



1
00:00:10,443 --> 00:00:09,342
>> IN 1977, THE GREATEST

2
00:00:12,111 --> 00:00:10,510
ADVENTURE IN SPACE

3
00:00:13,546 --> 00:00:12,178
EXPLORATION COMMENCED.

4
00:00:16,449 --> 00:00:13,613
>> WE HAVE IGNITION,

5
00:00:18,317 --> 00:00:16,516
AND WE HAVE LIFT-OFF!

6
00:00:19,986 --> 00:00:18,384
>> OUR EYES, OUR MINDS,

7
00:00:21,888 --> 00:00:20,053
OUR SOULS ARE MOVING OUT

8
00:00:22,855 --> 00:00:21,955
THROUGH THE UNIVERSE.

9
00:00:24,957 --> 00:00:22,922
>> YOU CAN ONLY DO THINGS

10
00:00:26,392 --> 00:00:25,024
FOR THE FIRST TIME ONCE.

11
00:00:27,527 --> 00:00:26,459
AND VOYAGER KEPT DOING THINGS

12
00:00:29,529 --> 00:00:27,594
FOR THE FIRST TIME

13
00:00:30,596 --> 00:00:29,596

OVER AND OVER AGAIN.

14

00:00:32,999 --> 00:00:30,663

>> TWO ROBOTS WERE BUILT

15

00:00:34,801 --> 00:00:33,066

TO BE ABLE TO THINK AND EXPLORE

16

00:00:37,937 --> 00:00:34,868

BY THEMSELVES IN THE DEEP

17

00:00:38,905 --> 00:00:38,004

REACHES OF OUR SOLAR SYSTEM.

18

00:00:39,772 --> 00:00:38,972

>> NONE OF THE MANAGERS

19

00:00:41,374 --> 00:00:39,839

REALLY APPRECIATED

20

00:00:42,508 --> 00:00:41,441

THE COMPLEXITY AND THE AUTONOMY

21

00:00:45,545 --> 00:00:42,575

THAT WE HAD JUST LAUNCHED

22

00:00:46,579 --> 00:00:45,612

INTO SPACE.

23

00:00:48,681 --> 00:00:46,646

>> YET BOTH MISSIONS WENT

24

00:00:50,683 --> 00:00:48,748

SERIOUSLY WRONG ONLY MOMENTS

25

00:00:51,384 --> 00:00:50,750

AFTER TAKING FLIGHT.

26
00:00:53,853 --> 00:00:51,451
>> WE THOUGHT THAT

27
00:00:54,821 --> 00:00:53,920
WE'D LOST THE SPACECRAFT.

28
00:00:56,989 --> 00:00:54,888
>> THEY WENT ON TO MAKE

29
00:00:57,924 --> 00:00:57,056
ASTOUNDING AND UNEXPECTED

30
00:01:00,193 --> 00:00:57,991
DISCOVERIES.

31
00:01:01,160 --> 00:01:00,260
[CHEERING]

32
00:01:02,595 --> 00:01:01,227
>> WHEN YOU SEE THINGS THAT

33
00:01:03,329 --> 00:01:02,662
YOU DID NOT PREDICT,

34
00:01:09,702 --> 00:01:03,396
THAT'S WHEN THERE'S

35
00:01:22,181 --> 00:01:09,769
THE MOST TO LEARN.

36
00:01:24,951 --> 00:01:22,248
[APPLAUSE]

37
00:01:27,086 --> 00:01:25,018
>> FORTY YEARS AGO, THE GREATEST

38
00:01:28,287 --> 00:01:27,153

ADVENTURE IN SPACE EXPLORATION

39

00:01:29,722 --> 00:01:28,354
BEGAN WITH THE LAUNCH OF

40

00:01:31,657 --> 00:01:29,789
THE VOYAGERS.

41

00:01:34,527 --> 00:01:31,724
AND WE'RE HERE TODAY

42

00:01:35,895 --> 00:01:34,594
TO REMEMBER, TO CELEBRATE

43

00:01:37,296 --> 00:01:35,962
AND TO FIND OUT

44

00:01:40,032 --> 00:01:37,363
WHAT THESE MAGNIFICENT

45

00:01:40,766 --> 00:01:40,099
MACHINES ARE STILL DOING.

46

00:01:42,235 --> 00:01:40,833
I WANT TO INTRODUCE

47

00:01:43,236 --> 00:01:42,302
OUR PANELISTS, BUT IF YOU WILL,

48

00:01:44,637 --> 00:01:43,303
PLEASE HOLD YOUR APPLAUSE

49

00:01:46,939 --> 00:01:44,704
'TIL THE END.

50

00:01:48,608 --> 00:01:47,006
FIRST IS SUZY DODD.

51
00:01:51,043 --> 00:01:48,675
SUZY'S FIRST JOB OUT OF COLLEGE

52
00:01:52,378 --> 00:01:51,110
WAS TO WORK ON VOYAGER.

53
00:01:54,180 --> 00:01:52,445
SHE WENT ON TO BECOME

54
00:01:56,115 --> 00:01:54,247
THE PROJECT MANAGER OF VOYAGER

55
00:01:58,618 --> 00:01:56,182
AND HEAD THAT TOP JOB

56
00:02:00,653 --> 00:01:58,685
WHEN VOYAGER 1 BECAME THE FIRST

57
00:02:03,656 --> 00:02:00,720
SPACECRAFT EVER TO REACH

58
00:02:05,858 --> 00:02:03,723
INTERSTELLAR SPACE.

59
00:02:07,093 --> 00:02:05,925
CHRIS JONES IS JPL'S

60
00:02:07,927 --> 00:02:07,160
CHIEF ENGINEER.

61
00:02:09,662 --> 00:02:07,994
HE HELPED TO BRING

62
00:02:11,030 --> 00:02:09,729
THE VOYAGERS INTO BEING,

63
00:02:12,999 --> 00:02:11,097

AND THESE DAYS HE'S STILL

64

00:02:15,301 --> 00:02:13,066

PROVIDING ADVICE AND GUIDANCE

65

00:02:16,135 --> 00:02:15,368

ON HOW TO KEEP THEM WORKING.

66

00:02:17,904 --> 00:02:16,202

CHRIS PLAYED A VERY

67

00:02:19,338 --> 00:02:17,971

IMPORTANT ROLE IN THE SAVING

68

00:02:21,007 --> 00:02:19,405

OF VOYAGER 2, AND WE'LL HEAR

69

00:02:22,275 --> 00:02:21,074

ABOUT THAT IN A MINUTE.

70

00:02:23,176 --> 00:02:22,342

JOHN CASANI.

71

00:02:25,411 --> 00:02:23,243

JOHN IS ONE OF THE GREAT

72

00:02:28,147 --> 00:02:25,478

PIONEERS IN SPACE EXPLORATION.

73

00:02:29,549 --> 00:02:28,214

HE ARRIVED AT JPL IN THE 1950s,

74

00:02:30,850 --> 00:02:29,616

AND IF YOU'RE A FAN OF

75

00:02:32,351 --> 00:02:30,917

THE GOLD RECORD, YOU HAVE

76

00:02:33,886 --> 00:02:32,418

JOHN TO THANK.

77

00:02:34,921 --> 00:02:33,953

AND DR. ED STONE.

78

00:02:36,889 --> 00:02:34,988

PROFESSOR OF PHYSICS

79

00:02:38,157 --> 00:02:36,956

AT CALTECH, HE SERVED AS

80

00:02:41,160 --> 00:02:38,224

DIRECTOR OF JPL

81

00:02:44,630 --> 00:02:41,227

FROM 1991 TO 2001.

82

00:02:46,165 --> 00:02:44,697

AND IN 1972 HE WAS NAMED

83

00:02:47,466 --> 00:02:46,232

THE PROJECT SCIENTIST

84

00:02:48,568 --> 00:02:47,533

FOR VOYAGER.

85

00:02:52,038 --> 00:02:48,635

IT IS A POSITION THAT

86

00:02:53,906 --> 00:02:52,105

HE HAS HELD FOR 45 YEARS.

87

00:02:55,908 --> 00:02:53,973

THE ONE AND THE ONLY PROJECT

88

00:02:57,677 --> 00:02:55,975

SCIENTIST THAT VOYAGER

89

00:02:58,578 --> 00:02:57,744
HAS EVER KNOWN.

90

00:02:59,912 --> 00:02:58,645
WILL YOU PLEASE GIVE

91

00:03:00,980 --> 00:02:59,979
A VERY WARM WELCOME

92

00:03:17,797 --> 00:03:01,047
TO OUR PANELISTS.

93

00:03:20,132 --> 00:03:17,864
[APPLAUSE]

94

00:03:21,767 --> 00:03:20,199
NOW, THERE ARE OTHER MEMBERS

95

00:03:24,370 --> 00:03:21,834
OF THE VOYAGER TEAM WHO ARE

96

00:03:25,438 --> 00:03:24,437
HERE-- SOME THAT ARE STILL

97

00:03:26,806 --> 00:03:25,505
WORKING IN THE LAB, SOME

98

00:03:28,040 --> 00:03:26,873
THAT HAVE MADE SPECIAL EFFORT

99

00:03:29,742 --> 00:03:28,107
TO BE HERE TODAY.

100

00:03:30,810 --> 00:03:29,809
AND WE WOULD BE AMISS

101
00:03:32,478 --> 00:03:30,877
WITHOUT ACKNOWLEDGING

102
00:03:33,746 --> 00:03:32,545
THEIR CONTRIBUTIONS

103
00:03:34,814 --> 00:03:33,813
TO THIS MISSION.

104
00:03:35,881 --> 00:03:34,881
SO WOULD YOU PLEASE,

105
00:03:37,550 --> 00:03:35,948
EVERYONE WHO'S EVER WORKED

106
00:03:38,517 --> 00:03:37,617
ON VOYAGER, WOULD YOU PLEASE

107
00:03:41,087 --> 00:03:38,584
STAND SO WE COULD

108
00:04:01,173 --> 00:03:41,154
RECOGNIZE YOU?

109
00:04:02,341 --> 00:04:01,240
[APPLAUSE]

110
00:04:03,709 --> 00:04:02,408
THERE ARE A LOT OF REASONS WHY

111
00:04:05,478 --> 00:04:03,776
VOYAGER IS SO EXTRAORDINARY

112
00:04:06,846 --> 00:04:05,545
AND SPECIAL, BUT ONE HAS TO DO

113
00:04:08,114 --> 00:04:06,913

WITH THE ALIGNMENT OF

114

00:04:09,081 --> 00:04:08,181

THE PLANETS.

115

00:04:10,049 --> 00:04:09,148

AND I WAS WONDERING, ED,

116

00:04:12,351 --> 00:04:10,116

IF YOU COULD TELL US

117

00:04:13,019 --> 00:04:12,418

WHAT THAT WAS ALL ABOUT.

118

00:04:13,819 --> 00:04:13,086

>> WELL, THERE WAS

119

00:04:16,455 --> 00:04:13,886

A GRADUATE STUDENT FROM

120

00:04:18,357 --> 00:04:16,522

CALTECH WHO WAS-- THE SUMMER

121

00:04:19,425 --> 00:04:18,424

OF 1965, AND HE'D BEEN GIVEN

122

00:04:20,693 --> 00:04:19,492

THE TASK OF LOOKING FOR

123

00:04:22,228 --> 00:04:20,760

OPPORTUNITIES TO FLY BY

124

00:04:23,696 --> 00:04:22,295

JUPITER AS A WAY TO

125

00:04:24,930 --> 00:04:23,763

SPEED THINGS UP IN THE OUTER

126
00:04:26,365 --> 00:04:24,997
SOLAR SYSTEM.

127
00:04:28,601 --> 00:04:26,432
SO THESE ARE GRAVITY ASSIST

128
00:04:29,702 --> 00:04:28,668
FLY-BYS, AND IN THAT PROCESS

129
00:04:31,604 --> 00:04:29,769
HE DISCOVERED THAT

130
00:04:35,908 --> 00:04:31,671
IF YOU LAUNCHED A SPACECRAFT

131
00:04:38,544 --> 00:04:35,975
IN 1977, OR '76, OR '78,

132
00:04:39,779 --> 00:04:38,611
THE PLANETS JUPITER, SATURN,

133
00:04:42,214 --> 00:04:39,846
URANUS, AND NEPTUNE WERE ALL

134
00:04:43,516 --> 00:04:42,281
LINED UP SO THAT WITH ONE

135
00:04:45,384 --> 00:04:43,583
ASSIST AFTER THE OTHER,

136
00:04:46,719 --> 00:04:45,451
ONE COULD SPEED UP THE JOURNEY

137
00:04:48,954 --> 00:04:46,786
OUT TO NEPTUNE, NORMALLY

138
00:04:50,523 --> 00:04:49,021

30 YEARS, DOWN TO 12 YEARS.

139

00:04:53,292 --> 00:04:50,590
AND THIS SOON WAS CALLED

140

00:04:55,294 --> 00:04:53,359
THE GRAND TOUR, AND LED TO

141

00:04:57,430 --> 00:04:55,361
WHAT EVENTUALLY BECAME

142

00:04:58,331 --> 00:04:57,497
VOYAGER 1 AND 2.

143

00:05:00,466 --> 00:04:58,398
>> SO WHEN THIS OPPORTUNITY

144

00:05:01,334 --> 00:05:00,533
WAS THERE, WERE WE READY, JOHN?

145

00:05:02,535 --> 00:05:01,401
WE'D NEVER BEEN TO

146

00:05:03,836 --> 00:05:02,602
THE OUTER PLANETS.

147

00:05:04,937 --> 00:05:03,903
WE HADN'T BEEN ANY FURTHER

148

00:05:05,871 --> 00:05:05,004
THAN MARS, RIGHT?

149

00:05:06,739 --> 00:05:05,938
>> THAT'S RIGHT, WE'D BEEN--

150

00:05:07,840 --> 00:05:06,806
THAT'S FAR-- MARS IS

151
00:05:10,376 --> 00:05:07,907
AS FAR AS WE'D BEEN, SO

152
00:05:12,044 --> 00:05:10,443
IT WAS QUITE A CHALLENGE.

153
00:05:13,512 --> 00:05:12,111
I MEAN, THERE--

154
00:05:15,648 --> 00:05:13,579
NASA HAD FUNDED US

155
00:05:17,116 --> 00:05:15,715
AN ADVANCED TECHNOLOGY

156
00:05:18,284 --> 00:05:17,183
DEVELOPMENT PROGRAM TO EXPLORE

157
00:05:20,486 --> 00:05:18,351
AND DEVELOP SOME OF THE NEW

158
00:05:22,455 --> 00:05:20,553
TECHNOLOGIES THAT WE THOUGHT

159
00:05:23,622 --> 00:05:22,522
WE WERE GOING TO NEED.

160
00:05:25,157 --> 00:05:23,689
THE PROBLEM WAS TIME.

161
00:05:27,326 --> 00:05:25,224
WE HAD NEVER DEVELOPED

162
00:05:29,862 --> 00:05:27,393
ANYTHING RELIABLY THAT WOULD

163
00:05:31,397 --> 00:05:29,929

LAST BEYOND MARS, YOU KNOW,

164

00:05:32,398 --> 00:05:31,464

AND NOBODY HAD REALLY FLOWN

165

00:05:33,699 --> 00:05:32,465

ANYTHING BEYOND MARS

166

00:05:34,533 --> 00:05:33,766

BEFORE THAT.

167

00:05:37,703 --> 00:05:34,600

AND SO I THINK THAT'S

168

00:05:39,071 --> 00:05:37,770

WHAT OCCUPIED OUR CONCERN,

169

00:05:40,039 --> 00:05:39,138

FOR THE MOST PART.

170

00:05:41,173 --> 00:05:40,106

I MEAN, WE'D BUILT A LOT OF

171

00:05:43,109 --> 00:05:41,240

MARINER SPACECRAFT,

172

00:05:45,211 --> 00:05:43,176

AND THE MARINER FAMILY, WE HAD

173

00:05:46,145 --> 00:05:45,278

A LONG SERIES OF SUCCESS.

174

00:05:47,346 --> 00:05:46,212

BUT THOSE WERE-- I MEAN,

175

00:05:48,714 --> 00:05:47,413

IT'S A MARS MISSION.

176
00:05:50,049 --> 00:05:48,781
AND WE WERE GOING TO TAKE ON

177
00:05:51,384 --> 00:05:50,116
SOMETHING THAT WAS NOT GOING TO

178
00:05:52,318 --> 00:05:51,451
TAKE TWO YEARS OR THREE YEARS--

179
00:05:53,786 --> 00:05:52,385
IT WAS GOING TO TAKE

180
00:05:55,621 --> 00:05:53,853
12 OR 30 YEARS, AND--

181
00:05:57,123 --> 00:05:55,688
WE'RE TALKING ABOUT

182
00:05:58,958 --> 00:05:57,190
THE GRAND TOUR, BUT EVEN

183
00:06:00,025 --> 00:05:59,025
WHEN IT WAS CUT BACK TO JUST

184
00:06:01,494 --> 00:06:00,092
JUPITER AND SATURN, IT WAS

185
00:06:03,229 --> 00:06:01,561
STILL 10 OR 12 YEARS.

186
00:06:03,963 --> 00:06:03,296
AND THAT WAS KIND OF SCARY.

187
00:06:06,298 --> 00:06:04,030
>> AND YOU WERE FUNDED

188
00:06:07,733 --> 00:06:06,365

JUST FOR GOING TO THE FIRST TWO

189

00:06:09,702 --> 00:06:07,800

OF THE OUTER PLANETS, AND

190

00:06:12,071 --> 00:06:09,769

YOU SOMEHOW WORKED IT OUT

191

00:06:14,507 --> 00:06:12,138

SO THAT IT WAS A POSSIBILITY

192

00:06:16,342 --> 00:06:14,574

TO GO FURTHER, CORRECT?

