nasa

7
00:00:23,670 --> 00:00:22,000
visualizers have been able to recreate

8
00:00:25,990 --> 00:00:23,680
the experience of the apollo 8

9
00:00:27,670 --> 00:00:26,000
astronauts as they scrambled to take

10
00:00:29,269 --> 00:00:27,680
these photographs in both black and

11
00:00:31,349 --> 00:00:29,279
white and in color

12
00:00:33,350 --> 00:00:31,359
this new visualization essentially lets

13
00:00:36,229 --> 00:00:33,360

you sit on the shoulders of these three

14

00:00:38,150 --> 00:00:36,239

astronauts in their small space capsule

15

00:00:41,190 --> 00:00:38,160

or while they orbited the moon and

16

00:00:42,950 --> 00:00:41,200

experience this moment of earth rise

17

00:00:44,709 --> 00:00:42,960

i'm aries keck here at nasa goddard

18

00:00:46,549 --> 00:00:44,719

space flight center in maryland and

19

00:00:48,470 --> 00:00:46,559

during this hangout we'll be talk taking

20

00:00:50,630 --> 00:00:48,480

your questions and talking about this

21

00:00:52,310 --> 00:00:50,640

moment in history how the visualization

22

00:00:54,790 --> 00:00:52,320

was made and the other scientific

23

00:00:57,189 --> 00:00:54,800

discoveries being made by nasa's lunar

24

00:00:58,709 --> 00:00:57,199

reconnaissance orbiter to ask a question

25

00:01:01,110 --> 00:00:58,719

just put it in the comments section of

26
00:01:03,270 --> 00:01:01,120
this hangout or on the comment section

27
00:01:06,149 --> 00:01:03,280
of youtube or on twitter we'll be

28
00:01:06,950 --> 00:01:06,159
moderating the hashtag earthrise all one

29
00:01:09,030 --> 00:01:06,960
word

30
00:01:10,710 --> 00:01:09,040
um joining us for this hangout is the

31
00:01:12,870 --> 00:01:10,720
project scientist for the lunar

32
00:01:16,950 --> 00:01:12,880
reconnaissance orbiter which is also

33
00:01:18,550 --> 00:01:16,960
known as Iro and that's john keller

34
00:01:21,190 --> 00:01:18,560
seated in front of nasa goddard's

35
00:01:22,149 --> 00:01:21,200
hyperwall is science visualizer ernie

36
00:01:24,390 --> 00:01:22,159
wright

37
00:01:27,109 --> 00:01:24,400
and joining us from his home in vermont

38
00:01:29,270 --> 00:01:27,119

is space historian andrew chaiken

39

00:01:30,870 --> 00:01:29,280

andrew is the author of the book a man

40

00:01:33,429 --> 00:01:30,880

on the moon which formed the basis for

41

00:01:34,950 --> 00:01:33,439

the 12-part hbo series about nasa's

42

00:01:37,190 --> 00:01:34,960

apollo project

43

00:01:38,550 --> 00:01:37,200

it was called from the earth to the moon

44

00:01:40,390 --> 00:01:38,560

and andrew we're going to go to you

45

00:01:41,670 --> 00:01:40,400

first can you set the stage here for

46

00:01:44,069 --> 00:01:41,680

this moment in history that we're going

47

00:01:47,109 --> 00:01:44,079

to watch a little bit in this hangout

48

00:01:49,910 --> 00:01:47,119

well sure hi aries thank you um

49

00:01:52,069 --> 00:01:49,920

you know this is one of the most

50

00:01:53,910 --> 00:01:52,079

incredible moments in the history of

51
00:01:55,109 --> 00:01:53,920
exploration

52
00:01:57,510 --> 00:01:55,119
apollo

53
00:02:00,149 --> 00:01:57,520
was the program that landed humans on

54
00:02:03,270 --> 00:02:00,159
the moon and we rightfully focus on the

55
00:02:05,670 --> 00:02:03,280
moon landing as the big triumphant

56
00:02:08,949 --> 00:02:05,680
moment for apollo but really

57
00:02:11,750 --> 00:02:08,959
in a human sense it was apollo 8

58
00:02:13,430 --> 00:02:11,760
that really kind of was a climax because

59
00:02:15,830 --> 00:02:13,440
it was the first time

60
00:02:17,670 --> 00:02:15,840
humans left their home planet

61
00:02:20,550 --> 00:02:17,680
and journeyed to another world when

62
00:02:23,030 --> 00:02:20,560
frank foreman jim lovell and bill anders

63
00:02:25,430 --> 00:02:23,040

fired their uh booster to go out of

64

00:02:28,070 --> 00:02:25,440

earth orbit and then make a journey of

65

00:02:29,510 --> 00:02:28,080

about 230 000 miles to go into orbit

66

00:02:31,270 --> 00:02:29,520

around the moon

67

00:02:33,589 --> 00:02:31,280

and you know the

68

00:02:35,509 --> 00:02:33,599

i wrote about this extensively and i

69

00:02:36,869 --> 00:02:35,519

talked to the astronauts and i thought

70

00:02:39,509 --> 00:02:36,879

there i thought i knew everything that

71

00:02:41,030 --> 00:02:39,519

there was to know about apollo 8 and

72

00:02:42,470 --> 00:02:41,040

particularly about the moment that we

73

00:02:45,670 --> 00:02:42,480

call earthrise

74

00:02:48,309 --> 00:02:45,680

but what's amazing is how this new

75

00:02:50,790 --> 00:02:48,319

uh lunar reconnaissance orbiter data

76

00:02:53,830 --> 00:02:50,800

has allowed ernie wright and his

77

00:02:56,630 --> 00:02:53,840

colleagues at goddard to go back and

78

00:02:59,110 --> 00:02:56,640

literally perform detective work and

79

00:03:02,550 --> 00:02:59,120

uncover new details and i'll just give

80

00:03:05,430 --> 00:03:02,560

you a brief sense of what is so amazing

81

00:03:07,350 --> 00:03:05,440

about this um you know the moment of the

82

00:03:09,589 --> 00:03:07,360

earth rise you can only see an earth

83

00:03:11,509 --> 00:03:09,599

rise from orbit around the moon what

84

00:03:14,309 --> 00:03:11,519

happens is and i have my visual aids

85

00:03:15,670 --> 00:03:14,319

here you actually are going over the

86

00:03:18,790 --> 00:03:15,680

moon

87

00:03:20,550 --> 00:03:18,800

and your orbital motion carries you

88

00:03:22,229 --> 00:03:20,560

around the moon and as you come around

89

00:03:24,470 --> 00:03:22,239

from the far side of the moon to the

90

00:03:25,430 --> 00:03:24,480

near side the side that always faces the

91

00:03:29,030 --> 00:03:25,440

earth

92

00:03:30,470 --> 00:03:29,040

comes up above the horizon it actually

93

00:03:32,630 --> 00:03:30,480

pops up

94

00:03:34,630 --> 00:03:32,640

what i'd always thought

95

00:03:36,149 --> 00:03:34,640

and most of us had always thought was

96

00:03:38,789 --> 00:03:36,159

that the spacecraft was coming around

97

00:03:41,030 --> 00:03:38,799

the moon like so with its nose roughly

98

00:03:43,509 --> 00:03:41,040

pointed at the earth or maybe slightly

99

00:03:45,509 --> 00:03:43,519

to the side or something like that

100

00:03:47,430 --> 00:03:45,519

what ernie was able to figure out from

101
00:03:50,550 --> 00:03:47,440
the onboard photography because there

102
00:03:52,229 --> 00:03:50,560
was a another camera that was pointed

103
00:03:55,030 --> 00:03:52,239
sort of boresighted with the nose of the

104
00:03:57,509 --> 00:03:55,040
spacecraft like a gun camera on a world

105
00:03:59,270 --> 00:03:57,519
war ii fighter that kind of thing

106
00:04:00,869 --> 00:03:59,280
anyway those photographs reveal that the

107
00:04:04,710 --> 00:04:00,879
spacecraft was actually pointed at the

108
00:04:07,589 --> 00:04:04,720
moon and was actually rotating

109
00:04:10,309 --> 00:04:07,599
such that as the astronauts came around

110
00:04:12,309 --> 00:04:10,319
from the moon for the fourth time

111
00:04:14,470 --> 00:04:12,319
the spacecraft rotated so that bill

112
00:04:16,469 --> 00:04:14,480
anders in the right-hand seat

113
00:04:18,789 --> 00:04:16,479

could see the earth coming up now this

114

00:04:20,229 --> 00:04:18,799

was something that had happened three

115

00:04:22,390 --> 00:04:20,239

times before

116

00:04:23,990 --> 00:04:22,400

on apollo 8

117

00:04:25,430 --> 00:04:24,000

but because the windows were pointed

118

00:04:27,030 --> 00:04:25,440

away from the earth as they came around

119

00:04:29,270 --> 00:04:27,040

they didn't see it

120

00:04:30,950 --> 00:04:29,280

and now as you see in the video the new

121

00:04:33,590 --> 00:04:30,960

video which is

122

00:04:36,469 --> 00:04:33,600

beautiful recreations of the event using

123

00:04:38,310 --> 00:04:36,479

the Iro data but it's also synchronized

124

00:04:40,790 --> 00:04:38,320

with the onboard voice tape and it's

125

00:04:42,629 --> 00:04:40,800

it's a fantastic human moment of

126
00:04:43,909 --> 00:04:42,639
exploration you can hear the the

127
00:04:46,070 --> 00:04:43,919
amazement

128
00:04:48,070 --> 00:04:46,080
in bill's voice as he sees the earth

129
00:04:50,710 --> 00:04:48,080
coming up and then jim lovell

130
00:04:54,629 --> 00:04:50,720
comes up and sees it too and

131
00:04:57,430 --> 00:04:54,639
there ensues a scramble for color film

132
00:04:59,990 --> 00:04:57,440
and finally um anders is able to capture

133
00:05:01,430 --> 00:05:00,000
the photo he took one black and white

134
00:05:03,510 --> 00:05:01,440
right away and then he's able to capture

135
00:05:05,350 --> 00:05:03,520
the color shot that became an icon of

136
00:05:06,710 --> 00:05:05,360
the 20th century

137
00:05:08,550 --> 00:05:06,720
and i know we're working on getting some

138
00:05:10,870 --> 00:05:08,560

of that video up in a minute now i

139

00:05:12,629 --> 00:05:10,880

wonder andrew is the historian here i

140

00:05:14,390 --> 00:05:12,639

breezed over the three astronauts but

141

00:05:17,189 --> 00:05:14,400

who exactly were these men how many

142

00:05:20,550 --> 00:05:17,199

times have they been up right well

143

00:05:24,150 --> 00:05:20,560

apollo 8 was truly the

144

00:05:27,350 --> 00:05:24,160

the moment at which nasa

145

00:05:29,189 --> 00:05:27,360

could could uh take a giant leap uh

146

00:05:31,830 --> 00:05:29,199

maybe not to the surface of the moon but

147

00:05:34,150 --> 00:05:31,840

away from the earth to orbit the moon

148

00:05:36,310 --> 00:05:34,160

and to command that mission

149

00:05:38,790 --> 00:05:36,320

um they go they gave that mission to

150

00:05:40,469 --> 00:05:38,800

frank borman who had been the commander

151
00:05:43,590 --> 00:05:40,479
of gemini 7

152
00:05:45,590 --> 00:05:43,600
which was a mission in december of 1965

153
00:05:46,550 --> 00:05:45,600
in which he and jim lovell spent two

154
00:05:49,189 --> 00:05:46,560
weeks

155
00:05:50,310 --> 00:05:49,199
orbiting the earth in a very tiny very

156
00:05:53,350 --> 00:05:50,320
cramped

157
00:05:55,749 --> 00:05:53,360
gemini cockpit uh to show that humans

158
00:05:57,510 --> 00:05:55,759
could survive in space long enough to

159
00:05:59,990 --> 00:05:57,520
make a lunar voyage

160
00:06:03,110 --> 00:06:00,000
um jim lovell who was his crewmate on

161
00:06:06,070 --> 00:06:03,120
that flight gemini 7 was also with him

162
00:06:08,150 --> 00:06:06,080
on apollo 8 as the flight's navigator

163
00:06:09,430 --> 00:06:08,160

and the third crewman bill anders was a

164

00:06:11,110 --> 00:06:09,440

rookie

165

00:06:13,270 --> 00:06:11,120

who was making his first and as it

166

00:06:14,390 --> 00:06:13,280

turned out only space flight

167

00:06:16,870 --> 00:06:14,400

and his

168

00:06:18,550 --> 00:06:16,880

uh function on the mission was to be the

169

00:06:20,469 --> 00:06:18,560

systems engineer keep track of the

170

00:06:23,270 --> 00:06:20,479

systems also

171

00:06:24,390 --> 00:06:23,280

did a lot of the photographic work and a

172

00:06:27,029 --> 00:06:24,400

lot of the

173

00:06:28,550 --> 00:06:27,039

uh business of observing the moon

174

00:06:31,189 --> 00:06:28,560

through the spacecraft windows from

175

00:06:33,510 --> 00:06:31,199

lunar orbit so it was a

176
00:06:34,790 --> 00:06:33,520
and for me as a storyteller of space as

177
00:06:36,870 --> 00:06:34,800
a historian

178
00:06:37,749 --> 00:06:36,880
what i love about the apollo 8 story is

179
00:06:40,150 --> 00:06:37,759
that they're such different

180
00:06:43,590 --> 00:06:40,160
personalities frank borman is sort of

181
00:06:45,350 --> 00:06:43,600
the gruff nonsense military style

182
00:06:47,430 --> 00:06:45,360
commander

183
00:06:48,790 --> 00:06:47,440
anders is the rookie

184
00:06:53,590 --> 00:06:48,800
a little more

185
00:06:56,870 --> 00:06:53,600
um and lovell

186
00:06:59,189 --> 00:06:56,880
really has a kind of a great spirit

187
00:07:01,990 --> 00:06:59,199
that comes through in his comments about

188
00:07:04,390 --> 00:07:02,000

the earth as a grand oasis from space he

189

00:07:06,070 --> 00:07:04,400

designed the mission patch

190

00:07:07,510 --> 00:07:06,080

which was a beautiful figure eight going

191

00:07:09,189 --> 00:07:07,520

around the moon and the earth so you

192

00:07:11,670 --> 00:07:09,199

have these three very different

193

00:07:13,909 --> 00:07:11,680

personalities in this spacecraft

194

00:07:16,309 --> 00:07:13,919

experiencing one of the most

195

00:07:18,870 --> 00:07:16,319

unbelievable moments in the history of

196

00:07:20,790 --> 00:07:18,880

exploration

197

00:07:22,629 --> 00:07:20,800

and now ernie you're the visualizer

198

00:07:26,230 --> 00:07:22,639

taking some of this data from a current

199

00:07:28,230 --> 00:07:26,240

mission Iro and recreating this moment

200

00:07:30,710 --> 00:07:28,240

what inspired you to try to recreate

201
00:07:32,230 --> 00:07:30,720
this moment um we you know we already

202
00:07:33,909 --> 00:07:32,240
had the audio and we already had the

203
00:07:36,870 --> 00:07:33,919
still pictures why put the time into

204
00:07:38,309 --> 00:07:36,880
taking true scientific data of the moon

205
00:07:39,830 --> 00:07:38,319
and recreating something that happened

206
00:07:41,430 --> 00:07:39,840
so long ago

207
00:07:43,830 --> 00:07:41,440
well there were a couple of reasons for

208
00:07:45,909 --> 00:07:43,840
that i mean it started when my wife got

209
00:07:48,070 --> 00:07:45,919
me a poster of the earthrise image for

210
00:07:49,589 --> 00:07:48,080
christmas a couple years ago

211
00:07:56,710 --> 00:07:49,599
and

212
00:08:00,390 --> 00:07:56,720
it i said you know i've got a ton of

213
00:08:02,309 --> 00:08:00,400

great Iro data that maybe i could use to

214

00:08:03,510 --> 00:08:02,319

recreate this

215

00:08:06,309 --> 00:08:03,520

and so

216

00:08:08,550 --> 00:08:06,319

last year for earth day we released a

217

00:08:09,510 --> 00:08:08,560

very simple sort of recreation that

218

00:08:12,150 --> 00:08:09,520

matched

219

00:08:14,550 --> 00:08:12,160

the photographs with Iro terrain and i

220

00:08:16,950 --> 00:08:14,560

was happy with that one but as i did the

221

00:08:19,270 --> 00:08:16,960

write-up for it i realized that there

222

00:08:22,150 --> 00:08:19,280

was a lot that we didn't know about the

223

00:08:24,150 --> 00:08:22,160

circumstances surrounding that photo

224

00:08:27,270 --> 00:08:24,160

so i sort of filed that away

225

00:08:29,350 --> 00:08:27,280

and about a year later um i started to

226

00:08:32,230 --> 00:08:29,360

look at some of the other apollo 8

227

00:08:34,070 --> 00:08:32,240

photography and i realized as as andy

228

00:08:35,029 --> 00:08:34,080

mentioned there was a camera that was

229

00:08:36,709 --> 00:08:35,039

pointed

230

00:08:39,670 --> 00:08:36,719

straight down at the lunar surface and

231

00:08:41,190 --> 00:08:39,680

it was taking pictures every 20 seconds

232

00:08:42,870 --> 00:08:41,200

and right around the time of the

233

00:08:44,070 --> 00:08:42,880

authorized photographs

234

00:08:46,630 --> 00:08:44,080

you could see

235

00:08:48,870 --> 00:08:46,640

that the images that were taken by this

236

00:08:49,829 --> 00:08:48,880

camera were rotating

237

00:08:51,829 --> 00:08:49,839

and

238

00:08:53,750 --> 00:08:51,839

so i mean it told me two things it told

239

00:08:56,070 --> 00:08:53,760

me that the spacecraft was pointing

240

00:08:58,389 --> 00:08:56,080

straight down and it also told me that

241

00:08:59,750 --> 00:08:58,399

it was rolling when the photos were

242

00:09:02,630 --> 00:08:59,760

taken

243

00:09:03,670 --> 00:09:02,640

so i carefully matched those photos to

244

00:09:06,230 --> 00:09:03,680

the terrain

245

00:09:07,430 --> 00:09:06,240

determined which way the spacecraft was

246

00:09:08,389 --> 00:09:07,440

pointing

247

00:09:10,070 --> 00:09:08,399

and

248

00:09:13,190 --> 00:09:10,080

you know that opened up

249

00:09:16,870 --> 00:09:14,710

the recognition that there were other

250

00:09:18,470 --> 00:09:16,880

things going on like which window was

251
00:09:20,070 --> 00:09:18,480
the earth visible in

252
00:09:23,509 --> 00:09:20,080
um and these are things that we didn't

253
00:09:24,710 --> 00:09:23,519
know before so by the end of it

254
00:09:27,030 --> 00:09:24,720
we knew

255
00:09:30,470 --> 00:09:27,040
probably which window each photo was

256
00:09:31,829 --> 00:09:30,480
taken from and and who took them

257
00:09:34,870 --> 00:09:31,839
and it

258
00:09:37,350 --> 00:09:34,880
that was really possible because Iro has

259
00:09:40,470 --> 00:09:37,360
this amazing global

260
00:09:42,310 --> 00:09:40,480
data set that just didn't exist before

261
00:09:44,470 --> 00:09:42,320
we really didn't have

262
00:09:46,310 --> 00:09:44,480
a global

263
00:09:48,550 --> 00:09:46,320

elevation map for the moon that was good

264

00:09:50,790 --> 00:09:48,560

enough to do this

265

00:09:52,949 --> 00:09:50,800

so that's what made it possible it was

266

00:09:55,430 --> 00:09:52,959

this convergence of

267

00:09:58,790 --> 00:09:55,440

the data which i work with all the time

268

00:10:00,710 --> 00:09:58,800

and the idea of seeing if we could

269

00:10:02,710 --> 00:10:00,720

you know recreate earthrise just as a

270

00:10:04,630 --> 00:10:02,720

way to i mean it's

271

00:10:06,470 --> 00:10:04,640

it's in a funny way it's a way to ground

272

00:10:08,389 --> 00:10:06,480

truth the data you know if you can match

273

00:10:10,070 --> 00:10:08,399

that to a photograph taken by somebody

274

00:10:12,070 --> 00:10:10,080

who's actually there you know

275

00:10:15,430 --> 00:10:12,080

everything's good and it made me very

276

00:10:17,030 --> 00:10:15,440

happy when all of that came together

277

00:10:19,190 --> 00:10:17,040

that's fantastic one of the things you

278

00:10:20,949 --> 00:10:19,200

you brought up in part the reasons this

279

00:10:22,790 --> 00:10:20,959

made it possible was

280

00:10:25,670 --> 00:10:22,800

the the spacecraft that is currently

281

00:10:26,710 --> 00:10:25,680

right now orbiting our moon um Iro i'm

282

00:10:30,069 --> 00:10:26,720

going to try to say it one more time

283

00:10:31,990 --> 00:10:30,079

lunar reconnaissance orbiter um Iro john

284

00:10:33,829 --> 00:10:32,000

keller you're the project scientist for

285

00:10:35,990 --> 00:10:33,839

Iro can you tell us

286

00:10:37,990 --> 00:10:36,000

what that spacecraft is doing what

287

00:10:41,990 --> 00:10:38,000

instruments are on that as it's orbiting

288

00:10:47,910 --> 00:10:43,590

oh and john i think your microphone's

289

00:10:52,870 --> 00:10:51,509

It went into space in uh june of 2009

290

00:10:54,470 --> 00:10:52,880

it's a mission that's both uh

291

00:10:56,470 --> 00:10:54,480

exploration mission and a science

292

00:10:57,509 --> 00:10:56,480

mission there's seven instruments on

293

00:11:00,550 --> 00:10:57,519

there

294

00:11:02,630 --> 00:11:00,560

um the two that uh

295

00:11:04,069 --> 00:11:02,640

i should highlight are uh the laser

296

00:11:07,509 --> 00:11:04,079

altimeter

297

00:11:10,389 --> 00:11:07,519

um and the uh camera system because

298

00:11:13,350 --> 00:11:10,399

those are the two that were used by uh

299

00:11:14,870 --> 00:11:13,360

uh ernie to uh recreate the

300

00:11:16,310 --> 00:11:14,880

uh

301

00:11:17,670 --> 00:11:16,320

the earth rise

302

00:11:20,630 --> 00:11:17,680

and

303

00:11:23,350 --> 00:11:20,640

uh so so we have been you know with the

304

00:11:25,670 --> 00:11:23,360

with the laser it's an advanced laser

305

00:11:29,590 --> 00:11:25,680

that has uh

306

00:11:31,269 --> 00:11:29,600

ping the moon uh uh three billion shots

307

00:11:33,110 --> 00:11:31,279

over the time

308

00:11:34,870 --> 00:11:33,120

um and you just measure the time of

309

00:11:37,110 --> 00:11:34,880

flight for the laser to hit the surface

310

00:11:39,829 --> 00:11:37,120

and for it to come back and that tells

311

00:11:41,750 --> 00:11:39,839

you uh the surface how hot you know the

312

00:11:43,430 --> 00:11:41,760

distance to this to the surface and you

313

00:11:44,949 --> 00:11:43,440

get the shape of the moon

314

00:11:46,949 --> 00:11:44,959

uh prior to

315

00:11:49,030 --> 00:11:46,959

Iro going into space we actually knew

316

00:11:51,590 --> 00:11:49,040

the shape of mars better than we do do

317

00:11:53,430 --> 00:11:51,600

the moon did the moon and now

318

00:11:56,949 --> 00:11:53,440

uh we know the moon and the shape of the

319

00:11:59,750 --> 00:11:56,959

moon better than we know any any planet

320

00:12:02,069 --> 00:11:59,760

including earth and the earth because so

321

00:12:04,470 --> 00:12:02,079

much of the earth is underwater that we

322

00:12:06,310 --> 00:12:04,480

we don't know the topography that well

323

00:12:07,750 --> 00:12:06,320

john i have a quick question for you on

324

00:12:10,230 --> 00:12:07,760

that when you're shooting this laser

325

00:12:11,990 --> 00:12:10,240

down to the moon's surface from um the

326

00:12:13,590 --> 00:12:12,000
orbiter is it affecting the moon's

327

00:12:15,430 --> 00:12:13,600
surface at all or is it like those

328

00:12:16,949 --> 00:12:15,440
little lasers we play with our cats

329

00:12:19,430 --> 00:12:16,959
where it's just a light

330

00:12:21,190 --> 00:12:19,440
it's uh it's very uh it doesn't affect

331

00:12:23,110 --> 00:12:21,200
it at all because it's uh

332

00:12:24,470 --> 00:12:23,120
it's it's first of all it's not a very

333

00:12:26,389 --> 00:12:24,480
strong laser

334

00:12:28,470 --> 00:12:26,399
second it's it's broken up into five

335

00:12:31,509 --> 00:12:28,480
different spots so simultaneously we hit

336

00:12:33,350 --> 00:12:31,519
the moon with five spots and then third

337

00:12:34,629 --> 00:12:33,360
the distance for from which we were

338

00:12:35,910 --> 00:12:34,639

lazing from

339

00:12:37,030 --> 00:12:35,920

uh

340

00:12:39,350 --> 00:12:37,040

you know on

341

00:12:40,150 --> 00:12:39,360

most of most of it was 50 kilometers up

342

00:12:41,990 --> 00:12:40,160

so

343

00:12:44,710 --> 00:12:42,000

the spot size is spread out quite a bit

344

00:12:46,949 --> 00:12:44,720

by the time it reaches the moon

345

00:12:48,069 --> 00:12:46,959

and then the other uh part is is the

346

00:12:50,790 --> 00:12:48,079

camera

347

00:12:53,269 --> 00:12:50,800

and what ernie has to do is he takes the

348

00:12:55,269 --> 00:12:53,279

you know the the full moon is has been

349

00:12:58,949 --> 00:12:55,279

created has been

350

00:13:00,150 --> 00:12:58,959

photographed by Iro at uh a 100 meter

351

00:13:02,230 --> 00:13:00,160
resolution

352

00:13:05,430 --> 00:13:02,240
and and he

353

00:13:07,350 --> 00:13:05,440
he lays down the images of the uh

354

00:13:08,790 --> 00:13:07,360
that were taken by the camera onto this

355

00:13:10,790 --> 00:13:08,800
topography

356

00:13:12,870 --> 00:13:10,800
and by doing that that's

357

00:13:14,230 --> 00:13:12,880
that's what you're seeing in his uh

358

00:13:17,350 --> 00:13:14,240
in his video

359

00:13:19,590 --> 00:13:17,360
and and and really able to match what

360

00:13:21,910 --> 00:13:19,600
what the photographer

361

00:13:24,870 --> 00:13:21,920
bill anders was seen on

362

00:13:26,550 --> 00:13:24,880
on the apollo 8.