193

00:06:17,910 --> 00:06:16,409

>> WELL...

194

00:06:18,978 --> 00:06:17,977

[LAUGHTER]

195

00:06:21,013 --> 00:06:19,045

>> YOU CAN TELL IT NOW, JOHN.

196

00:06:22,214 --> 00:06:21,080

IT'S OKAY.

197

00:06:23,983 --> 00:06:22,281

>> WELL, WE WERE NOT

198

00:06:25,117 --> 00:06:24,050

SUPPOSED TO WORK ON ANYTHING

199

00:06:26,419 --> 00:06:25,184

FURTHER THAN SATURN,

200

00:06:27,853 --> 00:06:26,486

AND THAT WAS A PRETTY STRICT

201
00:06:28,721 --> 00:06:27,920
DIRECTION THAT WE HAD

202
00:06:29,922 --> 00:06:28,788
FROM HEADQUARTERS.

203
00:06:30,756 --> 00:06:29,989
AND I WASN'T THE FIRST

204
00:06:31,624 --> 00:06:30,823
PROJECT MANAGER.

205
00:06:32,892 --> 00:06:31,691
THE FIRST PROJECT MANAGER

206
00:06:33,793 --> 00:06:32,959
WAS BUD SCHURMEIER.

207
00:06:35,861 --> 00:06:33,860
>> OKAY.

208
00:06:37,096 --> 00:06:35,928
>> AND WHEN NASA DECIDED

209
00:06:39,331 --> 00:06:37,163
NOT TO GO FORWARD WITH

210
00:06:40,599 --> 00:06:39,398
THE GRAND TOUR, IT WAS

211
00:06:42,001 --> 00:06:40,666
SCHURMEIER WHO LED THE CHARGE

212
00:06:42,868 --> 00:06:42,068
WITH AN IDEA-- LOOK,

213
00:06:44,270 --> 00:06:42,935

WE DON'T HAVE TO DO

214

00:06:45,104 --> 00:06:44,337

ALL FOUR OF THOSE PLANETS.

215

00:06:47,173 --> 00:06:45,171

LET'S JUST CUT IT BACK

216

00:06:49,642 --> 00:06:47,240

TO TWO, AND IT'LL TAKE

217

00:06:51,343 --> 00:06:49,709

A LESS AGGRESSIVE APPROACH

218

00:06:54,146 --> 00:06:51,410

TO THE TECHNOLOGY, WE WON'T

219

00:06:55,714 --> 00:06:54,213

HAVE TO USE SO MUCH NEW STUFF.

220

00:06:57,349 --> 00:06:55,781

AND WE CAN CAPITALIZE ON

221

00:06:58,284 --> 00:06:57,416

THE MARINER BRAND NAME,

222

00:06:59,452 --> 00:06:58,351

BECAUSE MARINER, WE HAD

223

00:07:01,720 --> 00:06:59,519

A STRING OF 10 OR 11

224

00:07:03,522 --> 00:07:01,787

SUCCESSFUL MARINER MISSIONS.

225

00:07:04,957 --> 00:07:03,589

AND SO THAT SOUNDED LIKE

226

00:07:06,892 --> 00:07:05,024

A GOOD IDEA, AND

227

00:07:08,127 --> 00:07:06,959

HEADQUARTERS WENT FOR IT.

228

00:07:09,628 --> 00:07:08,194

AND WE GOT STARTED,

229

00:07:10,830 --> 00:07:09,695

I GUESS IT WAS '72.

230

00:07:11,964 --> 00:07:10,897

>> YEAH, '72.

231

00:07:13,098 --> 00:07:12,031

>> WAS THE OFFICIAL GO-AHEAD

232

00:07:13,833 --> 00:07:13,165

FOR THAT.

233

00:07:15,334 --> 00:07:13,900

>> YEAH, THAT'S-- I THINK

234

00:07:16,969 --> 00:07:15,401

ONE INTERESTING THING THAT

235

00:07:18,604 --> 00:07:17,036

IS NOT GENERALLY REALIZED

236

00:07:20,339 --> 00:07:18,671

IS WHEN VOYAGER WENT--

237

00:07:21,307 --> 00:07:20,406

MARINER JUPITER SATURN '77

238

00:07:22,208 --> 00:07:21,374

IS WHAT IT WAS CALLED.

239

00:07:24,777 --> 00:07:22,275

IT WAS A FOUR-YEAR MISSION,

240

00:07:26,512 --> 00:07:24,844

AND SUCCESS WAS ONE OF TWO--

241

00:07:27,713 --> 00:07:26,579

AT LEAST ONE-- ACTUALLY

242

00:07:28,881 --> 00:07:27,780

GETTING ALL THE WAY OUT

243

00:07:30,549 --> 00:07:28,948

TO SATURN.

244

00:07:31,984 --> 00:07:30,616

AND IT TURNED OUT THAT

245

00:07:33,486 --> 00:07:32,051

IN THOSE DAYS, A FISCAL YEAR

246

00:07:35,221 --> 00:07:33,553

ENDED IN JUNE.

247

00:07:37,490 --> 00:07:35,288

AND SO THE MISSION HAD TO END

248

00:07:38,757 --> 00:07:37,557

IN JUNE OF '81, AND THAT MEANT

249

00:07:40,192 --> 00:07:38,824

THAT THE AIM POINT TO GO

250

00:07:41,494 --> 00:07:40,259

INTO URANUS WAS INSIDE

251

00:07:45,030 --> 00:07:41,561

THE RINGS.

252

00:07:47,700 --> 00:07:45,097

SO IN FACT, UNTIL 19--

253

00:07:50,569 --> 00:07:47,767

ABOUT '75 OR '76 WHEN VOYAGER

254

00:07:52,238 --> 00:07:50,636

WAS THEN APPROVED TO MOVE

255

00:07:52,872 --> 00:07:52,305

THE AIM POINT FURTHER AWAY,

256

00:07:54,773 --> 00:07:52,939

AND THAT'S THE REASON

257

00:07:55,641 --> 00:07:54,840

WE ARRIVED LATER THAN JUNE.

258

00:07:56,675 --> 00:07:55,708

WE ARRIVED IN AUGUST--

259

00:07:57,676 --> 00:07:56,742

THAT WAS OUTSIDE THE RINGS,

260

00:07:59,144 --> 00:07:57,743

AND IN FACT, TO GO ON

261

00:07:59,912 --> 00:07:59,211

TO URANUS AND NEPTUNE.

262

00:08:01,213 --> 00:07:59,979

>> SO THAT WAS COMPLETELY

263

00:08:02,214 --> 00:08:01,280

FINANCIALLY DRIVEN?

264

00:08:03,182 --> 00:08:02,281

>> IT WAS DRIVEN BY THE FACT

265

00:08:04,617 --> 00:08:03,249

THAT THE FISCAL YEAR ENDED

266

00:08:06,151 --> 00:08:04,684

ON JUNE 30, AND THEY WANTED

267

00:08:08,420 --> 00:08:06,218

THE MISSION OVER BY JUNE 30.

268

00:08:08,921 --> 00:08:08,487

[LAUGHTER]

269

00:08:09,822 --> 00:08:08,988

>> WHO KNEW?

270

00:08:11,357 --> 00:08:09,889

I DIDN'T KNOW THAT.

271

00:08:11,991 --> 00:08:11,424

>> OKAY, ALL RIGHT.

272

00:08:13,626 --> 00:08:12,058

>> THEY WERE AFRAID

273

00:08:14,760 --> 00:08:13,693

SOME PROJECT SCIENTIST WOULD

274

00:08:17,863 --> 00:08:14,827

MAKE A CAREER OUT OF IT.

275

00:08:23,836 --> 00:08:17,930

[LAUGHTER]

276

00:08:25,237 --> 00:08:23,903

[APPLAUSE]

277

00:08:27,373 --> 00:08:25,304

>> ALL RIGHT, WELL, LET'S MOVE

278

00:08:28,440 --> 00:08:27,440

AHEAD TO THE LAUNCH PERIOD.

279

00:08:29,808 --> 00:08:28,507

JOHN, I UNDERSTAND YOU MADE

280

00:08:31,377 --> 00:08:29,875

THE DECISION TO LAUNCH

281

00:08:33,112 --> 00:08:31,444

THE FIRST ONE AND CALL IT

282

00:08:35,814 --> 00:08:33,179

VOYAGER 2, WHICH CONFUSED

283

00:08:36,916 --> 00:08:35,881

ALL OF MY BRETHREN IN THE PRESS

284

00:08:38,350 --> 00:08:36,983

AS TO WHY YOU WOULD

285

00:08:40,452 --> 00:08:38,417

LAUNCH VOYAGER 2-- BUT

286

00:08:42,187 --> 00:08:40,519

IT GOT EVEN MORE COMPLICATED

287

00:08:44,189 --> 00:08:42,254

DURING THE ACTUAL LAUNCH.

288

00:08:48,093 --> 00:08:44,256

SO LET'S SEE WHAT HAPPENED

289

00:08:49,828 --> 00:08:48,160
DURING THESE LAUNCHES.

290

00:08:53,799 --> 00:08:49,895
>> FIVE, FOUR,

291

00:08:55,568 --> 00:08:53,866
THREE, TWO, ONE.

292

00:08:58,571 --> 00:08:55,635
WE HAVE IGNITION,

293

00:08:59,605 --> 00:08:58,638
AND WE HAVE LIFT-OFF!

294

00:09:00,806 --> 00:08:59,672
WE HAVE LIFT-OFF

295

00:09:02,107 --> 00:09:00,873
OF THE TITAN-CENTAUR

296

00:09:03,943 --> 00:09:02,174
CARRYING THE FIRST OF TWO

297

00:09:05,377 --> 00:09:04,010
VOYAGER SPACECRAFT TO EXTEND

298

00:09:06,345 --> 00:09:05,444
MAN'S SENSES FARTHER INTO

299

00:09:08,147 --> 00:09:06,412
THE SOLAR SYSTEM

300

00:09:13,886 --> 00:09:08,214
THAN EVER BEFORE.

301

00:09:14,954 --> 00:09:13,953

[MUSIC]

302

00:09:16,722 --> 00:09:15,021

>> VOYAGER'S PROGRAMMERS

303

00:09:18,791 --> 00:09:16,789

HAD TAUGHT THE SPACECRAFT THAT

304

00:09:20,859 --> 00:09:18,858

IF IT SENSED ANYTHING UNUSUAL,

305

00:09:22,194 --> 00:09:20,926

TO SWITCH TO BACKUP SYSTEMS.

306

00:09:24,630 --> 00:09:22,261

AND THAT'S EXACTLY

307

00:09:25,965 --> 00:09:24,697

WHAT HAD ALREADY OCCURRED.

308

00:09:28,968 --> 00:09:26,032

ENGINEERS CALL THIS

309

00:09:30,569 --> 00:09:29,035

FAULT PROTECTION.

310

00:09:32,738 --> 00:09:30,636

>> THE FAULT PROTECTION

311

00:09:34,239 --> 00:09:32,805

STARTED DOING ITS THING,

312

00:09:34,940 --> 00:09:34,306

RECONFIGURING THE SYSTEM.

313

00:09:36,208 --> 00:09:35,007

WE'RE STILL ATTACHED TO

314

00:09:37,543 --> 00:09:36,275
THE LAUNCH VEHICLE.

315

00:09:40,212 --> 00:09:37,610
IT'S IN THE EARLY STAGES

316

00:09:41,146 --> 00:09:40,279
OF ITS FLIGHT, AND THE FIRST

317

00:09:44,149 --> 00:09:41,213
THING WE SEE ARE

318

00:09:45,184 --> 00:09:44,216
THE GYROS BEING SWAPPED.

319

00:09:46,885 --> 00:09:45,251
>> THE LAUNCH VEHICLE,

320

00:09:49,555 --> 00:09:46,952
AS PART OF ITS POWERED FLIGHT,

321

00:09:50,656 --> 00:09:49,622
WENT THROUGH A ROLL.

322

00:09:51,924 --> 00:09:50,723
AND THE SPACECRAFT WOULD'VE

323

00:09:53,525 --> 00:09:51,991
NEVER DONE THAT ON ITS OWN,

324

00:09:56,929 --> 00:09:53,592
SO THE SPACECRAFT THOUGHT

325

00:09:57,630 --> 00:09:56,996
THAT WAS A FAULT.

326

00:09:58,964 --> 00:09:57,697

>> I THINK THERE WERE

327

00:10:00,032 --> 00:09:59,031

SIX OR SEVEN DIFFERENT STATES

328

00:10:01,767 --> 00:10:00,099

THAT IT WENT THROUGH

329

00:10:02,701 --> 00:10:01,834

TRYING TO CORRECT THE FAULT.

330

00:10:04,403 --> 00:10:02,768

YOU KNOW, WELL, ASSUME

331

00:10:05,237 --> 00:10:04,470

I CAN'T HAVE TWO GYROS FAULT.

332

00:10:06,305 --> 00:10:05,304

MUST BE A COMPUTER

333

00:10:07,239 --> 00:10:06,372

THAT'S FAILED.

334

00:10:08,107 --> 00:10:07,306

IT SWITCHED OUT-- WE HAVEN'T

335

00:10:09,742 --> 00:10:08,174

DONE THE COMPUTER,

336

00:10:10,476 --> 00:10:09,809

SO IT SWITCHED OUT COMPUTERS.

337

00:10:11,443 --> 00:10:10,543

OH, IT CAN'T HAVE BEEN THAT,

338

00:10:12,144 --> 00:10:11,510

SO IT MUST BE SOMETHING ELSE.

339

00:10:13,779 --> 00:10:12,211

SO IT WENT THROUGH

340

00:10:14,446 --> 00:10:13,846

THIS WHOLE SEQUENCE OF

341

00:10:15,347 --> 00:10:14,513

TRYING THINGS.

342

00:10:16,882 --> 00:10:15,414

I MEAN, HOLY MACKEREL.

343

00:10:19,785 --> 00:10:16,949

THIS SPACECRAFT LOOKS LIKE

344

00:10:21,387 --> 00:10:19,852

IT'S GOING BONKERS.

345

00:10:25,424 --> 00:10:21,454

AND WE THOUGHT THAT

346

00:10:26,759 --> 00:10:25,491

WE'D LOST THE SPACECRAFT.

347

00:10:28,060 --> 00:10:26,826

>> FINALLY WE GOT TO SEPARATE

348

00:10:30,129 --> 00:10:28,127

FROM THE LAUNCH VEHICLE

349

00:10:33,866 --> 00:10:30,196

AND WE WERE ON OUR OWN.

350

00:10:35,034 --> 00:10:33,933

BUT THE PROBLEMS WEREN'T OVER.

351
00:10:50,449 --> 00:10:35,101
>> THE SPACECRAFT WAS NOW

352
00:10:52,017 --> 00:10:50,516
SLOWLY TUMBLING.

353
00:10:54,753 --> 00:10:52,084
>> CHRIS, HELP.

354
00:10:55,554 --> 00:10:54,820
[LAUGHTER]

355
00:10:56,422 --> 00:10:55,621
>> DO YOU REALIZE

356
00:10:58,223 --> 00:10:56,489
HOW TIRED I AM

357
00:10:59,591 --> 00:10:58,290
OF GIVING THIS TALK?

358
00:11:01,593 --> 00:10:59,658
[LAUGHTER]

359
00:11:03,128 --> 00:11:01,660
>> I DON'T CARE.

360
00:11:04,363 --> 00:11:03,195
>> OKAY, SO THERE'S A LONG

361
00:11:05,831 --> 00:11:04,430
VERSION AND A SHORT VERSION.

362
00:11:08,100 --> 00:11:05,898
I KIND OF LIKE THE WAY

363
00:11:08,934 --> 00:11:08,167

CASANI SET UP THE PACE OF THIS.

364

00:11:10,669 --> 00:11:09,001
THERE WERE A COUPLE OF

365

00:11:11,770 --> 00:11:10,736
GYRO SWAPS WHILE WE WERE STILL

366

00:11:12,805 --> 00:11:11,837
ON THE LAUNCH VEHICLE.

367

00:11:13,572 --> 00:11:12,872
OH, YEAH, THERE IT IS--

368

00:11:14,206 --> 00:11:13,639
THAT PICTURE.

369

00:11:15,040 --> 00:11:14,273
>> THERE YOU ARE,

370

00:11:17,009 --> 00:11:15,107
RIGHT IN THE MIDDLE.

371

00:11:17,843 --> 00:11:17,076
>> AND FAULT PROTECTION

372

00:11:20,145 --> 00:11:17,910
WAS FAIRLY QUIET

373

00:11:22,514 --> 00:11:20,212
UP 'TIL THAT POINT.

374

00:11:24,249 --> 00:11:22,581
WE DID THE INJECTION BURN

375

00:11:26,952 --> 00:11:24,316
WITH THE PROPULSION MODULE.

376

00:11:30,389 --> 00:11:27,019

THAT WAS JUST RIGHT ON.

377

00:11:32,858 --> 00:11:30,456

SEPARATED FROM THE PROPULSION

378

00:11:35,494 --> 00:11:32,925

MODULE, AND WE EXPERIENCED

379

00:11:36,995 --> 00:11:35,561

HIGH RATES, HIGH TIP-OFF RATES.

380

00:11:38,564 --> 00:11:37,062

AND SO WE ENDED UP

381

00:11:42,901 --> 00:11:38,631

SWITCHING THRUSTERS.