363

00:13:28,710 --> 00:13:26,560

fantastic i know we're going to pull up

364

00:13:30,310 --> 00:13:28,720

some of the just a segment of this

365

00:13:32,470 --> 00:13:30,320

recreation that ernie's created the

366

00:13:34,629 --> 00:13:32,480

entire length of the the video that we

367

00:13:35,910 --> 00:13:34,639

put out today is a full six minutes long

368

00:13:38,470 --> 00:13:35,920

it incorporates both some of the

369

00:13:40,629 --> 00:13:38,480

visualizations and some archival footage

370

00:13:42,870 --> 00:13:40,639

of the apollo astronauts themselves and

371

00:13:45,030 --> 00:13:42,880

you'll find that link on our

372

00:13:46,629 --> 00:13:45,040

goddard uh google plus page we'll have

373

00:13:48,870 --> 00:13:46,639

it on the youtube page shortly and it's

374

00:13:50,470 --> 00:13:48,880

out on nasa.gov as well

375

00:13:51,750 --> 00:13:50,480

um one of the things we're getting

376

00:13:53,430 --> 00:13:51,760

questions in i wanted to remind

377

00:13:55,350 --> 00:13:53,440

everybody we're taking your questions if

378

00:13:57,750 --> 00:13:55,360

you go hashtag earthrise i'm following

379

00:13:59,030 --> 00:13:57,760

along here on on an ipad or put the

380

00:14:01,509 --> 00:13:59,040

questions in

381

00:14:03,750 --> 00:14:01,519

the youtube section and comments or on

382

00:14:05,590 --> 00:14:03,760

google plus and i have a question that

383

00:14:08,470 --> 00:14:05,600

um comes from someone by the name of

384

00:14:11,350 --> 00:14:08,480

tyler waldrop at

385

00:14:14,230 --> 00:14:11,360

shadow404 and now we're holding this

386

00:14:17,269 --> 00:14:14,240

next week is the 45th anniversary of

387

00:14:19,590 --> 00:14:17,279

this event um he tyler wants to know how

388

00:14:21,189 --> 00:14:19,600

old each of us was back when apollo 8

389

00:14:22,710 --> 00:14:21,199

was happening i'm not going to answer

390

00:14:25,590 --> 00:14:22,720

that though i haven't easy out that i

391

00:14:26,949 --> 00:14:25,600

wasn't even around then but were you

392

00:14:28,389 --> 00:14:26,959

where's anybody anybody else in the

393

00:14:30,470 --> 00:14:28,399

hangout were you

394

00:14:34,069 --> 00:14:30,480

at an age where you remember this event

395

00:14:37,910 --> 00:14:35,509

well i'll just

396

00:14:39,910 --> 00:14:37,920

and say that uh

397

00:14:42,150 --> 00:14:39,920

you know for me uh

398

00:14:44,550 --> 00:14:42,160

i was every apollo mission i was glued

399

00:14:46,310 --> 00:14:44,560

to the tv i was 12 years old

400

00:14:47,430 --> 00:14:46,320

and i had my little mission control in

401
00:14:50,150 --> 00:14:47,440
the den

402
00:14:51,990 --> 00:14:50,160
with my maps of the moon and my models

403
00:14:54,069 --> 00:14:52,000
of the spacecraft and

404
00:14:56,310 --> 00:14:54,079
copies of time and newsweek and you know

405
00:14:58,310 --> 00:14:56,320
i was doing everything i could to you

406
00:15:01,509 --> 00:14:58,320
know vicariously participate in the

407
00:15:06,150 --> 00:15:01,519
mission so yes i remember it as one of

408
00:15:12,310 --> 00:15:08,790
yeah for me uh i i uh i certainly

409
00:15:16,069 --> 00:15:12,320
remember the apollo 11 landing and i

410
00:15:21,670 --> 00:15:19,829
i yeah i was i was six years old

411
00:15:24,150 --> 00:15:21,680
and remember

412
00:15:26,790 --> 00:15:24,160
what i remember most clearly is 11

413
00:15:27,750 --> 00:15:26,800

because my parents let me stay up late

414

00:15:28,629 --> 00:15:27,760

um

415

00:15:34,230 --> 00:15:28,639

11

416

00:15:36,710 --> 00:15:34,240

their first spacewalk at about 10 30

417

00:15:39,030 --> 00:15:36,720

eastern time and that was way past my

418

00:15:41,750 --> 00:15:39,040

bedtime but they they let me stay up and

419

00:15:43,590 --> 00:15:41,760

watch it and so that memory is imprinted

420

00:15:45,430 --> 00:15:43,600

um but you know when you're six you

421

00:15:46,310 --> 00:15:45,440

think you go to the moon every day and

422

00:15:47,750 --> 00:15:46,320

so

423

00:15:49,829 --> 00:15:47,760

that part of it didn't make a big

424

00:15:52,790 --> 00:15:49,839

impression on me until i was much older

425

00:15:55,509 --> 00:15:52,800

and i was grateful that i that i could

426
00:15:57,350 --> 00:15:55,519
see that as a as a you know it's in my

427
00:15:58,310 --> 00:15:57,360
living memory but um

428
00:16:01,030 --> 00:15:58,320
it took a little while for me to

429
00:16:02,389 --> 00:16:01,040
understand the significance of it

430
00:16:03,990 --> 00:16:02,399
that's fantastic we have another

431
00:16:05,430 --> 00:16:04,000
question as we get the video with the

432
00:16:06,470 --> 00:16:05,440
audio queued up we're going to play a

433
00:16:09,430 --> 00:16:06,480
little bit of it so you'll be able to

434
00:16:11,590 --> 00:16:09,440
hear the astronauts as they they grab

435
00:16:13,430 --> 00:16:11,600
cameras and take this image and part of

436
00:16:15,350 --> 00:16:13,440
the gorgeous visualization that ernie

437
00:16:17,430 --> 00:16:15,360
wright put together please keep asking

438
00:16:19,110 --> 00:16:17,440

questions at hashtag earthrise i'm

439

00:16:20,389 --> 00:16:19,120

mary's keck here at nasa goddard space

440

00:16:22,870 --> 00:16:20,399

flight center and we're talking about

441

00:16:24,710 --> 00:16:22,880

this amazing image and actually while uh

442

00:16:26,230 --> 00:16:24,720

while we also still have ernie up he's

443

00:16:28,310 --> 00:16:26,240

sitting in front of a hyper wall which

444

00:16:29,430 --> 00:16:28,320

is a whole bunch of big flat screen tvs

445

00:16:31,749 --> 00:16:29,440

that we use here for science

446

00:16:33,509 --> 00:16:31,759

visualizations and that's one of that's

447

00:16:35,509 --> 00:16:33,519

the image we're talking about this image

448

00:16:37,110 --> 00:16:35,519

of the earth actually rising just like

449

00:16:39,670 --> 00:16:37,120

how the sun rises when we're here on

450

00:16:42,230 --> 00:16:39,680

earth the earth rising over the horizon

451
00:16:44,949 --> 00:16:42,240
of the moon um one of the next questions

452
00:16:48,069 --> 00:16:44,959
we've got is at vr doug and what he

453
00:16:49,110 --> 00:16:48,079
wanted to know is what about this vr

454
00:16:53,670 --> 00:16:49,120
what

455
00:16:55,030 --> 00:16:53,680
makes this photo realistic and i'm

456
00:16:56,870 --> 00:16:55,040
wondering ernie that's a question for

457
00:16:59,509 --> 00:16:56,880
you was it in lining up

458
00:17:01,670 --> 00:16:59,519
the the sort of the original image and

459
00:17:04,390 --> 00:17:01,680
then taking the new Iro data with its

460
00:17:06,069 --> 00:17:04,400
really high quality information and

461
00:17:08,230 --> 00:17:06,079
lining up to make it essentially a

462
00:17:10,710 --> 00:17:08,240
recreation

463
00:17:12,870 --> 00:17:10,720

that's exactly right

464

00:17:14,069 --> 00:17:12,880

for every photograph that you see in the

465

00:17:15,510 --> 00:17:14,079

video

466

00:17:18,069 --> 00:17:15,520

i was using

467

00:17:20,549 --> 00:17:18,079

animation software and positioned a

468

00:17:21,510 --> 00:17:20,559

virtual camera over a model of the

469

00:17:24,150 --> 00:17:21,520

terrain

470

00:17:25,750 --> 00:17:24,160

and i really did this by eye you know i

471

00:17:27,270 --> 00:17:25,760

moved the camera a little bit this way

472

00:17:28,470 --> 00:17:27,280

that way

473

00:17:30,310 --> 00:17:28,480

changed the

474

00:17:31,510 --> 00:17:30,320

change the direction that it was

475

00:17:33,430 --> 00:17:31,520

pointing

476
00:17:35,190 --> 00:17:33,440
until i got an exact match with the

477
00:17:36,070 --> 00:17:35,200
photographs

478
00:17:37,750 --> 00:17:36,080
and

479
00:17:39,669 --> 00:17:37,760
that information tells you something

480
00:17:41,110 --> 00:17:39,679
about which way the spacecraft is

481
00:17:42,630 --> 00:17:41,120
turning too because once you get the

482
00:17:44,950 --> 00:17:42,640
camera in the right place

483
00:17:46,549 --> 00:17:44,960
you know that the real camera was in a

484
00:17:48,310 --> 00:17:46,559
certain position and pointed in a

485
00:17:49,190 --> 00:17:48,320
certain direction

486
00:17:51,909 --> 00:17:49,200
so

487
00:17:54,150 --> 00:17:51,919
the the visuals and

488
00:17:54,950 --> 00:17:54,160

the understanding of the geometry kind

489

00:17:59,510 --> 00:17:54,960

of

490

00:18:04,710 --> 00:18:02,310

fantastic and andrew um i wanted to ask

491

00:18:06,870 --> 00:18:04,720

you again real quick when

492

00:18:08,789 --> 00:18:06,880

is it unusual for historians to use

493

00:18:10,549 --> 00:18:08,799

these types of animations or computer

494

00:18:12,310 --> 00:18:10,559

recreations to see things from a new

495

00:18:13,830 --> 00:18:12,320

angle or a different angle or is that

496

00:18:15,350 --> 00:18:13,840

becoming something that historians use

497

00:18:17,430 --> 00:18:15,360

quite a bit with different for a

498

00:18:20,230 --> 00:18:17,440

different aspect

499

00:18:21,990 --> 00:18:20,240

well it certainly wasn't available 25

500

00:18:23,830 --> 00:18:22,000

years ago when i was riding a man on the

501
00:18:24,870 --> 00:18:23,840
moon i mean i was

502
00:18:29,350 --> 00:18:24,880
my

503
00:18:31,990 --> 00:18:29,360
using

504
00:18:33,190 --> 00:18:32,000
the onboard voice tape

505
00:18:35,510 --> 00:18:33,200
my

506
00:18:37,750 --> 00:18:35,520
delving through the transcripts of the

507
00:18:39,430 --> 00:18:37,760
communications the post flight

508
00:18:40,310 --> 00:18:39,440
debriefing and of course my interviews

509
00:18:41,909 --> 00:18:40,320
with

510
00:18:43,029 --> 00:18:41,919
frank warm and jim lovell and bill

511
00:18:45,510 --> 00:18:43,039
anders

512
00:18:47,190 --> 00:18:45,520
what's so neat about

513
00:18:49,270 --> 00:18:47,200

being able to revisit this now with

514

00:18:51,669 --> 00:18:49,280

today's technology

515

00:18:53,750 --> 00:18:51,679

is that first of all we've got images

516

00:18:55,190 --> 00:18:53,760

from lro that are so good i mean if you

517

00:18:59,430 --> 00:18:55,200

go on the web

518

00:19:01,029 --> 00:18:59,440

and you google lro apollo landing sites

519

00:19:02,549 --> 00:19:01,039

you will see images that are so good

520

00:19:04,710 --> 00:19:02,559

that you can literally

521

00:19:06,230 --> 00:19:04,720

see the astronauts tracks

522

00:19:08,310 --> 00:19:06,240

that they made with their feet

523

00:19:10,070 --> 00:19:08,320

disturbing the lunar soil

524

00:19:12,630 --> 00:19:10,080

so that gives you some idea of how

525

00:19:15,350 --> 00:19:12,640

powerful the cameras are and then as as

526
00:19:16,870 --> 00:19:15,360
john pointed out when combined with the

527
00:19:19,270 --> 00:19:16,880
really beautiful

528
00:19:20,710 --> 00:19:19,280
uh laser altimetry data on the

529
00:19:22,870 --> 00:19:20,720
topography

530
00:19:26,230 --> 00:19:22,880
that nails down the three-dimensionality

531
00:19:30,070 --> 00:19:26,240
of the moon and the last piece of the

532
00:19:33,110 --> 00:19:30,080
puzzle is this ability to do

533
00:19:35,830 --> 00:19:33,120
computer generated scenes

534
00:19:37,590 --> 00:19:35,840
that can be viewed from any realistic

535
00:19:39,430 --> 00:19:37,600
viewpoint and there are realistic

536
00:19:40,470 --> 00:19:39,440
computer models of the spacecraft we can

537
00:19:43,590 --> 00:19:40,480
use

538
00:19:45,909 --> 00:19:43,600

and as ernie said you set up a virtual

539

00:19:50,070 --> 00:19:45,919

camera so

540

00:19:51,430 --> 00:19:50,080

is it unusual i think probably nowadays

541

00:19:53,909 --> 00:19:51,440

it's going to become more and more

542

00:19:57,029 --> 00:19:53,919

common but you know it's it's sort of

543

00:19:59,350 --> 00:19:57,039

the old maxim about

544

00:20:01,029 --> 00:19:59,360

um computers in general you're you know

545

00:20:02,789 --> 00:20:01,039

if your data is no good

546

00:20:05,590 --> 00:20:02,799

as they used to say in the old days of

547

00:20:07,669 --> 00:20:05,600

computing garbage and garbage out

548

00:20:09,430 --> 00:20:07,679

what's so great about this is the data

549

00:20:11,590 --> 00:20:09,440

is so good

550

00:20:14,710 --> 00:20:11,600

that the historical conclusions that

551
00:20:17,750 --> 00:20:14,720
come out of that data and it's been it's

552
00:20:19,590 --> 00:20:17,760
been interpreted so beautifully by ernie

553
00:20:21,750 --> 00:20:19,600
and his his colleagues

554
00:20:22,870 --> 00:20:21,760
the historical knowledge that comes out

555
00:20:25,909 --> 00:20:22,880
of that

556
00:20:28,230 --> 00:20:25,919
is so good that it matches up precisely

557
00:20:29,430 --> 00:20:28,240
with everything we knew before you can

558
00:20:31,990 --> 00:20:29,440
in fact

559
00:20:33,669 --> 00:20:32,000
one little detail that i'll share

560
00:20:35,029 --> 00:20:33,679
the tape one of the things that ernie

561
00:20:37,190 --> 00:20:35,039
noticed on the tape i'm a little

562
00:20:38,630 --> 00:20:37,200
embarrassed that i didn't notice this 25

563
00:20:40,630 --> 00:20:38,640

years ago but ernie

564

00:20:43,110 --> 00:20:40,640

beat me to it

565

00:20:43,990 --> 00:20:43,120

is that you can literally hear on the

566

00:20:45,669 --> 00:20:44,000

tape

567

00:20:48,230 --> 00:20:45,679

when bill anders

568

00:20:50,549 --> 00:20:48,240

clicks the shutter on the hasselblad you

569

00:20:51,990 --> 00:20:50,559

hear the shutter and then the motorized

570

00:20:54,230 --> 00:20:52,000

film advance

571

00:20:55,510 --> 00:20:54,240

as he takes each of these three photos

572

00:20:56,870 --> 00:20:55,520

first of black and white and then the

573

00:21:01,430 --> 00:20:56,880

two color

574

00:21:03,510 --> 00:21:01,440

and that allowed him to precisely place

575

00:21:05,830 --> 00:21:03,520

the audio

576

00:21:07,990 --> 00:21:05,840

with the recreated motion of the

577

00:21:11,110 --> 00:21:08,000

spacecraft and the visual of the moon so

578

00:21:13,190 --> 00:21:11,120

it is a full literally a full recreation

579

00:21:15,110 --> 00:21:13,200

of the event and i'm just glad

580

00:21:17,190 --> 00:21:15,120

that technology has progressed to the

581

00:21:19,510 --> 00:21:17,200

point where we can do that i mean it

582

00:21:22,470 --> 00:21:19,520

would have made my life a lot easier 25

583

00:21:23,830 --> 00:21:22,480

years ago but better late than never

584

00:21:25,510 --> 00:21:23,840

that's great well the biggest comment

585

00:21:27,750 --> 00:21:25,520

we're getting after was play the

586

00:21:29,510 --> 00:21:27,760

animation already so we're going to mute

587

00:21:32,789 --> 00:21:29,520

our microphones and we're going to share

588

00:21:34,710 --> 00:21:32,799

this just a snippet of this longer video

589

00:21:37,110 --> 00:21:34,720

you can see the full length video at the

590

00:21:38,310 --> 00:21:37,120

website and let's all mute our mix and

591

00:22:01,430 --> 00:21:38,320

they're going to play some of this with

592

00:22:06,230 --> 00:22:04,149

the impact crater with uh

593

00:22:08,310 --> 00:22:06,240

at

594

00:22:10,630 --> 00:22:08,320

this part of the sub solar point on the

595

00:22:16,230 --> 00:22:10,640

south side and the floor that's uh

596

00:22:18,630 --> 00:22:17,830

but i could get a quick enough look at

597

00:22:34,870 --> 00:22:18,640

it

598

00:22:34,880 --> 00:22:46,230

uh

599

00:22:48,630 --> 00:22:47,750

oh my god look at that picture over

600

00:22:53,190 --> 00:22:48,640

there

601
00:22:53,200 --> 00:22:59,510
hey don't take that off schedule

602
00:23:05,190 --> 00:23:02,230
got a color film jim

603
00:23:10,390 --> 00:23:05,200
hand me a roll of color questions

604
00:23:22,390 --> 00:23:14,630
okay it's out here just grab me a color

605
00:23:27,110 --> 00:23:23,990
that one

606
00:23:48,390 --> 00:23:27,120
yeah looking for one c368

607
00:23:48,400 --> 00:23:54,710
yeah i got it right here

608
00:23:57,909 --> 00:23:56,710
so i got it crazy it's very clear right

609
00:23:59,510 --> 00:23:57,919
here

610
00:24:01,830 --> 00:23:59,520
you got it

611
00:24:03,669 --> 00:24:01,840
it takes several trouble here

612
00:24:05,750 --> 00:24:03,679
let me just get the right

613
00:24:11,669 --> 00:24:05,760

okay calm down rubble

614

00:24:11,679 --> 00:24:37,190

250 level

615

00:24:41,029 --> 00:24:39,350

that was fantastic i love hearing them

616

00:24:43,110 --> 00:24:41,039

argue a little bit of like i got it i

617

00:24:44,149 --> 00:24:43,120

got it we're fine i got it

618

00:24:46,310 --> 00:24:44,159

um

619

00:24:47,909 --> 00:24:46,320

and uh and you taken remind us again

620

00:24:49,669 --> 00:24:47,919

just who are the three gentlemen we just

621

00:24:51,590 --> 00:24:49,679

heard talking and that was the audio the

622

00:24:53,990 --> 00:24:51,600

original audio with ernie wright's

623

00:24:56,149 --> 00:24:54,000

brilliant recreation of that moment as

624

00:24:57,669 --> 00:24:56,159

we were out in space looking at the

625

00:24:59,029 --> 00:24:57,679

apollo capsule who are those three guys

626

00:25:02,070 --> 00:24:59,039

we just heard talk

627

00:25:03,990 --> 00:25:02,080

right so so the first voice you hear is

628

00:25:05,510 --> 00:25:04,000

frank borman the mission commander who's

629

00:25:07,990 --> 00:25:05,520

over in the left seat

630

00:25:09,510 --> 00:25:08,000

uh left-hand side of the spacecraft and

631

00:25:11,350 --> 00:25:09,520

he announces that they're about to

632

00:25:14,149 --> 00:25:11,360

perform a role maneuver which is in the

633

00:25:16,230 --> 00:25:14,159

flight plan the reason he's doing it is

634

00:25:17,909 --> 00:25:16,240

because he wants to rotate the

635

00:25:20,149 --> 00:25:17,919

spacecraft so that jim lovell the

636

00:25:22,870 --> 00:25:20,159

navigator who's down in the lower

637

00:25:25,190 --> 00:25:22,880

equipment bay can use the onboard sexton

638

00:25:27,990 --> 00:25:25,200

to side on lunar landmarks

639

00:25:30,630 --> 00:25:28,000

anders meanwhile is in the right seat

640

00:25:32,549 --> 00:25:30,640

he's looking out his window at the moon

641

00:25:34,390 --> 00:25:32,559

and making observations into the tape

642

00:25:35,990 --> 00:25:34,400

recorder for the benefit of the

643

00:25:37,909 --> 00:25:36,000

scientists back on earth when they hear

644

00:25:39,990 --> 00:25:37,919

those tapes

645

00:25:42,230 --> 00:25:40,000

when the earth comes up as the as the

646

00:25:44,870 --> 00:25:42,240

spacecraft rotates and anders suddenly

647

00:25:47,190 --> 00:25:44,880

sees it coming out his side window

648

00:25:49,350 --> 00:25:47,200

he says oh my god look at that picture

649

00:25:51,190 --> 00:25:49,360

over there and borman

650

00:25:53,350 --> 00:25:51,200

jokes with him and says don't take that

651
00:25:54,630 --> 00:25:53,360
it's not scheduled and the reason borman

652
00:25:57,190 --> 00:25:54,640
says that

653
00:25:59,190 --> 00:25:57,200
is because earlier in

654
00:26:00,710 --> 00:25:59,200
the day while they had

655
00:26:02,789 --> 00:26:00,720
pretty shortly after they had fired

656
00:26:04,470 --> 00:26:02,799
their engine to go into lunar orbit

657
00:26:07,029 --> 00:26:04,480
they were looking down at the moon and

658
00:26:09,269 --> 00:26:07,039
they were amazed and frank borman

659
00:26:11,909 --> 00:26:09,279
wanted to take a picture and he asked

660
00:26:13,750 --> 00:26:11,919
bill anders for the camera and bill was

661
00:26:15,990 --> 00:26:13,760
the keeper of the photo plan and bill

662
00:26:17,590 --> 00:26:16,000
got very kind of intense about it

663
00:26:19,350 --> 00:26:17,600

and you can hear on the onboard voice

664

00:26:21,909 --> 00:26:19,360

tapes frank says i just want to take a

665

00:26:23,110 --> 00:26:21,919

picture i mean he's just like tourists

666

00:26:25,350 --> 00:26:23,120

everywhere

667

00:26:26,549 --> 00:26:25,360

so when it comes to this moment of the

668

00:26:28,310 --> 00:26:26,559

earth rise

669

00:26:30,789 --> 00:26:28,320

it's anders who has the camera and

670

00:26:32,470 --> 00:26:30,799

borman who's flying the spacecraft just

671

00:26:34,310 --> 00:26:32,480

kind of gives him a little jab there

672

00:26:36,390 --> 00:26:34,320

about hey don't take that it's not

673

00:26:39,350 --> 00:26:36,400

scheduled and indeed it wasn't scheduled

674

00:26:41,669 --> 00:26:39,360

because this was a a complete surprise

675

00:26:43,350 --> 00:26:41,679

then you hear lovell come up from the

676

00:26:46,149 --> 00:26:43,360

lower equipment bay

677

00:26:48,310 --> 00:26:46,159

to join anders at the window you hear

678

00:26:49,830 --> 00:26:48,320

him say oh man that's great anders

679

00:26:53,990 --> 00:26:49,840

meanwhile who has already taken the

680

00:26:56,630 --> 00:26:54,000

black and white is now intensely focused

681

00:26:59,350 --> 00:26:56,640

on getting a color magazine so he can

682

00:27:00,390 --> 00:26:59,360

slap that on it takes level a few

683

00:27:03,350 --> 00:27:00,400

minutes if

684

00:27:05,750 --> 00:27:03,360

several long moments to find it by that

685

00:27:08,070 --> 00:27:05,760

time the earth has disappeared from the

686

00:27:11,110 --> 00:27:08,080

side window because spacecraft's still

687

00:27:12,549 --> 00:27:11,120

turning but now it's in view in the

688

00:27:14,789 --> 00:27:12,559

rendezvous window which is right in

689

00:27:17,510 --> 00:27:14,799

front of anders and also the center

690

00:27:19,590 --> 00:27:17,520

hatch window which is actually kind of

691

00:27:21,350 --> 00:27:19,600

cloudy it actually

692

00:27:23,110 --> 00:27:21,360

is kind of surprising that lovell said

693

00:27:24,630 --> 00:27:23,120

i've got it right here it's very clear

694

00:27:27,110 --> 00:27:24,640

because really that window is pretty

695

00:27:29,350 --> 00:27:27,120

well clouded up but anders has the

696

00:27:30,789 --> 00:27:29,360

telephoto lens and he aims it through

697

00:27:33,750 --> 00:27:30,799

the render window

698

00:27:36,549 --> 00:27:33,760

and takes the color pictures

699

00:27:38,310 --> 00:27:36,559

and then at the very end one last little

700

00:27:40,070 --> 00:27:38,320

touch

701
00:27:41,750 --> 00:27:40,080
and this was something that built i

702
00:27:45,110 --> 00:27:41,760
played the tape sitting next to bill

703
00:27:47,350 --> 00:27:45,120
anders in his office in 1987

704
00:27:50,310 --> 00:27:47,360
and uh you hear a level say are you sure

705
00:27:54,470 --> 00:27:50,320
you got it now and anders kind of dryly

706
00:27:56,070 --> 00:27:54,480
says yeah i think it'll come up again

707
00:27:58,070 --> 00:27:56,080
and that that leads us beautifully to a

708
00:27:59,510 --> 00:27:58,080
question we have coming in um and please

709
00:28:01,750 --> 00:27:59,520
bring your questions in as we go through

710
00:28:03,430 --> 00:28:01,760
and take out this tape the entire long

711
00:28:06,310 --> 00:28:03,440
visualization is available on the

712
00:28:08,710 --> 00:28:06,320
internet at that url behind me um john

713
00:28:11,110 --> 00:28:08,720

heasley uh wants to know was the crew of

714

00:28:13,269 --> 00:28:11,120

apollo 8 able to see the earth rise on

715

00:28:17,110 --> 00:28:13,279

later orbits and how about other

716

00:28:19,110 --> 00:28:17,120

missions andrew yes and in fact um

717

00:28:22,149 --> 00:28:19,120

this was a bit of research that i had

718

00:28:24,789 --> 00:28:22,159

done before ernie and i got hooked up uh

719

00:28:26,789 --> 00:28:24,799

this was several years ago i i just took

720

00:28:29,350 --> 00:28:26,799

the there were later earthrise photos

721

00:28:30,549 --> 00:28:29,360

taken with a wider lens an 80 millimeter

722

00:28:33,029 --> 00:28:30,559

lens and

723

00:28:34,870 --> 00:28:33,039

for example if you've ever seen

724

00:28:38,149 --> 00:28:34,880

you collectors out there the look

725

00:28:40,070 --> 00:28:38,159

magazine special issue on apollo 8 you