382

00:11:44,903 --> 00:11:42,968

AND SO FOUR THRUSTER SWAPS,

383

00:11:47,406 --> 00:11:44,970

TWO HIBIC SWAPS,

384

00:11:50,876 --> 00:11:47,473

AND A PROCESSOR SWAP LATER,

385

00:11:52,611 --> 00:11:50,943

ALL WITHIN 14 SECONDS,

386

00:11:55,647 --> 00:11:52,678

SOMETHING LIKE THAT--

387

00:11:56,582 --> 00:11:55,714

WAS A VERY ACTIVE TIME

388

00:11:57,249 --> 00:11:56,649

FOR THE FAULT PROTECTION.

389

00:11:58,584 --> 00:11:57,316

WE'D NEVER DONE

390

00:11:59,284 --> 00:11:58,651

ANYTHING LIKE THAT IN TEST.

391

00:12:00,552 --> 00:11:59,351

IT WAS A VERY GOOD

392

00:12:01,720 --> 00:12:00,619

STRESS TEST.

393

00:12:05,257 --> 00:12:01,787

[LAUGHTER]

394

00:12:06,625 --> 00:12:05,324

FOR THE VEHICLE, BUT IT WASN'T

395

00:12:09,728 --> 00:12:06,692

WHAT WE WERE LOOKING FOR.

396

00:12:11,930 --> 00:12:09,795

AND SO FINALLY, THE THING

397

00:12:14,600 --> 00:12:11,997

THAT SAVED THE DAY WAS

398

00:12:17,202 --> 00:12:14,667

THAT PROCESSOR SWAP, BECAUSE

399

00:12:19,538 --> 00:12:17,269

THAT BROUGHT ONLINE A FRESH

400

00:12:21,406 --> 00:12:19,605

SOFTWARE LOAD SET AS THOUGH

401
00:12:23,008 --> 00:12:21,473
IT WERE FOR LAUNCH.

402
00:12:26,445 --> 00:12:23,075
ALL THE ERRORS,

403
00:12:28,213 --> 00:12:26,512
ACCRUED ERRORS ARE ZERO,

404
00:12:31,850 --> 00:12:28,280
AND SO IT WAS LIKE GIVING

405
00:12:34,052 --> 00:12:31,917
THE SPACECRAFT A SECOND CHANCE.

406
00:12:36,155 --> 00:12:34,119
AND THEN JUST WAIT FOR

407
00:12:38,056 --> 00:12:36,222
THE CRAFT TO RECOVER,

408
00:12:40,058 --> 00:12:38,123
AND RECOVER IT DID.

409
00:12:42,227 --> 00:12:40,125
WE GOT TO A POINT WHERE

410
00:12:43,962 --> 00:12:42,294
ALL THE COMMANDS, ALL THE CODED

411
00:12:48,033 --> 00:12:44,029
COMMANDS IN THE SEQUENCE

412
00:12:50,035 --> 00:12:48,100
HAD EXECUTED, BUT WE WERE NOT

413
00:12:53,305 --> 00:12:50,102

POINTED AT THE SUN.

414

00:12:54,540 --> 00:12:53,372

AND SO WE-- THE SPACECRAFT

415

00:12:56,441 --> 00:12:54,607

AUTOMATICALLY INITIATED

416

00:12:58,677 --> 00:12:56,508

A SUN SEARCH COMMAND,

417

00:13:01,647 --> 00:12:58,744

AND WE BEGAN TURNING

418

00:13:02,881 --> 00:13:01,714

IN AN EFFORT TO CATCH THE SUN.

419

00:13:04,016 --> 00:13:02,948

A THERMAL GUY ONCE TOLD ME,

420

00:13:05,450 --> 00:13:04,083

HE SAID, "WHEN IN DOUBT,

421

00:13:06,919 --> 00:13:05,517

"KEEP MOVING."

422

00:13:08,654 --> 00:13:06,986

AND THAT'S REALLY WHAT

423

00:13:11,557 --> 00:13:08,721

YOU NEED TO DO NEAR EARTH.

424

00:13:13,158 --> 00:13:11,624

AND SO WE GOT THROUGH

425

00:13:14,259 --> 00:13:13,225

THE FIRST TURN-- NO SUN.

426
00:13:15,861 --> 00:13:14,326
WE GOT THROUGH THE SECOND

427
00:13:17,462 --> 00:13:15,928
TURN-- NO SUN.

428
00:13:20,465 --> 00:13:17,529
AND THEN PARTWAY THROUGH

429
00:13:21,567 --> 00:13:20,532
THE THIRD TURN, WE SAW THE SUN

430
00:13:23,101 --> 00:13:21,634
IN THE SUN SENSITIVE

431
00:13:25,003 --> 00:13:23,168
FIELD OF VIEW,

432
00:13:25,671 --> 00:13:25,070
AND THE REST WAS EASY.

433
00:13:26,638 --> 00:13:25,738
>> AND ONE OF THE HARD

434
00:13:27,706 --> 00:13:26,705
PARTS OF THIS, THOUGH, WAS

435
00:13:30,375 --> 00:13:27,773
THE FACT THAT THERE WAS

436
00:13:32,711 --> 00:13:30,442
A QUESTION OF WHETHER TO RESET

437
00:13:34,580 --> 00:13:32,778
AND-- AND THE COOL GUY

438
00:13:36,582 --> 00:13:34,647

WHO SAID, "JUST LET IT GO,"

439

00:13:37,683 --> 00:13:36,649

WAS THIS MAN HERE, WHO SAID--

440

00:13:39,184 --> 00:13:37,750

>> TOO MODEST.

441

00:13:40,219 --> 00:13:39,251

>> YEAH.

442

00:13:41,553 --> 00:13:40,286

SAVED THE MISSION.

443

00:13:42,221 --> 00:13:41,620

>> HE DID.

444

00:13:44,089 --> 00:13:42,288

>> AND JUST IMAGINE HOW

445

00:13:50,429 --> 00:13:44,156

IT WOULD'VE BEEN DIFFERENTLY.

446

00:13:51,263 --> 00:13:50,496

[APPLAUSE]

447

00:13:52,431 --> 00:13:51,330

ALL RIGHT, WELL, WE HAVE TO

448

00:13:53,131 --> 00:13:52,498

GET ON, BECAUSE WE HAVEN'T

449

00:13:54,333 --> 00:13:53,198

EVEN GOTTEN OUT OF

450

00:13:55,267 --> 00:13:54,400

EARTH ORBIT YET.

451
00:13:56,201 --> 00:13:55,334
>> YEAH, THAT WAS JUST

452
00:13:57,769 --> 00:13:56,268
THE SHORT VERSION.

453
00:13:59,705 --> 00:13:57,836
[LAUGHTER]

454
00:14:00,873 --> 00:13:59,772
>> AND JUST TO SAY THAT

455
00:14:02,474 --> 00:14:00,940
THE SECOND LAUNCH

456
00:14:04,343 --> 00:14:02,541
HAD ITS PROBLEMS, ALSO.

457
00:14:06,044 --> 00:14:04,410
AND FORTUNATELY, THE COMPUTER

458
00:14:07,246 --> 00:14:06,111
WAS ABLE TO RECALCULATE,

459
00:14:08,714 --> 00:14:07,313
AND JUST A FEW SECONDS

460
00:14:10,215 --> 00:14:08,781
OF FUEL LEFT, I THINK.

461
00:14:11,617 --> 00:14:10,282
>> THE CENTAUR GUIDANCE--

462
00:14:12,551 --> 00:14:11,684
>> YES, I KNOW-- NO PROBLEM

463
00:14:13,752 --> 00:14:12,618

WITH JPL ENGINEERING

464

00:14:14,820 --> 00:14:13,819
ON THAT ONE, NO.

465

00:14:16,321 --> 00:14:14,887
[LAUGHTER]

466

00:14:17,589 --> 00:14:16,388
SO THAT WAS GOOD.

467

00:14:18,457 --> 00:14:17,656
>> BY THE WAY, THERE WAS

468

00:14:19,424 --> 00:14:18,524
NO PROBLEM WITH JPL

469

00:14:20,659 --> 00:14:19,491
ENGINEERING ON THE FAULT

470

00:14:23,195 --> 00:14:20,726
PROTECTION, EITHER.

471

00:14:26,098 --> 00:14:23,262
[LAUGHTER]

472

00:14:26,932 --> 00:14:26,165
>> WELL NOTED, JUST WELL NOTED.

473

00:14:27,633 --> 00:14:26,999
>> FOR THOSE PEOPLE

474

00:14:29,167 --> 00:14:27,700
WHO MAY HAVE SEEN

475

00:14:29,968 --> 00:14:29,234
"THE FARTHEST" FILM,

476

00:14:30,903 --> 00:14:30,035

THERE'S A LITTLE BIT WITH

477

00:14:31,870 --> 00:14:30,970

CHARLEY AND ME IN IT

478

00:14:33,405 --> 00:14:31,937

IN THE BLACK HOUSE

479

00:14:34,406 --> 00:14:33,472

ON THE SECOND LAUNCH WHEN--

480

00:14:35,140 --> 00:14:34,473

BUT THEY ALL DEPEND--

481

00:14:36,408 --> 00:14:35,207

>> THIS IS CHARLEY KOHLHASE,

482

00:14:37,843 --> 00:14:36,475

WHO WAS VERY MUCH INVOLVED--

483

00:14:38,844 --> 00:14:37,910

A GENIUS OF NAVIGATION

484

00:14:40,145 --> 00:14:38,911

ON VOYAGER THROUGHOUT

485

00:14:41,113 --> 00:14:40,212

ITS MISSION.

486

00:14:47,786 --> 00:14:41,180

GREAT JOB.

487

00:14:50,656 --> 00:14:47,853

[APPLAUSE]

488

00:14:51,590 --> 00:14:50,723

>> THE-- CHARLEY'S SITTING

489

00:14:52,457 --> 00:14:51,657
IN FRONT OF A CONSOLE,

490

00:14:53,158 --> 00:14:52,524
AND I'M SITTING NEXT TO HIM.

491

00:14:54,426 --> 00:14:53,225
AND HE LEANS OVER TO ME

492

00:14:55,427 --> 00:14:54,493
AND SAYS, "JOHN,

493

00:14:56,395 --> 00:14:55,494
"THIS DOESN'T LOOK GOOD."

494

00:14:57,396 --> 00:14:56,462
I SAID, "WHAT'S THE PROBLEM?"

495

00:14:58,063 --> 00:14:57,463
HE SAYS, "I DON'T THINK

496

00:15:00,198 --> 00:14:58,130
"WE'RE GOING TO ACHIEVE

497

00:15:01,433 --> 00:15:00,265
"THE VELOCITY THAT'S REQUIRED."

498

00:15:02,668 --> 00:15:01,500
AND WE SAID-- WE DIDN'T KNOW

499

00:15:04,369 --> 00:15:02,735
WHY OR ANYTHING, BUT IT WAS

500

00:15:06,305 --> 00:15:04,436
PRETTY CLEAR AT THE END OF

501
00:15:08,106 --> 00:15:06,372
THE SECOND STAGE BURN

502
00:15:09,374 --> 00:15:08,173
THAT WE HADN'T MADE IT.

503
00:15:10,609 --> 00:15:09,441
BUT THE SYSTEM WAS BEING

504
00:15:11,443 --> 00:15:10,676
GUIDED BY THE CENTAUR

505
00:15:12,277 --> 00:15:11,510
GUIDANCE SYSTEM,

506
00:15:13,345 --> 00:15:12,344
AND THE CENTAUR GUIDANCE

507
00:15:15,380 --> 00:15:13,412
SYSTEM KNEW THAT THERE HAD BEEN

508
00:15:16,782 --> 00:15:15,447
A DEFICIT OF VELOCITY,

509
00:15:17,816 --> 00:15:16,849
AND IT JUST KEPT THE CENTAUR

510
00:15:20,852 --> 00:15:17,883
ENGINES BURNING A LITTLE

511
00:15:23,188 --> 00:15:20,919
LONGER, AND WE MADE UP FOR IT.

512
00:15:24,122 --> 00:15:23,255
BUT THAT WAS AMAZING.

513
00:15:25,857 --> 00:15:24,189

AND WHAT HAPPENED-- THERE WAS

514

00:15:27,192 --> 00:15:25,924

A LEAK IN THE PROPELLANT LINE,

515

00:15:28,894 --> 00:15:27,259

AND PROPELLANT WAS BEING

516

00:15:31,330 --> 00:15:28,961

SPEWED OVERBOARD.

517

00:15:32,264 --> 00:15:31,397

DIDN'T CAUSE A FIRE ANYWHERE

518

00:15:34,099 --> 00:15:32,331

IT WASN'T SUPPOSED TO,

519

00:15:36,535 --> 00:15:34,166

BUT THAT'S ANOTHER STORY.

520

00:15:37,469 --> 00:15:36,602

>> SO AS VOYAGER 1

521

00:15:38,770 --> 00:15:37,536

WAS LEAVING, IT TOOK

522

00:15:40,572 --> 00:15:38,837

THIS AMAZING PICTURE

523

00:15:41,840 --> 00:15:40,639

I WANT TO SHOW YOU.

524

00:15:44,076 --> 00:15:41,907

VERY HISTORIC-- THE FIRST

525

00:15:48,613 --> 00:15:44,143

TIME WE SAW THE EARTH

526
00:15:49,548 --> 00:15:48,680
AND THE MOON TOGETHER.

527
00:15:51,817 --> 00:15:49,615
BUT LET'S GET ON TO

528
00:15:52,584 --> 00:15:51,884
OUR FIRST PLANET ENCOUNTER.

529
00:15:53,452 --> 00:15:52,651
SO IF WE COULD

530
00:15:56,421 --> 00:15:53,519
ROLL THAT VIDEO,

531
00:16:08,333 --> 00:15:56,488
LET'S GO TO JUPITER.

532
00:16:09,134 --> 00:16:08,400
[MUSIC]

533
00:16:10,402 --> 00:16:09,201
>> FOR SEVEN YEARS

534
00:16:12,104 --> 00:16:10,469
WE'D BEEN PREPARING,

535
00:16:13,572 --> 00:16:12,171
AND SUDDENLY FOR A PERIOD

536
00:16:15,307 --> 00:16:13,639
OF SEVERAL MONTHS, WE WERE

537
00:16:16,908 --> 00:16:15,374
OVERWHELMED WITH A FLOOD

538
00:16:21,580 --> 00:16:16,975

OF DISCOVERIES, ONE AFTER

539

00:16:22,247 --> 00:16:21,647

THE OTHER-- MANY EVERY DAY.

540

00:16:22,914 --> 00:16:22,314

ONE OF THE CHALLENGES

541

00:16:23,548 --> 00:16:22,981

WE HAD IN PLANNING,

542

00:16:24,282 --> 00:16:23,615

BECAUSE ALL OF THIS

543

00:16:25,217 --> 00:16:24,349

HAS TO BE PRE-PLANNED--

544

00:16:26,284 --> 00:16:25,284

IT ALL HAS TO BE LOADED ONTO

545

00:16:28,520 --> 00:16:26,351

THE SPACECRAFT AND THEN

546

00:16:30,255 --> 00:16:28,587

EXECUTED AUTOMATICALLY--

547

00:16:31,056 --> 00:16:30,322

WHAT DO WE LOOK AT WHEN?

548

00:16:34,860 --> 00:16:31,123

WHAT DO WE OBSERVE

549

00:16:36,461 --> 00:16:34,927

AT WHAT TIME?

550

00:16:37,996 --> 00:16:36,528

>> STONE KNEW THAT

551
00:16:39,831 --> 00:16:38,063
TAKING THE POSITION WOULD MEAN

552
00:16:41,033 --> 00:16:39,898
COPING WITH SIZABLE SQUABBLES

553
00:16:43,535 --> 00:16:41,100
AMONG A SCIENCE TEAM

554
00:16:44,603 --> 00:16:43,602
NUMBERING OVER 200.

555
00:16:45,604 --> 00:16:44,670
>> I THINK THE POINT IS THAT

556
00:16:46,338 --> 00:16:45,671
WE DON'T WANT TO WORK

557
00:16:47,139 --> 00:16:46,405
THE PROBLEM HERE IF THERE ARE

558
00:16:50,609 --> 00:16:47,206
SOME PROBLEMS THAT THERE'S

559
00:16:51,810 --> 00:16:50,676
AN OUTSIDE FORUM TO DO IT.

560
00:16:52,878 --> 00:16:51,877
>> SURE.

561
00:16:53,779 --> 00:16:52,945
>> IT WAS A GREAT TRAINING

562
00:16:55,514 --> 00:16:53,846
GROUND FOR LEARNING

563
00:16:57,416 --> 00:16:55,581

HOW TO HANDLE CONFLICTING

564

00:16:58,083 --> 00:16:57,483

SCIENCE REQUIREMENTS.

565

00:16:59,951 --> 00:16:58,150

THERE'S A PHRASE THAT

566

00:17:02,320 --> 00:17:00,018

SHOWS UP IN DISCUSSING SCIENCE

567

00:17:04,056 --> 00:17:02,387

CONFLICTS-- "MY SCIENCE IS

568

00:17:05,924 --> 00:17:04,123

"BETTER THAN YOUR SCIENCE."

569

00:17:07,025 --> 00:17:05,991

AND IF THAT'S

570

00:17:08,026 --> 00:17:07,092

YOUR ONLY ARGUMENT,

571

00:17:08,693 --> 00:17:08,093

YOU'RE NOT GOING TO WIN.

572

00:17:10,495 --> 00:17:08,760

YOU'VE GOT TO CONVINCING

573

00:17:12,130 --> 00:17:10,562

THE OTHER GUYS THAT YOU'VE GOT

574

00:17:13,465 --> 00:17:12,197

A POINT THAT YOUR SCIENCE IS

575

00:17:17,235 --> 00:17:13,532

WORTH DOING, AND IT'S WORTH

576
00:17:19,104 --> 00:17:17,302
TRYING TO ACCOMMODATE IT.