726

00:28:42,710 --> 00:28:40,080

see a very wide view of the horizon a

727

00:28:43,669 --> 00:28:42,720

very small earth peaking up above it

728

00:28:46,230 --> 00:28:43,679

those

729

00:28:48,470 --> 00:28:46,240

photographs were taken i think early on

730

00:28:50,549 --> 00:28:48,480

what the sixth and seventh

731

00:28:52,149 --> 00:28:50,559

uh orbits of the moon whereas the ones

732

00:28:54,870 --> 00:28:52,159

we're looking at here were the fourth

733

00:28:55,830 --> 00:28:54,880

orbit so several hours later

734

00:28:58,710 --> 00:28:55,840

and

735

00:29:00,710 --> 00:28:58,720

we know that bill had the 250 millimeter

736

00:29:01,909 --> 00:29:00,720

telephoto lens

737

00:29:03,510 --> 00:29:01,919

when these

738

00:29:05,669 --> 00:29:03,520

these ones that we're looking at now

739

00:29:08,149 --> 00:29:05,679

were taken the fact that it was the wide

740

00:29:09,590 --> 00:29:08,159

lens suggests that it was probably born

741

00:29:11,350 --> 00:29:09,600

in fact you can see

742

00:29:13,350 --> 00:29:11,360

uh the outline of borman's rendezvous

743

00:29:15,510 --> 00:29:13,360

window i think isn't that right ernie i

744

00:29:19,350 --> 00:29:15,520

yeah it was actually orbits five and

745

00:29:22,070 --> 00:29:19,360

seven and because i was able to find the

746

00:29:23,909 --> 00:29:22,080

the cloud map the cloud pattern for the

747

00:29:26,149 --> 00:29:23,919

earth and match that

748

00:29:29,430 --> 00:29:26,159

it's very easy to match up you know the

749

00:29:31,909 --> 00:29:29,440

times that those photographs were taken

750

00:29:34,230 --> 00:29:31,919

i think it's even the case that on orbit

751

00:29:35,669 --> 00:29:34,240

seven the transcript has

752

00:29:37,909 --> 00:29:35,679

frank saying

753

00:29:39,669 --> 00:29:37,919

um you know guess what just came up

754

00:29:40,950 --> 00:29:39,679

again and he's talking to jim and he

755

00:29:42,470 --> 00:29:40,960

says you know

756

00:29:45,350 --> 00:29:42,480

and jim says something else he says no

757

00:29:47,990 --> 00:29:45,360

it was the earth and and so

758

00:29:49,990 --> 00:29:48,000

i'm fairly confident that frank took you

759

00:29:52,470 --> 00:29:50,000

know about 12 of those pictures with the

760

00:29:55,510 --> 00:29:52,480

shorter lens right um but we can

761

00:29:58,230 --> 00:29:55,520

we've matched those i've matched them up

762

00:30:00,230 --> 00:29:58,240

as still images as well and maybe at

763

00:30:02,149 --> 00:30:00,240

some point we'll put those out too

764

00:30:04,549 --> 00:30:02,159

but it was definitely orbit five and

765

00:30:07,350 --> 00:30:04,559

orbit seven that those and i have that

766

00:30:08,389 --> 00:30:07,360

look magazine uh issue by the way

767

00:30:10,230 --> 00:30:08,399

and there were

768

00:30:13,110 --> 00:30:10,240

earth rise pictures taken on the later

769

00:30:15,590 --> 00:30:13,120

missions every crew that went to moon

770

00:30:18,310 --> 00:30:15,600

talked about the earth as

771

00:30:20,710 --> 00:30:18,320

stu rusev from apollo 14 told me the

772

00:30:22,630 --> 00:30:20,720

earth was the magnet of the flight

773

00:30:24,710 --> 00:30:22,640

and that was the way they all felt that

774

00:30:26,870 --> 00:30:24,720

yes it was amazing to look down at the

775

00:30:32,070 --> 00:30:26,880

moon but seeing the earth from that

776

00:30:35,750 --> 00:30:33,990

thank you all so much please continue

777

00:30:37,830 --> 00:30:35,760

bringing your great questions on twitter

778

00:30:40,630 --> 00:30:37,840

at hashtag earthrise or in the google

779

00:30:41,990 --> 00:30:40,640

plus hangout um several people have been

780

00:30:43,590 --> 00:30:42,000

asking

781

00:30:45,830 --> 00:30:43,600

whether the

782

00:30:47,350 --> 00:30:45,840

Iro spacecraft the lunar reconnaissance

783

00:30:50,310 --> 00:30:47,360

orbiter the one that's orbiting the moon

784

00:30:51,590 --> 00:30:50,320

right now is taking earthrise images and

785

00:30:53,350 --> 00:30:51,600

that seems like a perfect question to

786

00:30:55,750 --> 00:30:53,360

john to talk about sort of the point of

787

00:30:58,149 --> 00:30:55,760

Iro and if it's getting any earthrise

788

00:30:59,110 --> 00:30:58,159

images or not john

789

00:31:01,430 --> 00:30:59,120

um

790

00:31:04,470 --> 00:31:01,440

it turns out that the way the uh the

791

00:31:06,230 --> 00:31:04,480

high resolution camera on on lrl works

792

00:31:08,630 --> 00:31:06,240

um we

793

00:31:11,190 --> 00:31:08,640

it's very difficult for us to to to

794

00:31:15,510 --> 00:31:11,200

recreate and earthrise although we have

795

00:31:20,389 --> 00:31:17,590

in the past and taken images of the

796

00:31:21,750 --> 00:31:20,399

earth and uh one example is where we did

797

00:31:25,190 --> 00:31:21,760

a um

798

00:31:27,669 --> 00:31:25,200

a uh a solar eclipse where we could we

799

00:31:29,029 --> 00:31:27,679

could we actually imaged the shadow of

800

00:31:31,669 --> 00:31:29,039

the moon

801
00:31:32,389 --> 00:31:31,679
uh on the earth

802
00:31:35,909 --> 00:31:32,399
but

803
00:31:37,990 --> 00:31:35,919
mostly uh Iro is is concentrating on its

804
00:31:40,870 --> 00:31:38,000
science objectives as i mentioned

805
00:31:43,350 --> 00:31:40,880
earlier it has seven instruments um just

806
00:31:45,590 --> 00:31:43,360
very quickly uh there's a radiation

807
00:31:48,070 --> 00:31:45,600
detector on there that has a

808
00:31:50,310 --> 00:31:48,080
tissue equivalent plastic and we study

809
00:31:51,590 --> 00:31:50,320
the radiation environment at the moon

810
00:31:53,430 --> 00:31:51,600
there's a

811
00:31:55,990 --> 00:31:53,440
lunar radiometer where we measure the

812
00:31:58,070 --> 00:31:56,000
temperature of the lunar surface and

813
00:31:58,950 --> 00:31:58,080

measure the coldest point

814

00:32:00,710 --> 00:31:58,960

uh

815

00:32:03,110 --> 00:32:00,720

measured in the solar system and that is

816

00:32:04,630 --> 00:32:03,120

in in these uh areas of poles of

817

00:32:05,750 --> 00:32:04,640

permanently shadowed craters of the

818

00:32:08,789 --> 00:32:05,760

poles

819

00:32:11,190 --> 00:32:08,799

uh we have a imaging uv spectrometer

820

00:32:12,549 --> 00:32:11,200

that's concentrated on looking for water

821

00:32:14,389 --> 00:32:12,559

and in some of these permanently

822

00:32:16,710 --> 00:32:14,399

shadowed craters and also looking at the

823

00:32:18,710 --> 00:32:16,720

atmosphere or the exosphere of the moon

824

00:32:20,470 --> 00:32:18,720

it doesn't really have an atmosphere

825

00:32:24,870 --> 00:32:20,480

there's a neutron detector that was

826

00:32:27,669 --> 00:32:24,880

contributed by the russian space agency

827

00:32:29,430 --> 00:32:27,679

the altimeter which we talked about and

828

00:32:32,070 --> 00:32:29,440

the the cameras

829

00:32:34,149 --> 00:32:32,080

they're really two camera systems uh one

830

00:32:35,990 --> 00:32:34,159

is uh is the wide angle camera which is

831

00:32:38,149 --> 00:32:36,000

what ernie used to recreate these and

832

00:32:41,590 --> 00:32:38,159

then there's a narrow angle camera

833

00:32:43,990 --> 00:32:41,600

uh which had from 50 kilometers up uh 50

834

00:32:45,430 --> 00:32:44,000

centimeter uh resolution and those are

835

00:32:47,110 --> 00:32:45,440

the ones that

836

00:32:48,070 --> 00:32:47,120

that was the camera system that we use

837

00:32:52,230 --> 00:32:48,080

for the

838

00:32:54,789 --> 00:32:52,240

uh the apollo landing site uh images

839

00:32:58,549 --> 00:32:54,799

and then finally we have a mini rf which

840

00:33:00,389 --> 00:32:58,559

is a radar system so we were able to to

841

00:33:01,350 --> 00:33:00,399

make measurements of the lunar surface

842

00:33:04,870 --> 00:33:01,360

using

843

00:33:06,950 --> 00:33:04,880

and now john i have a question you

844

00:33:08,789 --> 00:33:06,960

probably get all the time which is you

845

00:33:10,549 --> 00:33:08,799

know are you doing all the studying of

846

00:33:13,029 --> 00:33:10,559

the moon so we can ultimately live there

847

00:33:16,070 --> 00:33:13,039

or build a moon base there is it pure

848

00:33:18,230 --> 00:33:16,080

scientific discovery when what's the the

849

00:33:19,430 --> 00:33:18,240

point of gathering all this data aside

850

00:33:20,630 --> 00:33:19,440

from the fact that the moon is just

851
00:33:21,509 --> 00:33:20,640
beautiful

852
00:33:22,310 --> 00:33:21,519
well

853
00:33:24,630 --> 00:33:22,320
um

854
00:33:26,870 --> 00:33:24,640
it you know Iro started its life off as

855
00:33:28,630 --> 00:33:26,880
an exploration mission and so we were

856
00:33:31,430 --> 00:33:28,640
interested in in

857
00:33:33,269 --> 00:33:31,440
in scouting landing uh potential landing

858
00:33:34,549 --> 00:33:33,279
sites for robotic missions as well as

859
00:33:37,830 --> 00:33:34,559
human landers

860
00:33:40,070 --> 00:33:37,840
really Iro is creating the maps that

861
00:33:42,710 --> 00:33:40,080
will be used for generations

862
00:33:46,549 --> 00:33:42,720
for any number of purposes it's just

863
00:33:51,909 --> 00:33:48,870

the space agencies of the world want to

864

00:33:54,789 --> 00:33:51,919

want to use that that data uh but then

865

00:33:56,710 --> 00:33:54,799

also you know the moon is uh is a is a

866

00:33:57,669 --> 00:33:56,720

witness to the history of the solar

867

00:34:00,310 --> 00:33:57,679

system

868

00:34:02,789 --> 00:34:00,320

uh we're very interested in for example

869

00:34:04,789 --> 00:34:02,799

the cratering on the on the moon uh we

870

00:34:09,349 --> 00:34:04,799

we study those craters carefully in

871

00:34:14,149 --> 00:34:12,389

the crater the asteroids impacts on on

872

00:34:16,230 --> 00:34:14,159

the moon throughout throughout solar

873

00:34:17,750 --> 00:34:16,240

system history because the moon is right

874

00:34:19,669 --> 00:34:17,760

next to the earth

875

00:34:21,349 --> 00:34:19,679

by studying that we know what was going

876

00:34:22,389 --> 00:34:21,359

we can say something about what was

877

00:34:24,230 --> 00:34:22,399

happening

878

00:34:26,149 --> 00:34:24,240

on the on the earth in those early times

879

00:34:28,629 --> 00:34:26,159

whereas on the earth because of the

880

00:34:30,710 --> 00:34:28,639

earth's atmosphere and plate tectonics

881

00:34:33,349 --> 00:34:30,720

most of that information has been wiped

882

00:34:34,389 --> 00:34:33,359

out so the moon is our touchstone for

883

00:34:37,669 --> 00:34:34,399

understanding

884

00:34:39,109 --> 00:34:37,679

the early history of the solar system

885

00:34:40,790 --> 00:34:39,119

thank you so much and just a reminder

886

00:34:43,349 --> 00:34:40,800

that that's john keller he's the project

887

00:34:45,349 --> 00:34:43,359

scientist for the Iro mission joining us

888

00:34:47,909 --> 00:34:45,359

also is andrew chaikin he's a space

889

00:34:50,550 --> 00:34:47,919

historian and ernie wright who's a nasa

890

00:34:52,149 --> 00:34:50,560

goddard uh visualizer and i'm aries keck

891

00:34:54,310 --> 00:34:52,159

here at nasa goddard space flight center

892

00:34:55,909 --> 00:34:54,320

and we're talking about earthrise the

893

00:34:58,790 --> 00:34:55,919

iconic image that you can see right now

894

00:35:01,990 --> 00:34:58,800

behind ernie um and that was taken by

895

00:35:03,750 --> 00:35:02,000

the apollo 8 astronauts and also this

896

00:35:07,109 --> 00:35:03,760

beautiful recreation that we've done

897

00:35:10,390 --> 00:35:07,119

using lro data um i have a question that

898

00:35:12,390 --> 00:35:10,400

that probably leans more for ernie um

899

00:35:14,390 --> 00:35:12,400

and ernie people are asking a little bit

900

00:35:16,950 --> 00:35:14,400

about how to get your job you sit there

901
00:35:20,550 --> 00:35:16,960
and make awesome computer animation real

902
00:35:23,349 --> 00:35:20,560
data um two questions for you one could

903
00:35:25,270 --> 00:35:23,359
you talk a little bit about what you do

904
00:35:27,510 --> 00:35:25,280
and how this is different from

905
00:35:29,829 --> 00:35:27,520
what pixar does you know you use true

906
00:35:31,670 --> 00:35:29,839
scientific data and another question

907
00:35:33,589 --> 00:35:31,680
that falls into this a lot of people are

908
00:35:35,670 --> 00:35:33,599
asking apparently the new gran turismo

909
00:35:38,069 --> 00:35:35,680
video game has a moon track will you

910
00:35:39,510 --> 00:35:38,079
race cars on the moon did you know about

911
00:35:41,670 --> 00:35:39,520
that were you involved with sending them

912
00:35:44,150 --> 00:35:41,680
any of this data so they could build a

913
00:35:46,630 --> 00:35:44,160

racetrack on the moon in that video game

914

00:35:49,430 --> 00:35:46,640

i was not directly involved in that but

915

00:35:53,510 --> 00:35:49,440

i can tell you that the all of the

916

00:35:56,230 --> 00:35:53,520

data from Iro is being archived publicly

917

00:35:58,550 --> 00:35:56,240

it's in the planetary data system and i

918

00:36:00,150 --> 00:35:58,560

think if you just search for Iro

919

00:36:02,710 --> 00:36:00,160

pds

920

00:36:03,829 --> 00:36:02,720

you'll find that all of the terrain data

921

00:36:06,470 --> 00:36:03,839

and the

922

00:36:09,430 --> 00:36:06,480

the albedo maps and a lot of the other

923

00:36:12,470 --> 00:36:09,440

data is out there and so anybody who

924

00:36:14,790 --> 00:36:12,480

wants to do this can

925

00:36:16,710 --> 00:36:14,800

i have had inquiries from

926
00:36:18,550 --> 00:36:16,720
movie makers over the past couple of

927
00:36:20,950 --> 00:36:18,560
years who

928
00:36:22,710 --> 00:36:20,960
because we talk happen to know that i'm

929
00:36:24,230 --> 00:36:22,720
working on moon stuff and they've asked

930
00:36:27,190 --> 00:36:24,240
me where this data is and i just send

931
00:36:29,109 --> 00:36:27,200
them a link to the pds

932
00:36:29,910 --> 00:36:29,119
so i didn't know about that particular

933
00:36:31,270 --> 00:36:29,920
game

934
00:36:32,790 --> 00:36:31,280
but i know that

935
00:36:34,550 --> 00:36:32,800
imagery of the moon is getting better

936
00:36:36,230 --> 00:36:34,560
all the time and it's because we have

937
00:36:39,270 --> 00:36:36,240
all this great lro data and it's all

938
00:36:44,710 --> 00:36:41,829

as far as what the studio does and how

939

00:36:47,270 --> 00:36:44,720

it's different from other animation

940

00:36:50,390 --> 00:36:47,280

studios um we use a lot of the same

941

00:36:51,829 --> 00:36:50,400

software we use uh pixar's renderer um

942

00:36:54,710 --> 00:36:51,839

and for this one i also used a little

943

00:36:56,069 --> 00:36:54,720

bit of light wave

944

00:36:57,430 --> 00:36:56,079

but

945

00:37:01,190 --> 00:36:57,440

what makes it different is that

946

00:37:01,990 --> 00:37:01,200

everything we do is driven by data

947

00:37:04,710 --> 00:37:02,000

so

948

00:37:06,470 --> 00:37:04,720

we're not allowed to make anything up

949

00:37:08,150 --> 00:37:06,480

we get we get

950

00:37:09,670 --> 00:37:08,160

short-tempered with people who come and

951
00:37:11,349 --> 00:37:09,680
ask us to make things up because we

952
00:37:15,589 --> 00:37:11,359
don't know how

953
00:37:19,030 --> 00:37:15,599
our skills are really for

954
00:37:21,190 --> 00:37:19,040
taking data from scientific missions and

955
00:37:22,710 --> 00:37:21,200
showing them to other scientists and to

956
00:37:24,870 --> 00:37:22,720
the public

957
00:37:26,870 --> 00:37:24,880
in in ways that sort of illuminate what

958
00:37:28,950 --> 00:37:26,880
that data means

959
00:37:31,510 --> 00:37:28,960
and we have

960
00:37:33,510 --> 00:37:31,520
a website with several thousand of those

961
00:37:37,670 --> 00:37:33,520
animations that you can go to and it's

962
00:37:40,790 --> 00:37:37,680
if you search for sbs you'll find it

963
00:37:42,390 --> 00:37:40,800

if you want my job

964

00:37:45,270 --> 00:37:42,400

most of the people that work in our

965

00:37:47,750 --> 00:37:45,280

studio have computer science backgrounds

966

00:37:51,190 --> 00:37:47,760

we also have someone with a master of

967

00:37:53,109 --> 00:37:51,200

fine arts and we have an astrophysicist

968

00:37:55,750 --> 00:37:53,119

and so you bring your

969

00:37:57,750 --> 00:37:55,760

programming skills and your interest in

970

00:38:01,349 --> 00:37:57,760

space science

971

00:38:05,190 --> 00:38:01,359

and some experience with animation and

972

00:38:06,069 --> 00:38:05,200

we'll look at your resume um

973

00:38:08,390 --> 00:38:06,079

although

974

00:38:10,790 --> 00:38:08,400

i i'd like for it not to be my job i'd

975

00:38:12,550 --> 00:38:10,800

like for it to be a another opening

976

00:38:14,630 --> 00:38:12,560

um

977

00:38:16,550 --> 00:38:14,640

but it's a it's an odd skill set i mean

978

00:38:18,950 --> 00:38:16,560

it's not it's not a set of skills that

979

00:38:21,430 --> 00:38:18,960

everybody has

980

00:38:23,030 --> 00:38:21,440

so we're we're a very tight-knit group

981

00:38:25,030 --> 00:38:23,040

and we do a lot of

982

00:38:27,030 --> 00:38:25,040

custom programming that's the reason for

983

00:38:28,470 --> 00:38:27,040

the computer science background

984

00:38:30,150 --> 00:38:28,480

we need to

985

00:38:31,030 --> 00:38:30,160

almost every time

986

00:38:33,670 --> 00:38:31,040

write

987

00:38:35,910 --> 00:38:33,680

programs that translate scientific data

988

00:38:37,430 --> 00:38:35,920

into forms that can be used in animation

989

00:38:38,870 --> 00:38:37,440

software

990

00:38:40,550 --> 00:38:38,880

and we also have to apply a little bit

991

00:38:43,510 --> 00:38:40,560

of judgment about

992

00:38:45,589 --> 00:38:43,520

what a valid visual representation of

993

00:38:47,349 --> 00:38:45,599

this data is

994

00:38:48,790 --> 00:38:47,359

because it's pretty easy to misrepresent

995

00:38:51,990 --> 00:38:48,800

data if you just start goofing around

996

00:38:53,750 --> 00:38:52,000

with it and paste it wherever you like

997

00:38:57,030 --> 00:38:53,760

so those are kind of the things that we

998

00:39:00,150 --> 00:38:58,550

fantastic i'm going to try to go through

999

00:39:02,630 --> 00:39:00,160

some questions uh real quick thank you

1000

00:39:05,270 --> 00:39:02,640

all for sending them all in um

1001

00:39:07,109 --> 00:39:05,280

at erio donna wanted to know if earth

1002

00:39:10,069 --> 00:39:07,119

was the only planet that they were able

1003

00:39:11,109 --> 00:39:10,079

to see from the moon um ernie you're not

1004

00:39:12,870 --> 00:39:11,119

in if you want to take that i know

1005

00:39:15,190 --> 00:39:12,880

andrew probably also know that knows the

1006

00:39:16,790 --> 00:39:15,200

answer but were did the apollo

1007

00:39:17,910 --> 00:39:16,800

astronauts try to see other planets

1008

00:39:20,470 --> 00:39:17,920

while they were up there in their

1009

00:39:26,870 --> 00:39:23,990

uh well yeah go ahead ernie all right um

1010

00:39:29,190 --> 00:39:26,880

the thing i will say about that is that

1011

00:39:31,190 --> 00:39:29,200

it probably surprises people not to see

1012

00:39:33,270 --> 00:39:31,200

stars in a lot of these

1013

00:39:34,710 --> 00:39:33,280

images from apollo

1014

00:39:36,310 --> 00:39:34,720

and

1015

00:39:38,310 --> 00:39:36,320

that's because most of the time they

1016

00:39:40,470 --> 00:39:38,320

were in daylight

1017

00:39:44,470 --> 00:39:40,480

and the astronauts themselves said that

1018

00:39:47,750 --> 00:39:44,480

they didn't see um stars until

1019

00:39:48,870 --> 00:39:47,760

they were not only on the on the

1020

00:39:51,270 --> 00:39:48,880

side of the moon that was not

1021

00:39:53,510 --> 00:39:51,280

illuminated by the sun but also on the

1022

00:39:54,790 --> 00:39:53,520

part that was not illuminated by the

1023

00:39:59,990 --> 00:39:54,800

earth

1024

00:40:02,790 --> 00:40:00,000

but they really needed to be in complete

1025

00:40:04,870 --> 00:40:02,800

darkness before they started to see

1026

00:40:06,790 --> 00:40:04,880

um the rest of space and then when that

1027

00:40:08,710 --> 00:40:06,800

became apparent it was beautiful but

1028

00:40:12,470 --> 00:40:08,720

they didn't see it all the time

1029

00:40:14,630 --> 00:40:12,480

um i don't know and andy may know i

1030

00:40:16,390 --> 00:40:14,640

don't know whether apollo 8 saw any of

1031

00:40:18,950 --> 00:40:16,400

the other planets i know they saw stars

1032

00:40:20,550 --> 00:40:18,960

and they used stars for navigation

1033

00:40:21,829 --> 00:40:20,560

but there were many times when they

1034

00:40:24,230 --> 00:40:21,839

couldn't see them because they were

1035

00:40:26,470 --> 00:40:24,240

literally in daylight

1036

00:40:27,829 --> 00:40:26,480

yeah that's that's right i mean

1037

00:40:29,430 --> 00:40:27,839

this is uh

1038

00:40:32,390 --> 00:40:29,440

one of the things that

1039

00:40:34,710 --> 00:40:32,400

um you know there is a small

1040

00:40:37,270 --> 00:40:34,720

minority uh of people who actually don't

1041

00:40:39,109 --> 00:40:37,280

believe that the moon landings happened

1042

00:40:41,270 --> 00:40:39,119

and one of the things that they always

1043

00:40:42,870 --> 00:40:41,280

say is hey if they if they are on the

1044

00:40:44,950 --> 00:40:42,880

moon how come there are no stars in the

1045

00:40:45,829 --> 00:40:44,960

photos well the fact is that the stars

1046

00:40:48,630 --> 00:40:45,839

are

1047

00:40:51,190 --> 00:40:48,640

you know millions of times fainter

1048

00:40:52,550 --> 00:40:51,200

than the sun lit surface of the moon

1049

00:40:54,150 --> 00:40:52,560

itself

1050

00:40:56,150 --> 00:40:54,160

and so whether you're looking at it with

1051
00:40:58,150 --> 00:40:56,160
your eyeball or photographing it with a

1052
00:40:59,670 --> 00:40:58,160
camera

1053
00:41:01,829 --> 00:40:59,680
you've got to have the right conditions

1054
00:41:03,910 --> 00:41:01,839
to see stars in the daylight

1055
00:41:06,550 --> 00:41:03,920
and there's only one

1056
00:41:09,349 --> 00:41:06,560
example that i know of

1057
00:41:11,109 --> 00:41:09,359
where a planet is recorded in a lunar

1058
00:41:13,910 --> 00:41:11,119
surface photo it's a

1059
00:41:16,790 --> 00:41:13,920
photograph from apollo 16

1060
00:41:19,670 --> 00:41:16,800
and it does show venus if you know

1061
00:41:22,390 --> 00:41:19,680
exactly where to look in the photo

1062
00:41:25,349 --> 00:41:22,400
and it's only you know one little bright

1063
00:41:27,430 --> 00:41:25,359

dot because venus is extremely bright

1064

00:41:28,390 --> 00:41:27,440

and you know we can see venus even here

1065

00:41:29,670 --> 00:41:28,400

on earth

1066

00:41:31,190 --> 00:41:29,680

if you know exactly where it looks

1067

00:41:34,870 --> 00:41:31,200

sometimes you can see venus in the day

1068

00:41:36,390 --> 00:41:34,880

time but in general as ernie said

1069

00:41:37,990 --> 00:41:36,400

even if you're standing on the surface

1070

00:41:39,990 --> 00:41:38,000

of the moon if you want to see stars

1071

00:41:42,309 --> 00:41:40,000

you'd have to go into the shadow of the

1072

00:41:43,349 --> 00:41:42,319

lunar module and let your eyes dark

1073

00:41:45,030 --> 00:41:43,359

adapt

1074

00:41:47,670 --> 00:41:45,040

before you could really see them

1075

00:41:49,190 --> 00:41:47,680

otherwise you know you're really just

1076

00:41:54,390 --> 00:41:49,200

everything's washed out by the

1077

00:41:57,990 --> 00:41:56,150

um and uh we're getting questions in

1078

00:41:59,430 --> 00:41:58,000

fast and furious here uh one of the

1079

00:42:00,950 --> 00:41:59,440

questions that have come in people are

1080

00:42:03,030 --> 00:42:00,960

asking what part of earth are they

1081

00:42:04,790 --> 00:42:03,040

looking at and i actually was squinting

1082

00:42:07,430 --> 00:42:04,800