577
00:17:20,605 --> 00:17:19,171
>> I REMEMBER BEING IN THE OPS

578
00:17:22,507 --> 00:17:20,672
CENTER AT THE FIRST JUPITER

579
00:17:24,509 --> 00:17:22,574
ENCOUNTER AND SEEING

580
00:17:27,012 --> 00:17:24,576
THESE PICTURES RETURN

581
00:17:28,847 --> 00:17:27,079
IN REAL TIME-- AN IMAGE

582
00:17:30,549 --> 00:17:28,914
EVERY 42 SECONDS, DOWNLINKED

583
00:17:33,418 --> 00:17:30,616
FROM THE SPACECRAFT--

584
00:17:35,253 --> 00:17:33,485
AT THESE ODD-LOOKING WORLDS.

585
00:17:36,388 --> 00:17:35,320
JUST BLEW US AWAY.

586
00:17:45,097 --> 00:17:36,455
AND I REALLY EXPERIENCED

587
00:17:46,398 --> 00:17:45,164
THE SENSE OF DISCOVERY.

588
00:17:48,033 --> 00:17:46,465

>> AS WE APPROACHED IO,

589

00:17:49,935 --> 00:17:48,100
WE SAW AN OBJECT THAT

590

00:17:51,169 --> 00:17:50,002
LOOKED UNLIKE ANYTHING THAT

591

00:17:51,937 --> 00:17:51,236
WE'D EVER SEEN BEFORE.

592

00:17:57,742 --> 00:17:52,004
IN FACT, WE HAVE NOT SEEN

593

00:17:59,411 --> 00:17:57,809
ANYTHING LIKE IT SINCE.

594

00:18:00,679 --> 00:17:59,478
WE DID NOT UNDERSTAND

595

00:18:01,813 --> 00:18:00,746
WHAT WE WERE LOOKING AT AT ALL.

596

00:18:05,684 --> 00:18:01,880
IT WAS SO DIFFERENT THAN

597

00:18:06,918 --> 00:18:05,751
ANYTHING WE HAD IMAGINED.

598

00:18:09,121 --> 00:18:06,985
AND IT WAS ONLY AS WE WERE

599

00:18:10,188 --> 00:18:09,188
FLYING BY IO THAT A NAVIGATION

600

00:18:11,123 --> 00:18:10,255
IMAGE WAS TAKEN-- THAT IS,

601
00:18:12,424 --> 00:18:11,190
AN IMAGE TAKEN WITH

602
00:18:14,092 --> 00:18:12,491
A DEEP EXPOSURE TO FIND

603
00:18:15,360 --> 00:18:14,159
THE STARS IN THE BACKGROUND--

604
00:18:17,596 --> 00:18:15,427
THAT NAVIGATION ENGINEER

605
00:18:19,297 --> 00:18:17,663
LINDA MORABITO NOTICED THAT

606
00:18:20,999 --> 00:18:19,364
THERE WAS THIS LARGE PLUME

607
00:18:25,203 --> 00:18:21,066
OFF THE LIMB OF THIS LITTLE

608
00:18:26,538 --> 00:18:25,270
MOON OF JUPITER.

609
00:18:28,940 --> 00:18:26,605
>> THE PHANTOM MOON TURNED OUT

610
00:18:31,143 --> 00:18:29,007
TO BE A GIGANTIC PLUME OF GAS

611
00:18:33,645 --> 00:18:31,210
AND DUST SHOOTING SKYWARD

612
00:18:34,880 --> 00:18:33,712
FROM A VOLCANO.

613
00:18:36,615 --> 00:18:34,947

>> AND THAT WAS THE FIRST

614

00:18:38,250 --> 00:18:36,682

INDICATION THAT THIS IS

615

00:18:39,951 --> 00:18:38,317

THE MOST VOLCANICALLY ACTIVE

616

00:18:41,553 --> 00:18:40,018

BODY IN THE SOLAR SYSTEM--

617

00:18:44,256 --> 00:18:41,620

100 TIMES MORE VOLCANIC

618

00:18:44,856 --> 00:18:44,323

ACTIVITY THAN EARTH.

619

00:18:46,491 --> 00:18:44,923

AND YET, IT'S JUST

620

00:18:49,594 --> 00:18:46,558

A SMALL MOON ORBITING

621

00:18:50,495 --> 00:18:49,661

THIS GIANT PLANET.

622

00:18:51,630 --> 00:18:50,562

>> ALL TOLD, THE TWO

623

00:18:54,132 --> 00:18:51,697

VOYAGERS TOOK MORE THAN

624

00:18:58,069 --> 00:18:54,199

33,000 IMAGES OF JUPITER

625

00:18:59,171 --> 00:18:58,136

AND ITS MAJOR MOONS.

626

00:19:00,438 --> 00:18:59,238

WHAT THESE IMAGES AND

627

00:19:02,240 --> 00:19:00,505

THE OTHER SCIENCE RESULTS

628

00:19:03,475 --> 00:19:02,307

REVEALED WAS AN EXOTIC

629

00:19:06,611 --> 00:19:03,542

SYSTEM THAT WAS NOT ONLY

630

00:19:12,884 --> 00:19:06,678

VAST, BUT BEAUTIFUL, AND

631

00:19:15,287 --> 00:19:12,951

ALMOST BEYOND IMAGINING.

632

00:19:15,954 --> 00:19:15,354

[APPLAUSE]

633

00:19:18,957 --> 00:19:16,021

>> IT STILL TAKES YOUR BREATH

634

00:19:20,225 --> 00:19:19,024

AWAY, DOESN'T IT?

635

00:19:21,826 --> 00:19:20,292

SO ED, TWO QUESTIONS FOR YOU

636

00:19:24,162 --> 00:19:21,893

ABOUT THIS ENCOUNTER.

637

00:19:25,230 --> 00:19:24,229

ONE IS NOTHING LIKE THIS

638

00:19:26,565 --> 00:19:25,297

HAD REALLY HAPPENED WITH

639

00:19:27,699 --> 00:19:26,632

SCIENTISTS BEFORE, WHERE

640

00:19:29,267 --> 00:19:27,766

IT'S COMING DOWN SO QUICKLY

641

00:19:30,068 --> 00:19:29,334

AND THE PRESS IS--

642

00:19:31,836 --> 00:19:30,135

AND THE PUBLIC IS WANTING

643

00:19:32,671 --> 00:19:31,903

TO SAY, "WHAT IS IT?"

644

00:19:33,805 --> 00:19:32,738

AND THIS WHOLE NOTION

645

00:19:35,273 --> 00:19:33,872

OF INSTANT SCIENCE THAT

646

00:19:35,840 --> 00:19:35,340

YOU WERE SO INVOLVED IN.

647

00:19:37,442 --> 00:19:35,907

CAN YOU TALK ABOUT

648

00:19:38,376 --> 00:19:37,509

THE DECISION THAT YOU MADE

649

00:19:39,211 --> 00:19:38,443

TO DO THAT?

650

00:19:40,679 --> 00:19:39,278

THAT WAS SORT OF A RISK

651
00:19:41,446 --> 00:19:40,746
IN ANOTHER WAY, WASN'T IT?

652
00:19:44,082 --> 00:19:41,513
>> YEAH, THIS ALL BEGAN

653
00:19:45,283 --> 00:19:44,149
WHEN I WAS UP AT AMES FOR

654
00:19:46,651 --> 00:19:45,350
THE PIONEER-10 ENCOUNTER

655
00:19:47,886 --> 00:19:46,718
WITH JUPITER, AND I WALKED

656
00:19:49,187 --> 00:19:47,953
INTO AN AUDITORIUM FULL OF

657
00:19:50,222 --> 00:19:49,254
REPORTERS WANTING TO KNOW

658
00:19:51,223 --> 00:19:50,289
WHAT WAS HAPPENING,

659
00:19:52,624 --> 00:19:51,290
WHAT WAS BEING DISCOVERED.

660
00:19:54,025 --> 00:19:52,691
I REALIZED WE HAD

661
00:19:56,294 --> 00:19:54,092
A WONDERFUL OPPORTUNITY

662
00:19:58,430 --> 00:19:56,361
TO COMMUNICATE, BUT WE HAD TO

663
00:19:59,297 --> 00:19:58,497

PREPARE FOR THOSE INTERACTIONS

664

00:20:00,465 --> 00:19:59,364

SO THE PRESS COULD REALLY

665

00:20:01,700 --> 00:20:00,532

TELL THE STORY.

666

00:20:04,035 --> 00:20:01,767

AND SO WE SET UP A SCHEDULE

667

00:20:04,736 --> 00:20:04,102

OF SCIENCE DISCUSSIONS

668

00:20:05,737 --> 00:20:04,803

IN THE AFTERNOON,

669

00:20:07,038 --> 00:20:05,804

GETTING READY FOR THE PRESS

670

00:20:08,473 --> 00:20:07,105

CONFERENCE THE NEXT MORNING.

671

00:20:09,374 --> 00:20:08,540

THAT AFTERNOON, MORE SCIENCE

672

00:20:10,342 --> 00:20:09,441

FOR THE NEXT PRESS CONFERENCE

673

00:20:11,610 --> 00:20:10,409

THE NEXT MORNING.

674

00:20:13,812 --> 00:20:11,677

AND IT WAS A WAY OF DOING

675

00:20:15,247 --> 00:20:13,879

PEER REVIEW SO THAT IN FACT

676

00:20:16,815 --> 00:20:15,314

THERE WAS SOME ASSURANCE

677

00:20:18,583 --> 00:20:16,882

THAT WE WERE NOT

678

00:20:20,385 --> 00:20:18,650

TALKING NONSENSE.

679

00:20:21,753 --> 00:20:20,452

BUT WHEN YOU SEE THINGS LIKE

680

00:20:23,521 --> 00:20:21,820

EIGHT VOLCANOES, THAT'S

681

00:20:24,489 --> 00:20:23,588

A PRETTY EXCITING DISCOVERY,

682

00:20:25,590 --> 00:20:24,556

OF COURSE.

683

00:20:26,625 --> 00:20:25,657

BUT SINCE NOBODY HAD REALLY

684

00:20:27,792 --> 00:20:26,692

SUGGESTED THAT KIND OF

685

00:20:29,394 --> 00:20:27,859

VOLCANIC ACTIVITY--

686

00:20:31,463 --> 00:20:29,461

TEN TIMES THAT OF EARTH.

687

00:20:33,398 --> 00:20:31,530

SO YEAH, I WAS--

688

00:20:34,833 --> 00:20:33,465

THIS INSTANT SCIENCE WAS

689

00:20:35,934 --> 00:20:34,900

ALWAYS A CHALLENGE, BECAUSE

690

00:20:37,269 --> 00:20:36,001

SCIENTISTS REALLY ARE

691

00:20:38,203 --> 00:20:37,336

USED TO HAVING PEER REVIEW.

692

00:20:39,638 --> 00:20:38,270

AND THESE AFTERNOON

693

00:20:41,106 --> 00:20:39,705

SCIENCE DISCUSSIONS WERE

694

00:20:42,907 --> 00:20:41,173

OUR FORM OF PEER REVIEW,

695

00:20:44,976 --> 00:20:42,974

DECIDING WHAT'S READY FOR

696

00:20:46,911 --> 00:20:45,043

THE PRESS THE NEXT MORNING.

697

00:20:47,712 --> 00:20:46,978

NOW, AT THAT TIME, TO GET READY

698

00:20:48,713 --> 00:20:47,779

FOR THE NEXT MORNING,

699

00:20:50,649 --> 00:20:48,780

YOU HAD TO SEND MATERIAL OUT

700

00:20:52,083 --> 00:20:50,716

FOR PREPARATION.

701
00:20:53,385 --> 00:20:52,150
IMAGES-- THE IMAGING TEAM

702
00:20:54,719 --> 00:20:53,452
HAD TO CHOOSE WHICH IMAGES.

703
00:20:55,854 --> 00:20:54,786
THEY HAD TO WRITE THE CAPTIONS,

704
00:20:56,554 --> 00:20:55,921
PREPARE THEM FOR--

705
00:20:58,590 --> 00:20:56,621
>> HAVE THEM PRINTED.

706
00:20:59,591 --> 00:20:58,657
>> NO DIGITAL THEN.

707
00:21:01,960 --> 00:20:59,658
>> NO DIGITAL-- IF YOU WANTED

708
00:21:03,695 --> 00:21:02,027
A PICTURE FROM VOYAGER,

709
00:21:04,629 --> 00:21:03,762
YOU HAD TO BE HERE

710
00:21:06,331 --> 00:21:04,696
COLLECTING IT.

711
00:21:07,098 --> 00:21:06,398
THERE WAS NO INTERNET.

712
00:21:08,066 --> 00:21:07,165
THERE WAS NONE OF THAT.

713
00:21:08,933 --> 00:21:08,133

IT WAS ALL--

714

00:21:10,435 --> 00:21:09,000

YOU HAD TO BE HERE.

715

00:21:11,269 --> 00:21:10,502

SO PEOPLE WHO WERE HERE

716

00:21:12,804 --> 00:21:11,336

WERE REALLY-- WERE

717

00:21:14,406 --> 00:21:12,871

VERY ADVANTAGED.

718

00:21:15,640 --> 00:21:14,473

TODAY, EVERYBODY CAN BE THERE,

719

00:21:17,309 --> 00:21:15,707

BUT THEN IN THOSE DAYS, ONLY

720

00:21:18,143 --> 00:21:17,376

A LIMITED NUMBER OF PEOPLE

721

00:21:19,911 --> 00:21:18,210

COULD HAVE THE SENSE OF

722

00:21:22,013 --> 00:21:19,978

DISCOVERY THAT WE ALL ENJOYED

723

00:21:23,782 --> 00:21:22,080

DAY AFTER DAY AFTER DAY.

724

00:21:25,283 --> 00:21:23,849

>> AND YOU KNOW, YOU SORT OF

725

00:21:27,919 --> 00:21:25,350

HAVE THIS THEME THAT

726

00:21:28,853 --> 00:21:27,986

GETS SET WITH JUPITER,

727

00:21:30,221 --> 00:21:28,920

THAT AS WE GO THROUGH

728

00:21:31,823 --> 00:21:30,288

WE'RE GOING TO SEE THE WHOLE

729

00:21:34,659 --> 00:21:31,890

JOURNEY THROUGH THE OUTER

730

00:21:37,662 --> 00:21:34,726

PLANETS, OF BEING GEOLOGICALLY

731

00:21:39,698 --> 00:21:37,729

ALIVE, AND THE MOONS BEING

732

00:21:40,865 --> 00:21:39,765

SO IMPORTANT.

733

00:21:41,933 --> 00:21:40,932

>> OF COURSE, THE MOONS

734

00:21:43,668 --> 00:21:42,000

BEFORE VOYAGER WERE JUST

735

00:21:45,337 --> 00:21:43,735

LITERALLY POINTS OF LIGHT.

736

00:21:46,838 --> 00:21:45,404

WE HAD SOME IDEA OF COLOR,

737

00:21:47,639 --> 00:21:46,905

BECAUSE THAT YOU CAN GET

738

00:21:48,606 --> 00:21:47,706

FROM A POINT OF LIGHT,

739

00:21:50,742 --> 00:21:48,673

BUT OTHER THAN THAT,

740

00:21:52,544 --> 00:21:50,809

WE HAD LITTLE TO KNOW ABOUT

741

00:21:53,311 --> 00:21:52,611

WHAT THESE WORLDS WERE LIKE.

742

00:21:54,879 --> 00:21:53,378

AND IT TURNS OUT

743

00:21:56,014 --> 00:21:54,946

THEY'RE ALL DIVERSE--

744

00:21:56,948 --> 00:21:56,081

THEY'RE DISTINCT BODIES.

745

00:21:57,882 --> 00:21:57,015

THEY COULD'VE ALL BEEN

746

00:21:59,517 --> 00:21:57,949

HEAVILY CRATERED

747

00:22:02,153 --> 00:21:59,584

ANCIENT SURFACES.

748

00:22:03,321 --> 00:22:02,220

I THINK VERY FEW SURFACES

749

00:22:04,656 --> 00:22:03,388

HAVE BEEN FOUND IN THE SOLAR

750

00:22:06,624 --> 00:22:04,723

SYSTEM-- IT'S A VERY ACTIVE

751
00:22:09,127 --> 00:22:06,691
PLACE OUT THERE TODAY.

752
00:22:14,466 --> 00:22:09,194
>> LET'S GO TO SATURN.

753
00:22:16,067 --> 00:22:14,533
[MUSIC]

754
00:22:17,736 --> 00:22:16,134
>> AS VOYAGER 1 BORE DOWN ON

755
00:22:18,636 --> 00:22:17,803
SATURN, THE SPACECRAFT

756
00:22:22,707 --> 00:22:18,703
WAS CLOCKING NEARLY

757
00:22:23,475 --> 00:22:22,774
A MILLION MILES A DAY.

758
00:22:24,676 --> 00:22:23,542
AND EACH DAY,

759
00:22:26,277 --> 00:22:24,743
SATURN REVEALED ITSELF

760
00:22:26,945 --> 00:22:26,344
IN SOME NEW WAY.

761
00:22:28,513 --> 00:22:27,012
>> THIS FAINT ONE

762
00:22:29,347 --> 00:22:28,580
AND THIS FAINT ONE.

763
00:22:30,782 --> 00:22:29,414

>> AMONG THE TREMENDOUS

764

00:22:32,117 --> 00:22:30,849

SURPRISES THERE WAS THAT

765

00:22:33,752 --> 00:22:32,184

WE COULD BE STILL MORE THAN

766

00:22:34,853 --> 00:22:33,819

A MILLION KILOMETERS AWAY

767

00:22:35,954 --> 00:22:34,920

AND WE COULD SEE STRUCTURE

768

00:22:37,322 --> 00:22:36,021

IN THE RINGS.

769

00:22:40,058 --> 00:22:37,389

>> YOU'RE RIGHT.

770

00:22:41,526 --> 00:22:40,125

LOOK AT THAT!

771

00:22:42,961 --> 00:22:41,593

>> MORE AND MORE, THE RINGS

772

00:22:49,033 --> 00:22:43,028

WERE REVEALING THEIR INTRICATE

773

00:22:50,468 --> 00:22:49,100

AND BAFFLING STRUCTURES.

774

00:22:51,536 --> 00:22:50,535

FOR MANY SCIENTISTS,

775

00:22:55,073 --> 00:22:51,603

THE MOON TITAN WAS

776
00:22:56,674 --> 00:22:55,140
AS IMPORTANT AS SATURN ITSELF.

777
00:22:57,809 --> 00:22:56,741
TITAN IS SO LARGE THAT

778
00:22:59,310 --> 00:22:57,876
IF IT ORBITED THE SUN

779
00:23:02,046 --> 00:22:59,377
RATHER THAN SATURN,

780
00:23:03,181 --> 00:23:02,113
IT WOULD BE CALLED A PLANET.

781
00:23:04,449 --> 00:23:03,248
IT WAS ALREADY KNOWN THAT

782
00:23:05,650 --> 00:23:04,516
THIS WAS THE ONLY MOON

783
00:23:10,955 --> 00:23:05,717
IN THE SOLAR SYSTEM HAVING

784
00:23:12,023 --> 00:23:11,022
A SUBSTANTIAL ATMOSPHERE.

785
00:23:13,525 --> 00:23:12,090
THIS MIGHT BE A PLACE,

786
00:23:14,859 --> 00:23:13,592
SOME SCIENTISTS THEORIZE,

787
00:23:17,395 --> 00:23:14,926
THAT RESEMBLED THE EARTH

788
00:23:19,097 --> 00:23:17,462

BEFORE LIFE AROSE.

789

00:23:23,201 --> 00:23:19,164

AND THAT MADE THIS MOON

790

00:23:24,369 --> 00:23:23,268

AN IRRESISTIBLE TARGET.

791

00:23:28,106 --> 00:23:24,436

BUT GETTING THE BEST POSSIBLE

792

00:23:29,541 --> 00:23:28,173

VIEWS CAME WITH A STEEP PRICE:

793

00:23:30,508 --> 00:23:29,608

IT REQUIRED VOYAGER 1'S

794

00:23:33,978 --> 00:23:30,575

TOUR OF THE PLANETS

795

00:23:35,914 --> 00:23:34,045

TO END AT SATURN.

796

00:23:37,515 --> 00:23:35,981

THAT WAS THE CHOICE MADE,

797

00:23:41,886 --> 00:23:37,582

FOR TITAN WAS DEEMED

798

00:23:43,521 --> 00:23:41,953

THAT IMPORTANT.

799

00:23:44,789 --> 00:23:43,588

>> THERE WAS THIS GREAT HOPE

800

00:23:45,890 --> 00:23:44,856

THAT WE'D BE SEEING DOWN

801
00:23:47,392 --> 00:23:45,957
TO THE SURFACE THROUGH

802
00:23:49,027 --> 00:23:47,459
THIS THICK ATMOSPHERE,

803
00:23:51,930 --> 00:23:49,094
AND WE WOULD DISCOVER

804
00:23:53,031 --> 00:23:51,997
AMAZING THINGS.

805
00:23:53,965 --> 00:23:53,098
AS WE GOT CLOSER,

806
00:23:55,467 --> 00:23:54,032
AT THE TIME WHEN WE SHOULD'VE

807
00:23:57,135 --> 00:23:55,534
STARTED TO SEE FEATURES

808
00:24:00,438 --> 00:23:57,202
AND RESOLUTION, IT WAS

809
00:24:01,739 --> 00:24:00,505
AWFULLY BLANK.

810
00:24:03,842 --> 00:24:01,806
>> ALTHOUGH THE HAZY IMAGES

811
00:24:04,876 --> 00:24:03,909
OF TITAN WERE DISAPPOINTING,

812
00:24:06,945 --> 00:24:04,943
THE ATMOSPHERE WAS FOUND

813
00:24:09,614 --> 00:24:07,012

TO BE, LIKE OUR PLANET,

814

00:24:12,083 --> 00:24:09,681

RICH IN NITROGEN.

815

00:24:16,754 --> 00:24:12,150

AS HOPED, THIS WAS IN SOME WAYS

816

00:24:19,123 --> 00:24:16,821

A PRIMORDIAL EARTH.

817

00:24:20,892 --> 00:24:19,190

AFTER TITAN, VOYAGER 1 SWEEP

818

00:24:22,193 --> 00:24:20,959

UNDERNEATH SATURN, AND THEN

819

00:24:23,995 --> 00:24:22,260

ROSE UP OUT OF THE PLANE

820

00:24:29,734 --> 00:24:24,062

OF THE ECLIPTIC AND HEADED

821

00:24:30,468 --> 00:24:29,801

UP TOWARDS INTERSTELLAR SPACE.

822

00:24:31,769 --> 00:24:30,535

>> TO LOOK AT THAT

823

00:24:33,404 --> 00:24:31,836

AND REALIZE THAT YOUR

824

00:24:35,006 --> 00:24:33,471

SPACECRAFT, YOU'RE BASICALLY

825

00:24:36,140 --> 00:24:35,073

SAYING-- IT MUST'VE FELT LIKE

826
00:24:37,008 --> 00:24:36,207
YOU WERE SAYING GOODBYE TO IT

827
00:24:37,775 --> 00:24:37,075
AT THAT POINT.

828
00:24:39,077 --> 00:24:37,842
YOU DIDN'T KNOW HOW LONG

829
00:24:40,912 --> 00:24:39,144
IT WOULD LAST, AND YOU BUILT

830
00:24:41,880 --> 00:24:40,979
THIS THING, AND BYE-BYE

831
00:24:43,882 --> 00:24:41,947
AFTER TITAN.

832
00:24:44,682 --> 00:24:43,949
WAS THAT TOUGH ON YOU

833
00:24:46,584 --> 00:24:44,749
AS AN ENGINEER

834
00:24:47,519 --> 00:24:46,651
OR AS A SCIENTIST?

835
00:24:48,686 --> 00:24:47,586
>> [INDISTINCT]

836
00:24:49,521 --> 00:24:48,753
ABOUT THAT.

837
00:24:50,455 --> 00:24:49,588
>> ACTUALLY, OF COURSE,

838
00:24:51,956 --> 00:24:50,522

THIS WAS JUST THE BEGINNING

839

00:24:53,691 --> 00:24:52,023
OF THE INTERSTELLAR MISSION.

840

00:24:55,460 --> 00:24:53,758
IN FACT, WHEN WE FINISHED

841

00:24:56,628 --> 00:24:55,527
SATURN-- BEFORE SATURN

842

00:24:58,229 --> 00:24:56,695
IT WAS CALLED THE JUPITER

843

00:24:59,764 --> 00:24:58,296
SATURN TITAN MISSION.

844

00:25:02,567 --> 00:24:59,831
AND FOR VOYAGER 2, IT WAS

845

00:25:04,836 --> 00:25:02,634
THE JUPITER SATURN X MISSIONS--

846

00:25:06,204 --> 00:25:04,903
JSX-- JUPITER, SATURN, X,

847

00:25:08,473 --> 00:25:06,271
WHERE X WAS EITHER URANUS

848

00:25:10,241 --> 00:25:08,540
OR TITAN AGAIN.

849

00:25:11,276 --> 00:25:10,308
IF VOYAGER 1 HAD NOT FLOWN

850

00:25:12,443 --> 00:25:11,343
BY TITAN AND GOTTEN

851
00:25:13,411 --> 00:25:12,510
THE DATA, VOYAGER 2

852
00:25:14,612 --> 00:25:13,478
WOULD'VE DONE THE SAME THING

853
00:25:15,947 --> 00:25:14,679
AND ENDED UP GOING OUT OF

854
00:25:17,315 --> 00:25:16,014
THE PLANE OF THE ECLIPTIC,

855
00:25:18,750 --> 00:25:17,382
AND NO MORE PLANETS.

856
00:25:21,252 --> 00:25:18,817
SO IN THAT SENSE, VOYAGER 1

857
00:25:22,020 --> 00:25:21,319
DID ITS JOB FOR VOYAGER 2.

858
00:25:24,856 --> 00:25:22,087
>> WOULD YOU HAVE DONE THAT

859
00:25:26,124 --> 00:25:24,923
EVEN IF, WITH VOYAGER 1,

860
00:25:27,292 --> 00:25:26,191
YOU DIDN'T GET EXACTLY

861
00:25:28,860 --> 00:25:27,359
WHAT YOU WANTED AND YOU FELT

862
00:25:29,861 --> 00:25:28,927
LIKE YOU NEEDED TO GO BACK?

863
00:25:31,062 --> 00:25:29,928

>> I THINK WE WOULD NOT HAVE

864

00:25:33,097 --> 00:25:31,129

DONE THAT, BUT IF VOYAGER 1

865

00:25:34,532 --> 00:25:33,164

HAD NOT WORKED-- IN FACT,

866

00:25:35,633 --> 00:25:34,599

NASA SAID, "THIS IS

867

00:25:36,501 --> 00:25:35,700

"A MISSION TO SATURN.

868

00:25:37,702 --> 00:25:36,568

"YOU NEED TO DO

869

00:25:39,237 --> 00:25:37,769

"A SATURN MISSION."

870

00:25:40,071 --> 00:25:39,304

AND IF YOU WANT TO DO TITAN,

871

00:25:41,139 --> 00:25:40,138

WHICH IS CLEARLY A VERY

872

00:25:42,373 --> 00:25:41,206

IMPORTANT THING TO DO,

873

00:25:44,008 --> 00:25:42,440

YOU END UP OUT OF

874

00:25:44,776 --> 00:25:44,075

THE PLANE OF THE ECLIPTIC.

875

00:25:45,710 --> 00:25:44,843

>> THAT WAS A CLEAR GUIDANCE

876

00:25:48,212 --> 00:25:45,777
FROM HEADQUARTERS.

877

00:25:49,480 --> 00:25:48,279
AND BUD SCHURMEIER WAS

878

00:25:51,149 --> 00:25:49,547
THE FIRST PROJECT MANAGER

879

00:25:53,718 --> 00:25:51,216
AND WAS VERY, VERY FIRM

880

00:25:54,819 --> 00:25:53,785
ON US OBSERVING THAT.

881

00:25:56,154 --> 00:25:54,886
WE WERE NOT TO LOOK AT

882

00:25:57,488 --> 00:25:56,221
ANYTHING BEYOND SATURN.

883

00:25:58,790 --> 00:25:57,555
THIS WAS A SATURN MISSION--

884

00:25:59,824 --> 00:25:58,857
FOCUS ON SATURN.

885

00:26:01,192 --> 00:25:59,891
AND THE PRIMARY OBJECTIVE

886

00:26:03,027 --> 00:26:01,259
AT SATURN WAS TITAN,

887

00:26:05,229 --> 00:26:03,094
AND IF WE DID NOT ACHIEVE

888

00:26:06,497 --> 00:26:05,296

ALL OF THE TITAN OBJECTIVES--

889

00:26:07,465 --> 00:26:06,564

IS THE WAY I REMEMBER--

890

00:26:09,067 --> 00:26:07,532

WE WERE GOING TO SEND

891

00:26:10,501 --> 00:26:09,134

ITS TWIN SPACECRAFT,

892

00:26:11,869 --> 00:26:10,568

VOYAGER 2, RIGHT BACK.

893

00:26:14,606 --> 00:26:11,936

THAT WAS THE PLAN.

894

00:26:15,506 --> 00:26:14,673

>> WE HAD TO TARGET VOYAGER 1

895

00:26:17,442 --> 00:26:15,573

AND VOYAGER 2 DIFFERENTLY

896

00:26:18,643 --> 00:26:17,509

AT SATURN, BECAUSE A SINGLE

897

00:26:20,511 --> 00:26:18,710

SPACECRAFT CAN FLY BY

898

00:26:21,079 --> 00:26:20,578

CLOSE TO ONLY ONE OR TWO

899

00:26:22,146 --> 00:26:21,146

OF THE MOONS.

900

00:26:23,481 --> 00:26:22,213

YOU CAN'T GET ALL FOUR.

901
00:26:24,716 --> 00:26:23,548
SO WHAT WE DID WAS

902
00:26:26,517 --> 00:26:24,783
TO PURPOSELY FOCUS VOYAGER 2

903
00:26:28,052 --> 00:26:26,584
ON EUROPA, WHICH WAS THE ONLY

904
00:26:29,587 --> 00:26:28,119
ONE OF THE FOUR MOONS THAT

905
00:26:30,555 --> 00:26:29,654
WE HAD NOT GOTTEN UP CLOSE.

906
00:26:32,190 --> 00:26:30,622
AND OF COURSE, WHAT WE

907
00:26:33,858 --> 00:26:32,257
DISCOVERED WAS IT LOOKED LIKE

908
00:26:35,927 --> 00:26:33,925
A CRACKED, ICY SURFACE

909
00:26:36,861 --> 00:26:35,994
ON A LIQUID WATER OCEAN.

910
00:26:38,029 --> 00:26:36,928
THAT'S WHAT IT LOOKED LIKE,

911
00:26:39,564 --> 00:26:38,096
AND-- WITH NO MOUNTAINS

912
00:26:42,066 --> 00:26:39,631
AND NO VALLEYS, AND JUST

913
00:26:43,501 --> 00:26:42,133

THESE CRACKS WHERE STUFF

914

00:26:45,637 --> 00:26:43,568

HAD COME OUT ON THE SURFACE

915

00:26:46,404 --> 00:26:45,704

OF THE ICE.

916

00:26:47,639 --> 00:26:46,471

>> ED TOLD ME IT LOOKED LIKE

917

00:26:49,307 --> 00:26:47,706

THE CUE BALL HE USED TO

918

00:26:51,175 --> 00:26:49,374

PLAY POOL WITH AT CALTECH.

919

00:26:52,510 --> 00:26:51,242

[LAUGHTER]

920

00:26:54,112 --> 00:26:52,577

>> SO, CHRIS, WE'VE HAD FIRE,

921

00:26:55,079 --> 00:26:54,179

AND NOW WE HAVE ICE.

922

00:26:57,181 --> 00:26:55,146

>> YES.

923

00:26:58,049 --> 00:26:57,248

>> ALWAYS VARIATION GOING ON.

924

00:27:01,185 --> 00:26:58,116

NOW, WE'RE ABOUT TO GO

925

00:27:02,320 --> 00:27:01,252

TO URANUS, AND SUZY,

926
00:27:03,354 --> 00:27:02,387
THIS IS WHERE YOU COME INTO

927
00:27:04,322 --> 00:27:03,421
THE PICTURE.

928
00:27:05,189 --> 00:27:04,389
>> YEAH, YEAH.

929
00:27:07,025 --> 00:27:05,256
>> YOU KNOW, YOU WERE JUST

930
00:27:08,259 --> 00:27:07,092
GETTING OUT OF COLLEGE.

931
00:27:09,160 --> 00:27:08,326
>> RIGHT, A LITTLE COLLEGE

932
00:27:10,228 --> 00:27:09,227
DOWN THE STREET THERE

933
00:27:10,995 --> 00:27:10,295
IN PASADENA.

934
00:27:13,064 --> 00:27:11,062
I WENT TO CALTECH,

935
00:27:14,999 --> 00:27:13,131
SO IT WAS CLOSE BY.

936
00:27:17,502 --> 00:27:15,066
AND A MATTER OF FACT,

937
00:27:20,471 --> 00:27:17,569
I FOUND OUT ABOUT THE JOB

938
00:27:22,340 --> 00:27:20,538

AT JPL FROM BEING ON CAMPUS,

939

00:27:23,875 --> 00:27:22,407

AND PEOPLE THAT KNOW ME KNOW

940

00:27:24,575 --> 00:27:23,942

THAT I DO A LOT OF SWIMMING.

941

00:27:25,843 --> 00:27:24,642

THE PERSON IN THE LANE

942

00:27:28,546 --> 00:27:25,910

NEXT TO ME SAID, "HEY,

943

00:27:30,381 --> 00:27:28,613

"I HEAR ABOUT THIS JOB AT JPL,"

944

00:27:31,783 --> 00:27:30,448

AND IT'S GREAT.

945

00:27:32,784 --> 00:27:31,850

IT'S BEEN FABULOUS.

946

00:27:34,585 --> 00:27:32,851

>> WELL, LET'S GO

947

00:27:37,922 --> 00:27:34,652

AND RELIVE THAT EXPERIENCE

948

00:27:39,257 --> 00:27:37,989

AT URANUS NOW.

949

00:27:41,359 --> 00:27:39,324

>> AFTER TRIUMPHS AT JUPITER

950

00:27:42,627 --> 00:27:41,426

AND SATURN, VOYAGER 2 WAS

951
00:27:44,262 --> 00:27:42,694
CLOSING IN ON THE FIRST

952
00:27:51,169 --> 00:27:44,329
ENCOUNTER EVER WITH

953
00:27:52,637 --> 00:27:51,236
THE ICE GIANT PLANET URANUS.

954
00:27:59,077 --> 00:27:52,704
VOYAGER'S JOURNEY TO THIS POINT

955
00:28:00,144 --> 00:27:59,144
HAD TAKEN OVER EIGHT YEARS.

956
00:28:01,279 --> 00:28:00,211
AND THE WEAR AND TEAR OF

957
00:28:04,382 --> 00:28:01,346
A BILLION MILES WAS

958
00:28:05,316 --> 00:28:04,449
BEGINNING TO SHOW.