at the image behind ernie trying to see

1083

00:42:08,470 --> 00:42:07,440

what if i could see a consonant there um

1084

00:42:10,470 --> 00:42:08,480

andrew

1085

00:42:12,150 --> 00:42:10,480

what exactly what part of earth is seen

1086

00:42:13,990 --> 00:42:12,160

in earthwise and then the follow-up

1087

00:42:15,030 --> 00:42:14,000

question is people asking does it change

1088

00:42:19,430 --> 00:42:15,040

as

1089

00:42:21,190 --> 00:42:19,440

the moon goes around earth well well

1090

00:42:22,950 --> 00:42:21,200

ernie really nailed this down so i'll

1091

00:42:23,910 --> 00:42:22,960

let him talk about it

1092

00:42:25,510 --> 00:42:23,920

okay

1093

00:42:28,390 --> 00:42:25,520

um the

1094

00:42:31,349 --> 00:42:28,400

earthrise image that was taken um on the

1095

00:42:35,270 --> 00:42:31,359

fourth orbit shows uh the

1096

00:42:37,910 --> 00:42:35,280

western coast of africa at the bottom

1097

00:42:40,950 --> 00:42:37,920

and north is to the right in that image

1098

00:42:42,550 --> 00:42:40,960

and antarctica is visible on the left

1099

00:42:43,430 --> 00:42:42,560

side of that image

1100

00:42:44,390 --> 00:42:43,440

and

1101
00:42:46,710 --> 00:42:44,400
south america

1102
00:42:48,390 --> 00:42:46,720
is coming into view at the top

1103
00:42:49,430 --> 00:42:48,400
um in

1104
00:42:53,990 --> 00:42:49,440
later

1105
00:42:55,190 --> 00:42:54,000
africa has moved into night time

1106
00:42:57,829 --> 00:42:55,200
and

1107
00:42:59,750 --> 00:42:57,839
south america is central

1108
00:43:02,550 --> 00:42:59,760
in those pictures

1109
00:43:04,390 --> 00:43:02,560
um so yeah the the earth the earth is

1110
00:43:05,510 --> 00:43:04,400
rotating it took them about two hours

1111
00:43:08,069 --> 00:43:05,520
per orbit

1112
00:43:11,109 --> 00:43:08,079
so the earth would rotate one twelfth of

1113
00:43:13,430 --> 00:43:11,119

the way around in between each orbit

1114

00:43:16,550 --> 00:43:13,440

and the moon is also moving a little bit

1115

00:43:19,430 --> 00:43:16,560

and that has a has a smaller effect on

1116

00:43:21,510 --> 00:43:19,440

what part of the earth is visible um

1117

00:43:23,030 --> 00:43:21,520

those yeah those changes are absolutely

1118

00:43:24,630 --> 00:43:23,040

visible in the photography that they

1119

00:43:26,390 --> 00:43:24,640

took

1120

00:43:27,910 --> 00:43:26,400

fantastic um one of the questions we're

1121

00:43:29,510 --> 00:43:27,920

getting that i think someone who speaks

1122

00:43:32,150 --> 00:43:29,520

for the robots is noting that this was

1123

00:43:34,069 --> 00:43:32,160

the first earthrise taken by humans

1124

00:43:36,150 --> 00:43:34,079

now andrew you probably know this as

1125

00:43:38,150 --> 00:43:36,160

well what what was the first earthrise

1126
00:43:39,430 --> 00:43:38,160
image then ever taken i have the answer

1127
00:43:42,550 --> 00:43:39,440
here because they've been sending it to

1128
00:43:44,550 --> 00:43:42,560
us but right and i think i maybe know

1129
00:43:45,510 --> 00:43:44,560
who that person is who's asking that

1130
00:43:46,950 --> 00:43:45,520
question

1131
00:43:49,030 --> 00:43:46,960
i think i do too

1132
00:43:51,589 --> 00:43:49,040
they they're absolutely right the first

1133
00:43:54,069 --> 00:43:51,599
image of an earth rise

1134
00:43:55,910 --> 00:43:54,079
was actually taken by a robotic probe

1135
00:43:58,069 --> 00:43:55,920
called lunar orbiter

1136
00:43:59,510 --> 00:43:58,079
and i don't remember which lunar orbiter

1137
00:44:02,470 --> 00:43:59,520
it was i have a feeling it might have

1138
00:44:04,950 --> 00:44:02,480

been lunar orbiter 4 but i'm not sure

1139

00:44:07,589 --> 00:44:04,960

in 1966 i believe

1140

00:44:09,910 --> 00:44:07,599

it was a black and white image

1141

00:44:11,910 --> 00:44:09,920

because of the way that lunar the lunar

1142

00:44:14,710 --> 00:44:11,920

orbiter probes not to be confused with

1143

00:44:16,630 --> 00:44:14,720

today's lunar reconnaissance orbiter the

1144

00:44:17,589 --> 00:44:16,640

lunar orbiter probes which were the

1145

00:44:20,309 --> 00:44:17,599

first

1146

00:44:21,670 --> 00:44:20,319

to create detailed photographic maps of

1147

00:44:24,630 --> 00:44:21,680

the moon

1148

00:44:25,910 --> 00:44:24,640

had a unusual image system where they

1149

00:44:28,309 --> 00:44:25,920

actually shot

1150

00:44:30,790 --> 00:44:28,319

photographic film on board developed

1151

00:44:31,910 --> 00:44:30,800

that film on board and then scanned the

1152

00:44:34,550 --> 00:44:31,920

resulting

1153

00:44:35,430 --> 00:44:34,560

uh developed film and re and transmitted

1154

00:44:38,470 --> 00:44:35,440

that

1155

00:44:40,069 --> 00:44:38,480

uh as brightness variations

1156

00:44:42,390 --> 00:44:40,079

uh to the earth and that was then

1157

00:44:44,309 --> 00:44:42,400

reconstructed into an image so when you

1158

00:44:46,309 --> 00:44:44,319

see one of those lunar orbiter images

1159

00:44:48,150 --> 00:44:46,319

they're kind of like strips put together

1160

00:44:50,630 --> 00:44:48,160

now a recent project

1161

00:44:54,630 --> 00:44:50,640

called the lunar orbiter image recovery

1162

00:44:56,150 --> 00:44:54,640

project has done some beautiful work uh

1163

00:44:57,750 --> 00:44:56,160

reconstructing those images from the

1164

00:44:59,510 --> 00:44:57,760

original data tapes

1165

00:45:02,710 --> 00:44:59,520

and they're much more

1166

00:45:04,870 --> 00:45:02,720

um they're much nicer uh presentations

1167

00:45:06,470 --> 00:45:04,880

of those images than we had at the time

1168

00:45:09,829 --> 00:45:06,480

and one of the images that they've

1169

00:45:12,069 --> 00:45:09,839

recreated is that earthrise image from

1170

00:45:13,589 --> 00:45:12,079

lunar orbiter so if you google

1171

00:45:16,069 --> 00:45:13,599

loirp

1172

00:45:17,910 --> 00:45:16,079

for lunar orbiter image recovery project

1173

00:45:19,589 --> 00:45:17,920

and earthrise you will find that

1174

00:45:22,630 --> 00:45:19,599

recreated image

1175

00:45:25,670 --> 00:45:22,640

but the difference was just to add the

1176

00:45:28,550 --> 00:45:25,680

historian's perspective here

1177

00:45:29,990 --> 00:45:28,560

there's no comparison between

1178

00:45:32,870 --> 00:45:30,000

a camera

1179

00:45:35,349 --> 00:45:32,880

that is robotically controlled and a

1180

00:45:37,190 --> 00:45:35,359

camera held by a human this i'm a big

1181

00:45:39,670 --> 00:45:37,200

fan of robotic space flight i'm a huge

1182

00:45:43,030 --> 00:45:39,680

fan of robotic space flight but

1183

00:45:45,030 --> 00:45:43,040

once the astronauts got to the moon

1184

00:45:47,190 --> 00:45:45,040

the fact that she had a human taking

1185

00:45:49,349 --> 00:45:47,200

that picture who could then come home

1186

00:45:50,550 --> 00:45:49,359

and talk about what it was like to see

1187

00:45:54,550 --> 00:45:50,560

that

1188

00:45:57,750 --> 00:45:54,560

it just struck a accord on a much higher

1189

00:45:59,990 --> 00:45:57,760

uh more intense level for for the entire

1190

00:46:02,150 --> 00:46:00,000

world

1191

00:46:04,309 --> 00:46:02,160

fantastic um we're having some questions

1192

00:46:06,309 --> 00:46:04,319

here as well about what the orbiter we

1193

00:46:08,309 --> 00:46:06,319

have around the moon right now so i

1194

00:46:10,790 --> 00:46:08,319

wanted to throw it to john and

1195

00:46:13,190 --> 00:46:10,800

behind you on your bookshelf is i

1196

00:46:15,270 --> 00:46:13,200

believe a globe that shows the the topo

1197

00:46:17,670 --> 00:46:15,280

map that lro was able to create of the

1198

00:46:19,589 --> 00:46:17,680

moon in all those beautiful colors what

1199

00:46:21,670 --> 00:46:19,599

was the point of creating a very high

1200

00:46:24,309 --> 00:46:21,680

resolution

1201
00:46:25,109 --> 00:46:24,319
topo map of the moon and putting it in

1202
00:46:27,109 --> 00:46:25,119
those

1203
00:46:28,230 --> 00:46:27,119
to our eyes odd colors instead of the

1204
00:46:29,990 --> 00:46:28,240
black and white that we're used to

1205
00:46:31,670 --> 00:46:30,000
seeing

1206
00:46:34,950 --> 00:46:31,680
well i think uh the reason for the

1207
00:46:38,309 --> 00:46:34,960
coloring is it makes it uh to the to a

1208
00:46:39,910 --> 00:46:38,319
person looking at the moon

1209
00:46:42,309 --> 00:46:39,920
you can quickly see where the high

1210
00:46:44,230 --> 00:46:42,319
points are and where the low points are

1211
00:46:46,309 --> 00:46:44,240
um you know one of the reasons the

1212
00:46:48,950 --> 00:46:46,319
science one of the science reasons for

1213
00:46:50,630 --> 00:46:48,960

for making these maps

1214

00:46:52,069 --> 00:46:50,640

just as an example

1215

00:46:52,790 --> 00:46:52,079

um

1216

00:46:54,309 --> 00:46:52,800

we

1217

00:46:55,510 --> 00:46:54,319

by by looking

1218

00:46:58,069 --> 00:46:55,520

carefully

1219

00:47:00,230 --> 00:46:58,079

uh from both the high resolution images

1220

00:47:01,589 --> 00:47:00,240

and the and the and the

1221

00:47:02,710 --> 00:47:01,599

topography

1222

00:47:04,950 --> 00:47:02,720

we're able to

1223

00:47:06,470 --> 00:47:04,960

to see features on the moon

1224

00:47:09,190 --> 00:47:06,480

um

1225

00:47:11,190 --> 00:47:09,200

that indicate for example that that the

1226

00:47:13,829 --> 00:47:11,200

moon uh this is one of our science

1227

00:47:16,150 --> 00:47:13,839

discoveries that the moon is still in in

1228

00:47:18,150 --> 00:47:16,160

a state where it is still shrinking now

1229

00:47:21,589 --> 00:47:18,160

of course it's extremely slowly

1230

00:47:25,670 --> 00:47:21,599

shrinking but it shows up tectonically

1231

00:47:27,510 --> 00:47:25,680

in in wrinkle ridges on the moon uh

1232

00:47:29,670 --> 00:47:27,520

but the geologists you know they

1233

00:47:31,349 --> 00:47:29,680

recognize those from from

1234

00:47:33,910 --> 00:47:31,359

comparable features on the earth and

1235

00:47:36,230 --> 00:47:33,920

other planets uh mercury for example

1236

00:47:38,630 --> 00:47:36,240

they recognize that they see we we've

1237

00:47:41,270 --> 00:47:38,640

discovered that these ridges are are

1238

00:47:42,150 --> 00:47:41,280

globally distributed using these data

1239

00:47:45,750 --> 00:47:42,160

and

1240

00:47:48,710 --> 00:47:45,760

we determined that the that the moon is

1241

00:47:49,430 --> 00:47:48,720

still in a state of cooling and and

1242

00:47:51,670 --> 00:47:49,440

and

1243

00:47:52,390 --> 00:47:51,680

contracting very slightly

1244

00:47:54,870 --> 00:47:52,400

but

1245

00:47:57,510 --> 00:47:54,880

the reason it's important is that

1246

00:47:59,430 --> 00:47:57,520

then we can go back and say gee what was

1247

00:48:03,910 --> 00:47:59,440

the state of the moon when it was formed

1248

00:48:08,790 --> 00:48:06,309

did it have a solid core or was it in a

1249

00:48:10,630 --> 00:48:08,800

melted state and knowing a little bit

1250

00:48:12,870 --> 00:48:10,640

more about the thermal state of the moon

1251

00:48:15,829 --> 00:48:12,880

now allows us to

1252

00:48:18,390 --> 00:48:15,839

constrain those models of the moon when

1253

00:48:22,230 --> 00:48:18,400

it was when it was originally formed

1254

00:48:25,190 --> 00:48:22,240

so the topography has has a lot of

1255

00:48:27,990 --> 00:48:25,200

science drivers for it but then

1256

00:48:31,109 --> 00:48:28,000

you know as i've said it's also a map

1257

00:48:32,950 --> 00:48:31,119

for future explorers

1258

00:48:35,589 --> 00:48:32,960

i can see the headlines already nasa

1259

00:48:36,790 --> 00:48:35,599

says the moon is shrinking yeah how when

1260

00:48:38,069 --> 00:48:36,800

you say it's shrinking is this are we

1261

00:48:40,950 --> 00:48:38,079

talking

1262

00:48:43,910 --> 00:48:40,960

micrometer millimeters yeah something

1263

00:48:47,030 --> 00:48:43,920

that only geologists would notice or

1264

00:48:49,190 --> 00:48:47,040