959
00:28:06,684 --> 00:28:05,383
THE SCAN PLATFORM THAT

960
00:28:11,322 --> 00:28:06,751
MOVED VOYAGER'S CAMERA

961
00:28:12,390 --> 00:28:11,389
WAS PRONE TO SEIZING UP.

962
00:28:13,524 --> 00:28:12,457
TRANSMITTING INSTRUCTIONS

963
00:28:15,460 --> 00:28:13,591

TO THE SPACECRAFT WAS

964

00:28:16,661 --> 00:28:15,527

AN ELABORATE CHORE,

965

00:28:18,362 --> 00:28:16,728

AS THE PRIMARY RECEIVER

966

00:28:19,764 --> 00:28:18,429

WAS NO LONGER FUNCTIONING

967

00:28:23,101 --> 00:28:19,831

AND THE BACKUP WAS ONLY

968

00:28:24,235 --> 00:28:23,168

PARTIALLY WORKING.

969

00:28:27,438 --> 00:28:24,302

GETTING A SIGNAL BACK FROM

970

00:28:28,906 --> 00:28:27,505

VOYAGER WAS A CHALLENGE, TOO.

971

00:28:32,243 --> 00:28:28,973

ONE WAY TRANSMISSION TIME

972

00:28:33,945 --> 00:28:32,310

NOW TOOK THREE HOURS.

973

00:28:35,379 --> 00:28:34,012

>> THE EXTENSION OF THE MISSION

974

00:28:37,148 --> 00:28:35,446

TO URANUS AND NEPTUNE

975

00:28:39,117 --> 00:28:37,215

I THINK HIGHLIGHTS REALLY

976
00:28:40,585 --> 00:28:39,184
ONE OF THE UNSUNG HEROES

977
00:28:44,322 --> 00:28:40,652
OF JPL, AND THAT'S

978
00:28:45,757 --> 00:28:44,389
THE DEEP SPACE NETWORK.

979
00:28:46,958 --> 00:28:45,824
>> THE DEEP SPACE NETWORK

980
00:28:48,426 --> 00:28:47,025
IS A GROUP OF ANTENNAS

981
00:28:51,028 --> 00:28:48,493
ARRAYED IN THREE STRATEGIC

982
00:28:52,497 --> 00:28:51,095
LOCATIONS AROUND THE GLOBE.

983
00:28:53,598 --> 00:28:52,564
THIS IS THE ESSENTIAL LINK

984
00:28:55,133 --> 00:28:53,665
FOR TRACKING AND COMMUNICATING

985
00:28:59,704 --> 00:28:55,200
WITH ALL OF NASA'S

986
00:29:00,338 --> 00:28:59,771
INTERPLANETARY SPACECRAFT.

987
00:29:01,205 --> 00:29:00,405
>> THOSE ENCOUNTERS AT

988
00:29:02,340 --> 00:29:01,272

URANUS AND NEPTUNE WOULD'VE

989

00:29:03,674 --> 00:29:02,407
BEEN IMPOSSIBLE WITHOUT

990

00:29:04,876 --> 00:29:03,741
WHAT THE DEEP SPACE NETWORK,

991

00:29:07,411 --> 00:29:04,943
THE DSN, DID

992

00:29:08,079 --> 00:29:07,478
TO GET THAT DATA BACK.

993

00:29:08,980 --> 00:29:08,146
WHEN YOU THINK ABOUT IT,

994

00:29:10,381 --> 00:29:09,047
YOU'VE GOT THE VOYAGER

995

00:29:11,783 --> 00:29:10,448
RADIO TRANSMITTER POWERED

996

00:29:13,151 --> 00:29:11,850
AT ABOUT 23 WATTS,

997

00:29:15,319 --> 00:29:13,218
WHICH IS ABOUT THE POWER OF

998

00:29:16,587 --> 00:29:15,386
YOUR REFRIGERATOR LIGHT BULB.

999

00:29:17,655 --> 00:29:16,654
AND WE'RE TRYING TO PICK UP

1000

00:29:18,623 --> 00:29:17,722
THAT SIGNAL HERE ON EARTH

1001
00:29:20,792 --> 00:29:18,690
FROM WELL OVER

1002
00:29:22,994 --> 00:29:20,859
A BILLION MILES AWAY.

1003
00:29:24,629 --> 00:29:23,061
AND PICKING OUT THAT VERY TINY

1004
00:29:26,063 --> 00:29:24,696
LITTLE SIGNAL FROM THAT VAST

1005
00:29:27,465 --> 00:29:26,130
BACKGROUND OF OUTER SPACE

1006
00:29:28,232 --> 00:29:27,532
IS REALLY A REMARKABLE

1007
00:29:34,338 --> 00:29:28,299
ACHIEVEMENT, WHEN YOU

1008
00:29:35,373 --> 00:29:34,405
THINK ABOUT IT.

1009
00:29:36,808 --> 00:29:35,440
>> URANUS WAS A REAL

1010
00:29:39,076 --> 00:29:36,875
PLANNING CHALLENGE,

1011
00:29:41,579 --> 00:29:39,143
AND THE REASON WHY IS ONE,

1012
00:29:42,914 --> 00:29:41,646
WE ONLY GET ONE SHOT, AND TWO,

1013
00:29:45,349 --> 00:29:42,981

URANUS IS KIND OF TURNED UP

1014

00:29:47,585 --> 00:29:45,416

ON ITS EDGE, AND WE'RE NOW--

1015

00:29:48,986 --> 00:29:47,652

INSTEAD OF SEEING THE MOONS

1016

00:29:49,987 --> 00:29:49,053

IN A KIND OF PLANE WHERE

1017

00:29:51,489 --> 00:29:50,054

YOU CAN FLY THROUGH THIS PLANE

1018

00:29:55,126 --> 00:29:51,556

AND GET ONE AFTER THE OTHER,

1019

00:29:55,693 --> 00:29:55,193

WE'RE LOOKING AT A BULLSEYE.

1020

00:29:57,028 --> 00:29:55,760

>> THAT MEANT THAT

1021

00:29:58,229 --> 00:29:57,095

THE FLY-BY OF URANUS

1022

00:29:58,996 --> 00:29:58,296

AND ITS MOONS AND RINGS

1023

00:30:02,867 --> 00:29:59,063

WOULD OCCUR

1024

00:30:04,068 --> 00:30:02,934

NEARLY SIMULTANEOUSLY.

1025

00:30:06,404 --> 00:30:04,135

COPING WITH SO MUCH TO SEE

1026
00:30:07,939 --> 00:30:06,471
IN SUCH A SHORT PERIOD OF TIME

1027
00:30:12,643 --> 00:30:08,006
WOULD MAKE THIS THE MOST INTENSE

1028
00:30:13,311 --> 00:30:12,710
OF ALL THE VOYAGER ENCOUNTERS.

1029
00:30:15,112 --> 00:30:13,378
>> YOU'RE GIVEN

1030
00:30:15,847 --> 00:30:15,179
THIS PULSE OF DATA

1031
00:30:17,048 --> 00:30:15,914
NO ONE'S EVER SEEN,

1032
00:30:18,082 --> 00:30:17,115
AND YOU GET IT ALL AT ONCE.

1033
00:30:19,317 --> 00:30:18,149
YOU GET HIGH RESOLUTION--

1034
00:30:20,218 --> 00:30:19,384
IT COMES OUT VERY, VERY QUICKLY

1035
00:30:21,552 --> 00:30:20,285
BECAUSE THESE MOONS ARE SMALL

1036
00:30:23,921 --> 00:30:21,619
AND YOU'RE FLYING BY

1037
00:30:24,822 --> 00:30:23,988
AT LARGE VELOCITY.

1038
00:30:25,590 --> 00:30:24,889

SO IN A BLINK OF AN EYE,

1039

00:30:27,158 --> 00:30:25,657

BASICALLY, YOU GO

1040

00:30:27,959 --> 00:30:27,225

FROM VERY LOW RESOLUTION IMAGE

1041

00:30:28,893 --> 00:30:28,026

TO IN YOUR FACE,

1042

00:30:32,530 --> 00:30:28,960

HIGH RESOLUTION,

1043

00:30:33,764 --> 00:30:32,597

AND THEN GONE AGAIN.

1044

00:30:34,699 --> 00:30:33,831

>> THE INITIAL CALCULATION

1045

00:30:36,467 --> 00:30:34,766

SHOWED THAT WE WERE

1046

00:30:37,501 --> 00:30:36,534

IN GREAT DANGER OF GETTING

1047

00:30:38,769 --> 00:30:37,568

REALLY FUZZY PICTURES

1048

00:30:42,006 --> 00:30:38,836

OF PRACTICALLY EVERYTHING

1049

00:30:42,607 --> 00:30:42,073

IF WE DIDN'T DO SOMETHING.

1050

00:30:44,141 --> 00:30:42,674

AND SO WE ACTUALLY

1051

00:30:45,376 --> 00:30:44,208

DID SOME RE-ENGINEERING

1052

00:30:47,912 --> 00:30:45,443

OF THE SPACECRAFT WITH THE HELP

1053

00:30:48,646 --> 00:30:47,979

OF THE ENGINEERING TEAMS.

1054

00:30:51,916 --> 00:30:48,713

WE CALLED IT

1055

00:30:52,783 --> 00:30:51,983

OUR ANTI-SMEAR CAMPAIGN.

1056

00:30:55,519 --> 00:30:52,850

WE BASICALLY IMPROVED

1057

00:30:56,487 --> 00:30:55,586

OUR CAMERA PLATFORM IN FLIGHT

1058

00:31:03,194 --> 00:30:56,554

BY REMOTELY CHANGING

1059

00:31:05,029 --> 00:31:03,261

HOW WE OPERATED IT.

1060

00:31:06,063 --> 00:31:05,096

>> WELL, SUZY, IT STARTS OFF

1061

00:31:07,265 --> 00:31:06,130

THAT SEGMENT TALKING ABOUT

1062

00:31:08,366 --> 00:31:07,332

THIS UNSUNG HERO

1063

00:31:09,967 --> 00:31:08,433

OF THE DEEP SPACE NETWORK.

1064

00:31:11,469 --> 00:31:10,034

YOU NOW ARE THE DIRECTOR

1065

00:31:14,205 --> 00:31:11,536

OF THE DEEP SPACE NETWORK,

1066

00:31:16,040 --> 00:31:14,272

AND WHY DON'T YOU TELL US

1067

00:31:18,843 --> 00:31:16,107

WHY IT WAS SUCH AN UNSUNG HERO.

1068

00:31:20,044 --> 00:31:18,910

>> WELL, I THINK ANY MISSION,

1069

00:31:21,178 --> 00:31:20,111

DEEP SPACE MISSION, DEPENDS ON

1070

00:31:23,414 --> 00:31:21,245

THE DEEP SPACE NETWORK.

1071

00:31:25,216 --> 00:31:23,481

AND THE DEEP SPACE NETWORK

1072

00:31:26,384 --> 00:31:25,283

STARTED APPROXIMATELY

1073

00:31:28,619 --> 00:31:26,451

IN THE EARLY '60s,

1074

00:31:30,488 --> 00:31:28,686

AND AS ED LIKES TO SAY,

1075

00:31:32,356 --> 00:31:30,555

VOYAGER AND THE DSN

1076

00:31:33,324 --> 00:31:32,423

GREW UP TOGETHER.

1077

00:31:34,292 --> 00:31:33,391

THERE WERE A LOT OF

1078

00:31:35,893 --> 00:31:34,359

ENHANCEMENTS MADE TO

1079

00:31:38,763 --> 00:31:35,960

THE DEEP SPACE NETWORK,

1080

00:31:40,398 --> 00:31:38,830

PARTICULARLY FOR VOYAGER.

1081

00:31:41,799 --> 00:31:40,465

ONE OF THE ENHANCEMENTS

1082

00:31:43,734 --> 00:31:41,866

WAS BEING ABLE TO

1083

00:31:46,037 --> 00:31:43,801

ARRAY ANTENNAS ON THE GROUND

1084

00:31:48,105 --> 00:31:46,104

FOR THE URANUS DOWNLINK.

1085

00:31:49,707 --> 00:31:48,172

AND BETWEEN THE URANUS

1086

00:31:50,708 --> 00:31:49,774

AND NEPTUNE ENCOUNTER,

1087

00:31:52,410 --> 00:31:50,775

WE INCREASED THE SIZE

1088

00:31:54,745 --> 00:31:52,477

OF THE 64-METER ANTENNAS

1089

00:31:56,514 --> 00:31:54,812
TO 70 METERS,

1090

00:31:58,649 --> 00:31:56,581
JUST PARTICULARLY FOR VOYAGER,

1091

00:31:59,717 --> 00:31:58,716
AS WELL AS AT NEPTUNE

1092

00:32:01,385 --> 00:31:59,784
IN PARTICULAR, WE HAD

1093

00:32:03,721 --> 00:32:01,452
TO ARRAY OTHER ASSETS BESIDES

1094

00:32:04,655 --> 00:32:03,788
THE DEEP SPACE NETWORK--

1095

00:32:05,289 --> 00:32:04,722
THE VERY LARGE ARRAY.

1096

00:32:06,924 --> 00:32:05,356
WE ARRAYED

1097

00:32:08,759 --> 00:32:06,991
INTO THE DEEP SPACE NETWORK

1098

00:32:12,096 --> 00:32:08,826
TO GET THE DATA BACK.

1099

00:32:14,065 --> 00:32:12,163
AND YOU KNOW, THE DSN FOLKS

1100

00:32:14,832 --> 00:32:14,132
ARE VERY DEDICATED

1101
00:32:16,534 --> 00:32:14,899
TO WHAT THEY DO.

1102
00:32:17,868 --> 00:32:16,601
THEY ARE THE UNSUNG HEROES.

1103
00:32:20,304 --> 00:32:17,935
YOU WOULD GET ZERO DATA BACK

1104
00:32:21,238 --> 00:32:20,371
FROM ANY MISSION FROM MARS

1105
00:32:22,206 --> 00:32:21,305
AND BEYOND WITHOUT

1106
00:32:25,176 --> 00:32:22,273
THE DEEP SPACE NETWORK.

1107
00:32:26,978 --> 00:32:25,243
AND HONESTLY, THEY'RE SORT OF

1108
00:32:32,416 --> 00:32:27,045
HAPPY TO SIT IN THE BACKGROUND

1109
00:32:33,184 --> 00:32:32,483
AND JUST BE PART OF THE CROWD,

1110
00:32:35,052 --> 00:32:33,251
SO TO SPEAK.

1111
00:32:37,822 --> 00:32:35,119
BUT IT'S A VERY IMPORTANT

1112
00:32:39,023 --> 00:32:37,889
FUNCTION, AND WE WOULDN'T

1113
00:32:41,625 --> 00:32:39,090

HAVE THE DATA WE HAVE TODAY

1114

00:32:42,860 --> 00:32:41,692

WITHOUT THE ANTENNAS.

1115

00:32:47,465 --> 00:32:42,927

>> AND CHRIS, WE'RE NOW

1116

00:32:49,500 --> 00:32:47,532

AT THE POINT WHERE VOYAGER 2

1117

00:32:51,068 --> 00:32:49,567

IS AGING, AND I THINK

1118

00:32:52,837 --> 00:32:51,135

IT'S ARTHRITIC IN THE ARM,

1119

00:32:54,238 --> 00:32:52,904

IT'S A LITTLE HARD OF HEARING,

1120

00:32:55,406 --> 00:32:54,305

OR A LOT OF HARD OF HEARING.

1121

00:32:57,408 --> 00:32:55,473

CAN YOU TALK ABOUT SOME OF

1122

00:32:59,243 --> 00:32:57,475

THE ENGINEERING CHALLENGES

1123

00:33:00,578 --> 00:32:59,310

THAT YOU HAVE WITH

1124

00:33:01,912 --> 00:33:00,645

THE SPACECRAFT AT THIS POINT?

1125

00:33:02,847 --> 00:33:01,979

>> WELL, I MEAN, ONE THING

1126

00:33:05,049 --> 00:33:02,914

YOU NOTICE RIGHT AWAY

1127

00:33:06,584 --> 00:33:05,116

IS THAT THERE'S VERY LITTLE

1128

00:33:08,319 --> 00:33:06,651

REDUNDANCY LEFT.

1129

00:33:09,520 --> 00:33:08,386

>> TODAY IT'S LIKE

1130

00:33:10,087 --> 00:33:09,587

ZERO REDUNDANCY.

1131

00:33:10,855 --> 00:33:10,154

>> YES.

1132

00:33:11,922 --> 00:33:10,922

>> ON EITHER SPACECRAFT.

1133

00:33:16,894 --> 00:33:11,989

>> THAT'S RIGHT, THAT'S RIGHT.

1134

00:33:19,764 --> 00:33:16,961

AND THE PROBLEM THAT GIVES YOU

1135

00:33:21,265 --> 00:33:19,831

IS YOU STILL HAVE PEOPLE

1136

00:33:22,566 --> 00:33:21,332

ON THE TEAM WHO WANT TO

1137

00:33:26,837 --> 00:33:22,633

FIGURE OUT SOME WAY TO

1138

00:33:28,973 --> 00:33:26,904

USE THE EQUIPMENT THAT WE HAVE--

1139

00:33:30,574 --> 00:33:29,040
EVEN IF IT FAILS, YOU KNOW,

1140

00:33:31,909 --> 00:33:30,641
IS THERE A WAY WE CAN

1141

00:33:34,011 --> 00:33:31,976
GO THROUGH SOME BACK DOOR

1142

00:33:37,515 --> 00:33:34,078
AND FIND ANOTHER FUNCTION

1143

00:33:38,249 --> 00:33:37,582
THAT WE CAN USE INSTEAD?

1144

00:33:39,617 --> 00:33:38,316
THOSE THINGS DON'T EXIST,

1145

00:33:41,152 --> 00:33:39,684
REALLY, BUT IT KEEPS

1146

00:33:43,487 --> 00:33:41,219
THE TEAM SHARP.

1147

00:33:46,190 --> 00:33:43,554
AND IT MAKES THEM THINK

1148

00:33:48,192 --> 00:33:46,257
OF OTHER CREATIVE IDEAS

1149

00:33:50,828 --> 00:33:48,259
TO MAKE THE MISSION

1150

00:33:52,329 --> 00:33:50,895
THAT WE HAVE AHEAD OF US

1151
00:33:53,397 --> 00:33:52,396
STILL A VERY MEANINGFUL MISSION.

1152
00:33:54,498 --> 00:33:53,464
>> I THINK IT'S

1153
00:33:55,666 --> 00:33:54,565
REALLY SPECTACULAR, TOO,

1154
00:33:57,001 --> 00:33:55,733
WHEN YOU THINK ABOUT IT.

1155
00:33:58,102 --> 00:33:57,068
THERE'S TWO SPACECRAFT

1156
00:34:00,204 --> 00:33:58,169
THAT ARE STILL OPERATING--

1157
00:34:01,539 --> 00:34:00,271
NOT JUST ONE, BUT TWO THAT HAVE

1158
00:34:04,041 --> 00:34:01,606
GONE FROM A FOUR-YEAR MISSION

1159
00:34:05,609 --> 00:34:04,108
TO A FOUR-DECADE MISSION,

1160
00:34:07,878 --> 00:34:05,676
AND THAT'S REALLY REMARKABLE.

1161
00:34:09,447 --> 00:34:07,945
AND I'VE READ A LOT

1162
00:34:11,549 --> 00:34:09,514
ON THE HISTORY OF VOYAGER,

1163
00:34:15,352 --> 00:34:11,616

AND PICKING UP ON SOMETHING

1164

00:34:17,154 --> 00:34:15,419
THAT JOHN SAID, YOU KNOW,

1165

00:34:18,055 --> 00:34:17,221
IT WAS DESIGNED

1166

00:34:19,757 --> 00:34:18,122
AS A FOUR-YEAR MISSION.

1167

00:34:20,591 --> 00:34:19,824
THE ENGINEERS OR THE--

1168

00:34:21,692 --> 00:34:20,658
LET'S JUST PUT IT THIS WAY--

1169

00:34:23,994 --> 00:34:21,759
THE MANAGERS WERE TOLD

1170

00:34:25,396 --> 00:34:24,061
NOT TO THINK BEYOND FOUR YEARS.

1171

00:34:26,597 --> 00:34:25,463
THE ENGINEERS ALL THOUGHT

1172

00:34:28,199 --> 00:34:26,664
BEYOND FOUR YEARS.

1173

00:34:28,899 --> 00:34:28,266
WHEN YOU LOOK AT THE HISTORY

1174

00:34:30,401 --> 00:34:28,966
OF IT, THEY'LL SAY,

1175

00:34:32,403 --> 00:34:30,468
"WELL, I HAD A CHOICE BETWEEN

1176

00:34:33,737 --> 00:34:32,470

"PART A AND PART B.

1177

00:34:34,605 --> 00:34:33,804

"PART B WAS GOING TO

1178

00:34:35,873 --> 00:34:34,672

"LAST ME LONGER.

1179

00:34:37,608 --> 00:34:35,940

"I CHOSE THAT PART.

1180

00:34:38,642 --> 00:34:37,675

"I DIDN'T TELL MY BOSS.

1181

00:34:40,845 --> 00:34:38,709

"YOU KNOW, I WANTED TO MAKE IT

1182

00:34:43,481 --> 00:34:40,912

"AS ROBUST AS POSSIBLE."

1183

00:34:44,281 --> 00:34:43,548

AND IT'S TRUE-- I THINK

1184

00:34:45,149 --> 00:34:44,348

THE BOSSES KIND OF

1185

00:34:46,617 --> 00:34:45,216

LOOKED A DIFFERENT WAY.

1186

00:34:47,418 --> 00:34:46,684

AS LONG AS IT DIDN'T

1187

00:34:48,786 --> 00:34:47,485

AFFECT THE BUDGET TOO MUCH,

1188

00:34:50,221 --> 00:34:48,853

THE BOSS LOOKED THE OTHER WAY,

1189

00:34:52,523 --> 00:34:50,288

AND VOYAGER WAS BUILT

1190

00:34:53,290 --> 00:34:52,590

AS ROBUSTLY AS POSSIBLE.

1191

00:34:53,924 --> 00:34:53,357

>> WELL, YOU'RE ABSOLUTELY

1192

00:34:57,795 --> 00:34:53,991

RIGHT ABOUT THAT.

1193

00:34:59,930 --> 00:34:57,862

I WAS THE MANAGER OF DIVISION 34

1194

00:35:00,798 --> 00:34:59,997

BEFORE I WENT OVER TO VOYAGER.

1195

00:35:02,233 --> 00:35:00,865

AND WHAT I TOLD THE PEOPLE

1196

00:35:03,901 --> 00:35:02,300

IN DIVISION 34 WAS,

1197

00:35:05,136 --> 00:35:03,968

"LOOK, WE'VE GOT TO BE

1198

00:35:06,604 --> 00:35:05,203

"VERY, VERY SURE THAT WE DON'T

1199

00:35:08,239 --> 00:35:06,671

"BUILD ANYTHING INTO

1200

00:35:09,640 --> 00:35:08,306

"THIS SPACECRAFT DESIGN-WISE

1201

00:35:11,442 --> 00:35:09,707

"THAT'S GOING TO LIMIT ITS LIFE,

1202

00:35:13,043 --> 00:35:11,509

"OTHER THAN THE EXPENDABLES."

1203

00:35:14,178 --> 00:35:13,110

AND WE MADE SOME DESIGN CHANGES

1204

00:35:15,079 --> 00:35:14,245

THAT I NEVER TOLD

1205

00:35:17,481 --> 00:35:15,146

SCHURMEIER ABOUT.

1206

00:35:18,616 --> 00:35:17,548

[LAUGHTER]

1207

00:35:19,283 --> 00:35:18,683

ALONG THOSE LINES.

1208

00:35:20,918 --> 00:35:19,350

>> BUT ONE OF THOSE

1209

00:35:23,587 --> 00:35:20,985

WAS THE SUN SENSOR,

1210

00:35:24,522 --> 00:35:23,654

THE SUN SENSOR AT SATURN--

1211

00:35:26,290 --> 00:35:24,589

YOU'RE DOWN A FACTOR OF 100.

1212

00:35:27,324 --> 00:35:26,357

YOU COULD DESIGN IT FOR THAT,

1213

00:35:28,325 --> 00:35:27,391

AND THEN AS SOON AS YOU LEAVE--

1214

00:35:29,593 --> 00:35:28,392

GO BEYOND SATURN,

1215

00:35:30,528 --> 00:35:29,660

GUESS WHAT-- YOU COULDN'T

1216

00:35:31,195 --> 00:35:30,595

SEE THE SUN ANYMORE.

1217

00:35:33,030 --> 00:35:31,262

SO IN FACT,

1218

00:35:34,365 --> 00:35:33,097

THEY PUT AN OP AMP IN

1219

00:35:37,034 --> 00:35:34,432

TO INCREASE THE GAIN

1220

00:35:40,137 --> 00:35:37,101

SO THAT IN FACT NOW WE'RE ALMOST

1221

00:35:41,071 --> 00:35:40,204

140 ASTRONOMICAL UNITS AWAY,

1222

00:35:42,540 --> 00:35:41,138

AND IT STILL KNOWS

1223

00:35:43,274 --> 00:35:42,607

WHERE THE SUN IS.

1224

00:35:45,242 --> 00:35:43,341

>> SO I THINK THERE'S

1225

00:35:46,343 --> 00:35:45,309

SO MUCH FORESIGHT GIVEN

1226
00:35:47,578 --> 00:35:46,410
BY THE PART OF THE ENGINEERS

1227
00:35:48,612 --> 00:35:47,645
AND THE SCIENTISTS TO SAY,

1228
00:35:50,181 --> 00:35:48,679
"WE WANT TO MAKE THIS

1229
00:35:51,849 --> 00:35:50,248
"AN INTERSTELLAR MISSION."

1230
00:35:53,951 --> 00:35:51,916
AS JOHN SAID, "DON'T DO ANYTHING

1231
00:35:55,152 --> 00:35:54,018
"THAT SCREWS THAT UP,

1232
00:35:56,187 --> 00:35:55,219
"AND DO WHATEVER'S IN YOUR POWER

1233
00:35:57,922 --> 00:35:56,254
"TO MAKE THIS MISSION

1234
00:35:58,822 --> 00:35:57,989
"LAST AS LONG AS POSSIBLE."

1235
00:36:01,592 --> 00:35:58,889
>> YOU KNOW, SUZY,

1236
00:36:04,228 --> 00:36:01,659
I WANTED TO ASK YOU ABOUT--

1237
00:36:05,863 --> 00:36:04,295
AS ENGINEERING, WHAT CAN

1238
00:36:08,399 --> 00:36:05,930

YOU LEARN FROM VOYAGER THAT,

1239

00:36:09,466 --> 00:36:08,466

FOR THESE YOUNG ENGINEERS HERE,

1240

00:36:10,634 --> 00:36:09,533

WHO MAY NOT EVEN--

1241

00:36:11,202 --> 00:36:10,701

WEREN'T BORN--

1242

00:36:11,769 --> 00:36:11,269

>> YEAH, I ALWAYS

1243

00:36:12,736 --> 00:36:11,836

LIKE TO ASK THAT.

1244

00:36:13,370 --> 00:36:12,803

YOU KNOW, AS A SHOW OF HANDS,

1245

00:36:14,705 --> 00:36:13,437

PEOPLE THAT ARE

1246

00:36:17,474 --> 00:36:14,772

ACTUALLY 40 OR UNDER,

1247

00:36:18,842 --> 00:36:17,541

IF YOU WANT TO ADMIT IT.

1248

00:36:21,011 --> 00:36:18,909

ALL RIGHT, HEY, VERY GOOD.

1249

00:36:22,112 --> 00:36:21,078

[APPLAUSE]

1250

00:36:23,347 --> 00:36:22,179

THAT'S GREAT, THAT'S GREAT.

1251
00:36:24,915 --> 00:36:23,414
>> SO YOU KNOW, LET'S TAKE

1252
00:36:27,184 --> 00:36:24,982
A MOMENT HERE AND SEE IF WE CAN

1253
00:36:28,452 --> 00:36:27,251
JUST IMPART SOME WISDOM.

1254
00:36:29,119 --> 00:36:28,519
>> I WILL ADD MY TWO CENTS.

1255
00:36:30,354 --> 00:36:29,186
I'LL ASK CHRIS

1256
00:36:31,755 --> 00:36:30,421
TO ADD HIS IN A MINUTE--

1257
00:36:32,923 --> 00:36:31,822
BECAUSE CHRIS DESIGNED IT,

1258
00:36:34,992 --> 00:36:32,990
AND HE'S NOW COME BACK

1259
00:36:37,194 --> 00:36:35,059
TO HELP US WORK THROUGH

1260
00:36:39,863 --> 00:36:37,261
THE NEXT TEN YEARS

1261
00:36:40,864 --> 00:36:39,930
OF THE MISSION, LET'S SAY.

1262
00:36:41,532 --> 00:36:40,931
BUT I HAVE TWO TAKEAWAYS.

1263
00:36:42,666 --> 00:36:41,599

THE FIRST ONE I KIND OF

1264

00:36:43,801 --> 00:36:42,733

MENTIONED, WAS THE FACT THAT

1265

00:36:45,469 --> 00:36:43,868

THE ENGINEERS DESIGNED IT

1266

00:36:47,338 --> 00:36:45,536

TO BE AS ROBUST AS POSSIBLE.

1267

00:36:48,606 --> 00:36:47,405

I THINK YOU CAN TAKE THAT AWAY

1268

00:36:49,306 --> 00:36:48,673

FOR ANY MISSION

1269

00:36:50,941 --> 00:36:49,373

YOU'RE BUILDING--

1270

00:36:52,910 --> 00:36:51,008

BUT DO YOUR BEST JOB

1271

00:36:54,645 --> 00:36:52,977

AND BUILD IN THE ROBUSTNESS

1272

00:36:57,514 --> 00:36:54,712

TO MAKE THOSE ROVERS

1273

00:36:59,083 --> 00:36:57,581

LAST MORE THAN 90 DAYS,

1274

00:36:59,950 --> 00:36:59,150

LAST MORE THAN 2 YEARS,

1275

00:37:01,885 --> 00:37:00,017

OR WHATEVER MISSION

1276

00:37:04,888 --> 00:37:01,952

YOU'RE WORKING ON.

1277

00:37:08,993 --> 00:37:04,955

SECONDLY, DOCUMENT WHAT YOU DO.

1278

00:37:11,829 --> 00:37:09,060

[LAUGHTER]

1279

00:37:12,696 --> 00:37:11,896

THIS HAS BEEN--

1280

00:37:14,064 --> 00:37:12,763

[APPLAUSE]

1281

00:37:16,634 --> 00:37:14,131

THIS IS WHERE

1282

00:37:21,705 --> 00:37:16,701

CHRIS CAN CHIME IN.

1283

00:37:22,506 --> 00:37:21,772

AS WE ARE INTO THE 41st YEAR

1284

00:37:24,008 --> 00:37:22,573

OF THE VOYAGER MISSION,

1285

00:37:25,843 --> 00:37:24,075

WE ARE TRYING TO GO BACK

1286

00:37:28,545 --> 00:37:25,910

AND LOOK AT WHY DECISIONS

1287

00:37:29,813 --> 00:37:28,612

WERE MADE ON FAULT PROTECTION,

1288

00:37:31,315 --> 00:37:29,880

OR DESIGNS IN THE SOFTWARE,

1289

00:37:33,017 --> 00:37:31,382

AND THINGS LIKE THAT.

1290

00:37:34,885 --> 00:37:33,084

AND OFTENTIMES, YOU CAN ACTUALLY

1291

00:37:35,653 --> 00:37:34,952

FIND THE DECISION,

1292

00:37:36,887 --> 00:37:35,720

BUT YOU CAN'T FIND

1293

00:37:39,089 --> 00:37:36,954

ANY OF THE DISCUSSION

1294

00:37:40,858 --> 00:37:39,156

OF WHY THE DECISION WAS MADE.

1295

00:37:43,394 --> 00:37:40,925

AND WHEN I GO BACK

1296

00:37:44,328 --> 00:37:43,461

AND ASK CHRIS,

1297

00:37:46,930 --> 00:37:44,395

"WHAT DID YOU MEAN WHEN

1298

00:37:50,401 --> 00:37:46,997

"YOU WROTE THIS MEMO IN 1982,"

1299

00:37:51,769 --> 00:37:50,468

AND HE'S LIKE, "UMMM..."

1300

00:37:53,437 --> 00:37:51,836

"LET ME GO SEE WHAT I CAN FIND

1301
00:37:55,306 --> 00:37:53,504
"IN A BOX THAT I'VE SENT OUT

1302
00:37:56,140 --> 00:37:55,373
"TO ARCHIVES," YOU KNOW.

1303
00:37:56,874 --> 00:37:56,207
>> AT LEAST I DOCUMENTED IT.

1304
00:37:58,275 --> 00:37:56,941
>> YEAH.

1305
00:38:02,880 --> 00:37:58,342
[LAUGHTER]

1306
00:38:03,781 --> 00:38:02,947
SO IN THE FURY

1307
00:38:05,582 --> 00:38:03,848
OF GETTING READY TO

1308
00:38:08,052 --> 00:38:05,649
GET A MISSION LAUNCHED,

1309
00:38:09,086 --> 00:38:08,119
YOU'RE DESIGNING THINGS--

1310
00:38:10,554 --> 00:38:09,153
KEEP A RECORD

1311
00:38:11,689 --> 00:38:10,621
OF WHAT YOU DESIGNED.

1312
00:38:12,990 --> 00:38:11,756
KEEP THE RATIONALE.

1313
00:38:15,225 --> 00:38:13,057

KEEP THOSE NOTEBOOKS.

1314

00:38:16,327 --> 00:38:15,292
ED STONE CAN GO IN HIS OFFICE

1315

00:38:17,861 --> 00:38:16,394
AND PULL OUT A NOTEBOOK

1316

00:38:19,129 --> 00:38:17,928
FROM 1979 AND GO TO

1317

00:38:20,764 --> 00:38:19,196
THE EXACT PAGE HE NEEDS

1318

00:38:22,032 --> 00:38:20,831
TO GO TO TO FIND AN ANSWER.

1319

00:38:24,201 --> 00:38:22,099
I DON'T KNOW HOW MANY OF YOU

1320

00:38:25,636 --> 00:38:24,268
COULD DO THAT.

1321

00:38:27,404 --> 00:38:25,703
SO IT'S IMPORTANT

1322

00:38:29,807 --> 00:38:27,471
TO DOCUMENT THE RATIONALE

1323

00:38:31,408 --> 00:38:29,874
FOR DECISIONS, AND IT WILL

1324

00:38:33,510 --> 00:38:31,475
HELP THE PEOPLE

1325

00:38:35,012 --> 00:38:33,577
WHO FLY THE MISSION.

1326
00:38:35,679 --> 00:38:35,079
AND IF YOU'RE A PERSON

1327
00:38:36,747 --> 00:38:35,746
THAT GENERALLY

1328
00:38:38,982 --> 00:38:36,814
JUST BUILDS SPACECRAFT

1329
00:38:40,718 --> 00:38:39,049
AND THEN GOES TO THE NEXT THING

1330
00:38:41,952 --> 00:38:40,785
YOU'RE BUILDING AND YOU'RE NOT

1331
00:38:44,221 --> 00:38:42,019
INVOLVED IN THE OPERATIONS,

1332
00:38:45,456 --> 00:38:44,288
IT'S KEY FOR YOU TO PASS ON

1333
00:38:47,624 --> 00:38:45,523
THAT DEVELOPMENT KNOWLEDGE

1334
00:38:50,160 --> 00:38:47,691
TO THE OPERATIONS PEOPLE.