yeah it's it's it's extremely slow and

1265

00:48:51,270 --> 00:48:49,200

you know geologists thinking a short

1266

00:48:52,630 --> 00:48:51,280

period of time for a geologist is 100

1267

00:48:53,750 --> 00:48:52,640

million years

1268

00:48:57,190 --> 00:48:53,760

and so

1269

00:49:00,390 --> 00:48:57,200

uh in geology geological time scales

1270

00:49:02,790 --> 00:49:00,400

it's it's shrinking and and and we know

1271

00:49:03,829 --> 00:49:02,800

that these features are are relatively

1272

00:49:09,510 --> 00:49:03,839

new

1273

00:49:10,870 --> 00:49:09,520

look at at the cratering around those

1274

00:49:13,589 --> 00:49:10,880

features and if they're you know if

1275

00:49:15,349 --> 00:49:13,599

there were a lot of craters over the

1276
00:49:18,390 --> 00:49:15,359
features then we would say gee it's old

1277
00:49:21,430 --> 00:49:18,400
because it's had time for the

1278
00:49:23,910 --> 00:49:21,440
meteorites to uh

1279
00:49:25,829 --> 00:49:23,920
age age it and then

1280
00:49:27,670 --> 00:49:25,839
the fact that these features look fairly

1281
00:49:29,750 --> 00:49:27,680
fresh tells us that it's that they're

1282
00:49:32,390 --> 00:49:29,760
relatively new and new again in

1283
00:49:35,030 --> 00:49:32,400
geological speak it's 100 million years

1284
00:49:38,230 --> 00:49:35,040
300 million years

1285
00:49:40,150 --> 00:49:38,240
a long time is billions of years

1286
00:49:41,430 --> 00:49:40,160
in the geology time is a whole different

1287
00:49:43,589 --> 00:49:41,440
time scale than what we're used to

1288
00:49:46,150 --> 00:49:43,599

hearing um speaking of new those of us

1289

00:49:48,069 --> 00:49:46,160

here on the east coast recently saw a uh

1290

00:49:49,910 --> 00:49:48,079

rocket launch that carried another moon

1291

00:49:52,230 --> 00:49:49,920

mission that went up laddie john can you

1292

00:49:54,150 --> 00:49:52,240

tell us a little bit about what lady is

1293

00:49:56,230 --> 00:49:54,160

doing in in it's studying the moon and

1294

00:49:58,470 --> 00:49:56,240

then i can already hear the question how

1295

00:50:01,670 --> 00:49:58,480

are we making sure that lady and lro

1296

00:50:05,190 --> 00:50:01,680

don't swack into each other up there

1297

00:50:08,230 --> 00:50:05,200

well um the lady is uh is a mission to

1298

00:50:10,390 --> 00:50:08,240

the moon that is designed to look at the

1299

00:50:12,470 --> 00:50:10,400

exosphere the moon and the dust

1300

00:50:14,950 --> 00:50:12,480

environment

1301

00:50:17,990 --> 00:50:14,960

it is an orbit that is

1302

00:50:20,150 --> 00:50:18,000

largely equatorial and uh we're in a

1303

00:50:21,990 --> 00:50:20,160

polar orbit and so our orbit tracks

1304

00:50:23,270 --> 00:50:22,000

actually do cross

1305

00:50:25,670 --> 00:50:23,280

um

1306

00:50:27,109 --> 00:50:25,680

it so we're going like this and ladies

1307

00:50:29,510 --> 00:50:27,119

going like this and i've found that i

1308

00:50:30,309 --> 00:50:29,520

can't do both simultaneously i've tried

1309

00:50:32,069 --> 00:50:30,319

but

1310

00:50:34,630 --> 00:50:32,079

um

1311

00:50:37,109 --> 00:50:34,640

uh we we actually our orbit tracks do

1312

00:50:39,109 --> 00:50:37,119

cross uh uh

1313

00:50:41,270 --> 00:50:39,119

all the time and the closest we've been

1314

00:50:44,470 --> 00:50:41,280

so far at aladdin is uh

1315

00:50:45,270 --> 00:50:44,480

uh i think 10 about around 10 kilometers

1316

00:50:46,630 --> 00:50:45,280

but

1317

00:50:48,870 --> 00:50:46,640

um

1318

00:50:50,630 --> 00:50:48,880

the fact is is their orbit where we

1319

00:50:52,790 --> 00:50:50,640

cross is lower than ours and so there's

1320

00:50:54,710 --> 00:50:52,800

really no danger that that we run into

1321

00:50:56,230 --> 00:50:54,720

them um

1322

00:50:58,549 --> 00:50:56,240

you know even if we tried it's low

1323

00:50:59,510 --> 00:50:58,559

probability but but it's really not

1324

00:51:01,510 --> 00:50:59,520

possible

1325

00:51:03,510 --> 00:51:01,520

uh but it's interesting that you know

1326
00:51:07,109 --> 00:51:03,520
we're attempting to work with lady and

1327
00:51:09,270 --> 00:51:07,119
do some some coordinated studies ladie

1328
00:51:11,030 --> 00:51:09,280
uh because it's in its equatorial orbit

1329
00:51:12,790 --> 00:51:11,040
and it's got some very high sensitive

1330
00:51:14,630 --> 00:51:12,800
instruments that are designed

1331
00:51:17,109 --> 00:51:14,640
specifically for their mission which is

1332
00:51:19,510 --> 00:51:17,119
to look at the exosphere you know what's

1333
00:51:20,710 --> 00:51:19,520
in the atmosphere of the moon

1334
00:51:24,230 --> 00:51:20,720
um

1335
00:51:26,549 --> 00:51:24,240
it does that very well and we have uh

1336
00:51:28,069 --> 00:51:26,559
specifically the lamp instrument the uv

1337
00:51:29,589 --> 00:51:28,079
spectrometer on

1338
00:51:31,349 --> 00:51:29,599

on the moon

1339

00:51:34,069 --> 00:51:31,359

um

1340

00:51:36,470 --> 00:51:34,079

on Iro and and we're able to measure uh

1341

00:51:38,309 --> 00:51:36,480

some some of the atmosphere as well

1342

00:51:40,470 --> 00:51:38,319

and and because we're in a different

1343

00:51:42,390 --> 00:51:40,480

orbit we can kind of correlate what

1344

00:51:44,230 --> 00:51:42,400

their equatorial measurements with our

1345

00:51:45,829 --> 00:51:44,240

polar measurements and try to get a more

1346

00:51:48,230 --> 00:51:45,839

global picture of

1347

00:51:50,710 --> 00:51:48,240

the transport of these uh

1348

00:51:52,230 --> 00:51:50,720

very tenuous species that are

1349

00:51:53,349 --> 00:51:52,240

moving around

1350

00:51:55,910 --> 00:51:53,359

you know in the

1351
00:51:57,270 --> 00:51:55,920
exosphere

1352
00:51:59,190 --> 00:51:57,280
fantastic we've only got about three

1353
00:52:00,630 --> 00:51:59,200
minutes left in this hangout um and

1354
00:52:01,990 --> 00:52:00,640
we're getting a lot of questions and so

1355
00:52:03,430 --> 00:52:02,000
i'm going to try to do a bit of

1356
00:52:06,309 --> 00:52:03,440
summaries for some of them one of them

1357
00:52:08,150 --> 00:52:06,319
for for ernie um now that this is done

1358
00:52:09,589 --> 00:52:08,160
what are you doing next as people are

1359
00:52:11,430 --> 00:52:09,599
asking about are you planning on taking

1360
00:52:13,510 --> 00:52:11,440
the laddie data are you planning on

1361
00:52:15,190 --> 00:52:13,520
taking a vacation and you i know a lot

1362
00:52:16,470 --> 00:52:15,200
of work went into these six minutes that

1363
00:52:19,430 --> 00:52:16,480

we released today

1364

00:52:21,829 --> 00:52:19,440

i'm going to take a nap um and enjoy the

1365

00:52:22,790 --> 00:52:21,839

holidays but um as soon as i get back

1366

00:52:25,510 --> 00:52:22,800

i'm going to

1367

00:52:27,589 --> 00:52:25,520

restart with uh what i've been doing

1368

00:52:29,190 --> 00:52:27,599

with Iro

1369

00:52:31,109 --> 00:52:29,200

they have

1370

00:52:32,870 --> 00:52:31,119

data that i can't really talk about yet

1371

00:52:34,470 --> 00:52:32,880

but um we're going to do some cool

1372

00:52:37,030 --> 00:52:34,480

things with

1373

00:52:41,589 --> 00:52:39,510

yeah i mean the data's coming from Iro

1374

00:52:43,670 --> 00:52:41,599

all the time and we have to sort of pick

1375

00:52:45,190 --> 00:52:43,680

and choose what we what we

1376

00:52:46,790 --> 00:52:45,200

tell people about

1377

00:52:48,390 --> 00:52:46,800

and there will be something waiting for

1378

00:52:50,630 --> 00:52:48,400

me the first week of january when i come

1379

00:52:51,829 --> 00:52:50,640

back

1380

00:52:53,990 --> 00:52:51,839

thank you so much i have one last

1381

00:52:55,190 --> 00:52:54,000

question then for andrew um when it

1382

00:52:56,549 --> 00:52:55,200

comes to i mean you've you've

1383

00:52:58,470 --> 00:52:56,559

essentially made the apollo missions

1384

00:53:01,510 --> 00:52:58,480

your life's work what is it about the

1385

00:53:03,430 --> 00:53:01,520

apollo missions that that for you just

1386

00:53:05,670 --> 00:53:03,440

keeps you enthralled with them and keeps

1387

00:53:07,030 --> 00:53:05,680

them so interesting

1388

00:53:11,910 --> 00:53:07,040

um

1389

00:53:14,069 --> 00:53:11,920

history the the moment when we

1390

00:53:15,190 --> 00:53:14,079

left our home planet and and took our

1391

00:53:18,230 --> 00:53:15,200

first

1392

00:53:19,990 --> 00:53:18,240

voyages to another world and um

1393

00:53:23,589 --> 00:53:20,000

you know i just find that there's always

1394

00:53:27,109 --> 00:53:23,599

more to discover about apollo

1395

00:53:29,349 --> 00:53:27,119

looking at the earthrise photo now

1396

00:53:32,309 --> 00:53:29,359

i couldn't help but think of the the

1397

00:53:33,270 --> 00:53:32,319

quote the famous line from the great

1398

00:53:35,990 --> 00:53:33,280

russian

1399

00:53:37,510 --> 00:53:36,000

space visionary constantine siokovsky

1400

00:53:40,230 --> 00:53:37,520

who wrote that

1401
00:53:41,910 --> 00:53:40,240
uh the earth is the cradle of humanity

1402
00:53:42,950 --> 00:53:41,920
but one cannot live in the cradle

1403
00:53:45,910 --> 00:53:42,960
forever

1404
00:53:47,030 --> 00:53:45,920
and i i have to admit i i get kind of

1405
00:53:48,710 --> 00:53:47,040
emotional

1406
00:53:50,870 --> 00:53:48,720
looking at that picture

1407
00:53:53,750 --> 00:53:50,880
and realizing that for all of us that is

1408
00:53:55,829 --> 00:53:53,760
the cradle and to see it with those eyes

1409
00:53:58,790 --> 00:53:55,839
and realize we're still

1410
00:54:00,710 --> 00:53:58,800
in the process of leaving that cradle

1411
00:54:02,069 --> 00:54:00,720
it's taken a little longer than we would

1412
00:54:03,829 --> 00:54:02,079
have expected

1413
00:54:06,470 --> 00:54:03,839

45 years ago

1414

00:54:08,069 --> 00:54:06,480

but the fact that we can keep revisiting

1415

00:54:11,670 --> 00:54:08,079

that experience and getting more out of

1416

00:54:13,109 --> 00:54:11,680

it is just a it's an ongoing joy for me

1417

00:54:17,589 --> 00:54:13,119

and um

1418

00:54:20,390 --> 00:54:19,030

thank you all so much thank you to

1419

00:54:21,750 --> 00:54:20,400

everyone who's been watching this live

1420

00:54:23,589 --> 00:54:21,760

and thank you to everyone who's maybe

1421

00:54:26,150 --> 00:54:23,599

watching it later as it's archived on

1422

00:54:28,150 --> 00:54:26,160

youtube for uh for all time hopefully

1423

00:54:29,910 --> 00:54:28,160

joining us has been andrew chakin space

1424

00:54:32,710 --> 00:54:29,920

historian and author

1425

00:54:34,710 --> 00:54:32,720

john keller um the project scientist for

1426

00:54:37,349 --> 00:54:34,720

Iro the lunar reconnaissance orbiter

1427

00:54:39,030 --> 00:54:37,359

which is orbiting the moon right now and

1428

00:54:41,510 --> 00:54:39,040

ernie wright who is one of the science

1429

00:54:43,829 --> 00:54:41,520

visualizers there you will keep me f

1430

00:54:45,670 --> 00:54:43,839

keep answering your questions uh

1431

00:54:48,309 --> 00:54:45,680

throughout the weekend and such and also

1432

00:54:50,069 --> 00:54:48,319

if you go to the at Iro nasa twitter

1433

00:54:51,990 --> 00:54:50,079

feed they have been live tweeting this

1434

00:54:54,630 --> 00:54:52,000

entire event and we'll be continuing to

1435

00:54:56,710 --> 00:54:54,640

to post new things especially since

1436

00:54:58,950 --> 00:54:56,720

christmas eve coming up is the 45th

1437

00:55:00,710 --> 00:54:58,960

anniversary anniversary of this event so

1438

00:55:03,030 --> 00:55:00,720

it was 45 years ago and it's a big

1439

00:55:05,030 --> 00:55:03,040

anniversary for not only space missions

1440

00:55:07,190 --> 00:55:05,040

but i think for all of us here on earth

1441

00:55:08,790 --> 00:55:07,200

as viewed from the moon i'm mary's keck

1442

00:55:09,829 --> 00:55:08,800

here at nasa goddard thank you all so

1443

00:55:12,150 --> 00:55:09,839

much for listening and thank you