1335
00:38:52,129 --> 00:38:50,227
YOUR SUCCESS AS A DEVELOPER IS--

1336
00:38:53,197 --> 00:38:52,196
DEPENDS ON THE SUCCESS

1337
00:38:54,498 --> 00:38:53,264
OF THE MISSION GETTING

1338
00:38:56,900 --> 00:38:54,565

THE SCIENCE BACK,

1339

00:38:57,801 --> 00:38:56,967
AND SO YOU NEED TO HELP

1340

00:38:59,370 --> 00:38:57,868
THE OPERATIONS FOLKS

1341

00:39:01,271 --> 00:38:59,437
BY DOING DUE DILIGENCE

1342

00:39:03,841 --> 00:39:01,338
IN THE DEVELOPMENT PHASE.

1343

00:39:04,641 --> 00:39:03,908
>> WHEN WE TAKE ON A NEW TASK--

1344

00:39:06,210 --> 00:39:04,708
AND I DID SOME THINGS THAT

1345

00:39:08,912 --> 00:39:06,277
I NEVER TOLD JOHN ABOUT--

1346

00:39:09,747 --> 00:39:08,979
[LAUGHTER]

1347

00:39:10,848 --> 00:39:09,814
>> HE USED TO WORK FOR ME--

1348

00:39:12,182 --> 00:39:10,915
HE KNEW BETTER.

1349

00:39:13,317 --> 00:39:12,249
[LAUGHTER]

1350

00:39:14,952 --> 00:39:13,384
TO MOVE THE STATE

1351

00:39:17,621 --> 00:39:15,019

OF THE ART FORWARD,

1352

00:39:21,158 --> 00:39:17,688

TO IMPROVE THE SYSTEMS

1353

00:39:22,159 --> 00:39:21,225

THAT WE BUILD SO THAT THEY CAN

1354

00:39:24,294 --> 00:39:22,226

GET THE BEST SCIENCE--

1355

00:39:25,662 --> 00:39:24,361

NOT JUST THE REQUIRED SCIENCE,

1356

00:39:26,463 --> 00:39:25,729

BUT THE BEST SCIENCE.

1357

00:39:27,097 --> 00:39:26,530

THEN, YOU KNOW,

1358

00:39:27,798 --> 00:39:27,164

THERE'S SOME THINGS

1359

00:39:29,700 --> 00:39:27,865

THAT WE COULD BE DOING

1360

00:39:30,634 --> 00:39:29,767

THAT MAKE A LOT OF SENSE.

1361

00:39:33,837 --> 00:39:30,701

I'M NOT TELLING YOU NOT TO

1362

00:39:38,409 --> 00:39:33,904

TELL YOUR BOSS, BUT I THINK

1363

00:39:40,177 --> 00:39:38,476

THERE'S A LOT OF CAPABILITY HERE

1364

00:39:41,445 --> 00:39:40,244

THAT DOESN'T GET EXERCISED

1365

00:39:43,514 --> 00:39:41,512

BECAUSE WE LIMIT OURSELVES

1366

00:39:44,415 --> 00:39:43,581

TO WHAT THE LAST SYSTEM

1367

00:39:50,020 --> 00:39:44,482

LOOKED LIKE.

1368

00:39:50,754 --> 00:39:50,087

[APPLAUSE]

1369

00:39:51,355 --> 00:39:50,821

>> THEY LIKE THAT.

1370

00:39:51,889 --> 00:39:51,422

>> I GUESS.

1371

00:39:52,456 --> 00:39:51,956

>> ANYTHING FROM

1372

00:39:54,591 --> 00:39:52,523

THE SCIENCE SIDE

1373

00:39:55,259 --> 00:39:54,658

FOR YOUNG SCIENTISTS HERE?

1374

00:39:58,729 --> 00:39:55,326

>> WELL, I THINK

1375

00:39:59,663 --> 00:39:58,796

THE INTERESTING THING JPL DOES

1376
00:40:01,365 --> 00:39:59,730
IS MISSIONS THAT GO

1377
00:40:02,466 --> 00:40:01,432
WHERE NOTHING'S BEEN BEFORE,

1378
00:40:03,734 --> 00:40:02,533
DO THINGS THAT HAVEN'T

1379
00:40:04,368 --> 00:40:03,801
BEEN DONE BEFORE.

1380
00:40:05,335 --> 00:40:04,435
THAT'S WHAT SCIENCE

1381
00:40:06,804 --> 00:40:05,402
IS ALL ABOUT,

1382
00:40:07,738 --> 00:40:06,871
IS OBSERVING NATURE

1383
00:40:09,072 --> 00:40:07,805
AND UNDERSTANDING NATURE.

1384
00:40:11,041 --> 00:40:09,139
AND I THINK THAT'S THE--

1385
00:40:12,609 --> 00:40:11,108
AND WHAT'S REQUIRED

1386
00:40:13,410 --> 00:40:12,676
IS AN INVESTMENT.

1387
00:40:15,179 --> 00:40:13,477
IN THE CASE OF VOYAGER,

1388
00:40:18,015 --> 00:40:15,246

WE SPENT FIVE YEARS FROM

1389

00:40:19,983 --> 00:40:18,082

THE START OF PROJECT TO LAUNCH.

1390

00:40:20,717 --> 00:40:20,050

AND NO SCIENCE FOR FIVE YEARS,

1391

00:40:21,618 --> 00:40:20,784

BUT GETTING READY.

1392

00:40:24,688 --> 00:40:21,685

AND THEN WHEN WE FINALLY

1393

00:40:25,856 --> 00:40:24,755

GOT THERE IN 1979, IT WAS JUST

1394

00:40:27,157 --> 00:40:25,923

LOTS AND LOTS OF SCIENCE--

1395

00:40:28,559 --> 00:40:27,224

EXCITING, BUT YOU HAVE

1396

00:40:29,593 --> 00:40:28,626

TO BE PATIENT.

1397

00:40:31,862 --> 00:40:29,660

IT DOESN'T HAPPEN QUICKLY,

1398

00:40:33,764 --> 00:40:31,929

BUT YOU HAVE TO BE PATIENT.

1399

00:40:35,332 --> 00:40:33,831

>> ALL RIGHT, WELL, I THINK

1400

00:40:38,302 --> 00:40:35,399

OUR SPACECRAFT VOYAGER 2

1401
00:40:39,736 --> 00:40:38,369
IS ON ITS WAY NOW TO NEPTUNE.

1402
00:40:43,307 --> 00:40:39,803
LET'S SEE IF WE CAN GO THERE

1403
00:40:43,941 --> 00:40:43,374
AND SEE WHAT HAPPENED.

1404
00:40:45,876 --> 00:40:44,008
>> THE SCIENTISTS

1405
00:40:48,879 --> 00:40:45,943
KNEW THAT THIS WAS

1406
00:40:49,546 --> 00:40:48,946
AN EPIC MAKING EXPERIENCE.

1407
00:40:51,215 --> 00:40:49,613
THEIR KNOWLEDGE

1408
00:40:52,716 --> 00:40:51,282
OF OUR SOLAR SYSTEM

1409
00:40:53,417 --> 00:40:52,783
WAS ADVANCING SO QUICKLY

1410
00:40:54,751 --> 00:40:53,484
JUST BECAUSE OF

1411
00:40:55,385 --> 00:40:54,818
THESE ENCOUNTERS.

1412
00:40:56,920 --> 00:40:55,452
AND I THINK THE SCIENTISTS

1413
00:40:57,955 --> 00:40:56,987

REALIZED THIS.

1414

00:40:58,889 --> 00:40:58,022

THEY GOT CAUGHT UP

1415

00:40:59,690 --> 00:40:58,956

IN THIS ENTHUSIASM.

1416

00:41:01,325 --> 00:40:59,757

THEIR CURIOSITY

1417

00:41:05,696 --> 00:41:01,392

WAS BUBBLING OVER.

1418

00:41:06,530 --> 00:41:05,763

[CHEERING]

1419

00:41:08,332 --> 00:41:06,597

I THINK THAT ULTIMATELY

1420

00:41:08,999 --> 00:41:08,399

WAS ALSO PART OF WHAT DROVE

1421

00:41:10,901 --> 00:41:09,066

THE PUBLIC RESPONSE--

1422

00:41:14,471 --> 00:41:10,968

THAT THE PUBLIC SENSED

1423

00:41:17,774 --> 00:41:14,538

THE SCIENTIFIC EXCITEMENT.

1424

00:41:19,109 --> 00:41:17,841

[MUSIC]

1425

00:41:21,111 --> 00:41:19,176

NEWS CREWS

1426

00:41:21,778 --> 00:41:21,178
START DESCENDING ON JPL.

1427

00:41:22,446 --> 00:41:21,845
YOU START HAVING

1428

00:41:24,648 --> 00:41:22,513
ALL THESE NEWS VANS

1429

00:41:25,949 --> 00:41:24,715
OUT IN THE PARKING LOT.

1430

00:41:27,751 --> 00:41:26,016
YOU HAVE THE PRESS CONFERENCES

1431

00:41:31,221 --> 00:41:27,818
ATTENDED BY HUNDREDS

1432

00:41:32,723 --> 00:41:31,288
OF PEOPLE FROM THE MEDIA.

1433

00:41:34,291 --> 00:41:32,790
>> --RINGS, PERHAPS IN TERMS

1434

00:41:35,125 --> 00:41:34,358
OF PLANETARY FORMATION.

1435

00:41:36,460 --> 00:41:35,192
>> ONE CAN HAVE

1436

00:41:37,995 --> 00:41:36,527
GRAVITATIONAL INSTABILITIES

1437

00:41:38,562 --> 00:41:38,062
WHERE THE RINGS--

1438

00:41:39,696 --> 00:41:38,629

>> --WHICH WAS SOMETHING

1439

00:41:40,964 --> 00:41:39,763
THAT I THINK YOU DIDN'T SEE

1440

00:41:42,032 --> 00:41:41,031
PREVIOUSLY FOR A LOT

1441

00:41:42,933 --> 00:41:42,099
OF SCIENTIFIC EVENTS.

1442

00:41:45,202 --> 00:41:43,000
I THINK THAT'S FAIRLY SAFE

1443

00:41:46,370 --> 00:41:45,269
TO SAY.

1444

00:41:47,504 --> 00:41:46,437
>> NORMALLY MY EXPERIENCE

1445

00:41:48,272 --> 00:41:47,571
HAD BEEN GETTING

1446

00:41:50,274 --> 00:41:48,339
PRESS ATTENTION,

1447

00:41:51,108 --> 00:41:50,341
WANTING TO TELL MY STORY.

1448

00:41:54,077 --> 00:41:51,175
IN THIS CASE, THE PRESS

1449

00:41:55,078 --> 00:41:54,144
WANTED US TO TELL THE STORY.

1450

00:41:56,813 --> 00:41:55,145
>> THEY HAD BECOME, IN A SENSE,

1451
00:41:57,881 --> 00:41:56,880
KIND OF SPACE JUNKIES.

1452
00:41:58,715 --> 00:41:57,948
THEY LIKED THE SPACE PROGRAM,

1453
00:41:59,950 --> 00:41:58,782
THEY KNEW ABOUT IT,

1454
00:42:01,818 --> 00:42:00,017
AND THEY BECAME, IN A SENSE,

1455
00:42:02,719 --> 00:42:01,885
ALMOST FANS OF JPL.

1456
00:42:04,087 --> 00:42:02,786
>> WHAT IS THE ALBEDO

1457
00:42:06,857 --> 00:42:04,154
OF CLEAN ICE THAT IS

1458
00:42:08,659 --> 00:42:06,924
NOT EXACTLY PURELY CLEAN ICE

1459
00:42:10,294 --> 00:42:08,726
AND NOT EXACTLY DIRTY ICE?

1460
00:42:11,695 --> 00:42:10,361
>> TWO ROWS BACK, PLEASE.

1461
00:42:14,031 --> 00:42:11,762
>> DO YOU HAVE A ROUGH HANDLE

1462
00:42:14,831 --> 00:42:14,098
ON WHAT THE ORBITAL PERIOD

1463
00:42:16,934 --> 00:42:14,898

OR THE VELOCITY

1464

00:42:19,236 --> 00:42:17,001

OF A THEORETICAL MOON IN

1465

00:42:19,937 --> 00:42:19,303

THE CASSINI DIVISION WOULD BE?

1466

00:42:20,571 --> 00:42:20,004

>> IN THE SECOND ROW HERE

1467

00:42:21,972 --> 00:42:20,638

THERE'S BEEN A HAND UP

1468

00:42:22,573 --> 00:42:22,039

FOR SOME TIME.

1469

00:42:23,507 --> 00:42:22,640

>> WE SEEM TO BE LOSING

1470

00:42:24,474 --> 00:42:23,574

THE DISTINCTION

1471

00:42:25,809 --> 00:42:24,541

BETWEEN SMALL MOONS

1472

00:42:27,110 --> 00:42:25,876

AND LARGE RING PARTICLES.

1473

00:42:28,245 --> 00:42:27,177

AND I'D LIKE TO KNOW

1474

00:42:29,212 --> 00:42:28,312

IF ANYBODY IS ABLE

1475

00:42:30,547 --> 00:42:29,279

TO COME UP WITH A DEFINITION

1476

00:42:31,214 --> 00:42:30,614
OF WHICH IS WHICH.

1477

00:42:31,915 --> 00:42:31,281
THOSE OF US THAT

1478

00:42:33,951 --> 00:42:31,982
LIKE TO COUNT MOONS

1479

00:42:34,885 --> 00:42:34,018
ARE STARTING TO GET WORRIED.

1480

00:42:37,120 --> 00:42:34,952
>> WITH EACH ENCOUNTER,

1481

00:42:38,822 --> 00:42:37,187
VOYAGER BECAME BETTER KNOWN,

1482

00:42:41,158 --> 00:42:38,889
AND SCIENTISTS AND ENGINEERS

1483

00:42:42,225 --> 00:42:41,225
WERE MORE MEDIA-SAVVY.

1484

00:42:43,460 --> 00:42:42,292
SOME WERE EVEN DOUBLING UP

1485

00:42:44,294 --> 00:42:43,527
AS NEWS ANCHORS.

1486

00:42:46,096 --> 00:42:44,361
>> THIS MORNING WE HAVE

1487

00:42:46,930 --> 00:42:46,163
DR. JAY HOLBERG.

1488

00:42:48,932 --> 00:42:46,997

I JUST GOT ASKED.

1489

00:42:51,602 --> 00:42:48,999

I THINK JPL WAS LOOKING

1490

00:42:52,769 --> 00:42:51,669

FOR A YOUNG FEMALE ENGINEER

1491

00:42:54,271 --> 00:42:52,836

WHO KNEW SOMETHING

1492

00:42:55,339 --> 00:42:54,338

ABOUT THE VOYAGER PROJECT

1493

00:42:57,407 --> 00:42:55,406

AND WHAT VOYAGER

1494

00:42:59,209 --> 00:42:57,474

WAS GOING TO DO.

1495

00:43:01,244 --> 00:42:59,276

>> DODD JOINED THE VOYAGER TEAM

1496

00:43:03,413 --> 00:43:01,311

RIGHT OUT OF COLLEGE.

1497

00:43:04,381 --> 00:43:03,480

SHE HAD MOVED UP THE RANKS

1498

00:43:05,816 --> 00:43:04,448

AND WAS NOW RESPONSIBLE

1499

00:43:07,351 --> 00:43:05,883

FOR THE COMMANDS THAT WOULD

1500

00:43:11,355 --> 00:43:07,418

HAVE VOYAGER EXECUTING

1501
00:43:12,556 --> 00:43:11,422
A DAREDEVIL FLY-BY OF NEPTUNE.

1502
00:43:14,057 --> 00:43:12,623
>> I THOUGHT, "OKAY, MY CAREER

1503
00:43:15,392 --> 00:43:14,124
"IS KIND OF RIDING ON THIS ONE,

1504
00:43:16,393 --> 00:43:15,459
"BECAUSE I BUILT THE CLOSEST

1505
00:43:20,063 --> 00:43:16,460
"APPROACH SEQUENCE.

1506
00:43:21,198 --> 00:43:20,130
"AND IF IT GOES WRONG, IT'S--

1507
00:43:25,736 --> 00:43:21,265
"YOU KNOW, IT COULD BE

1508
00:43:26,970 --> 00:43:25,803
"MY FAULT."

1509
00:43:27,971 --> 00:43:27,037
>> THEN THE GRAVITATIONAL

1510
00:43:29,640 --> 00:43:28,038
FORCE OF THE PLANET

1511
00:43:32,809 --> 00:43:29,707
BENT THE SPACECRAFT DOWNWARDS

1512
00:43:33,844 --> 00:43:32,876
TOWARDS THE FINAL FLY-BY.

1513
00:43:36,013 --> 00:43:33,911

SCIENTISTS WHO WERE ACCUSTOMED

1514

00:43:36,947 --> 00:43:36,080
TO EXTRAORDINARY SIGHTS

1515

00:43:37,748 --> 00:43:37,014
WERE STILL AMAZED

1516

00:43:41,652 --> 00:43:37,815
BY WHAT THEY SAW

1517

00:43:42,753 --> 00:43:41,719
AT NEPTUNE'S MOON, TRITON.

1518

00:43:44,855 --> 00:43:42,820
>> LAST NIGHT WAS CERTAINLY

1519

00:43:46,056 --> 00:43:44,922
A NIGHT TO BE REMEMBERED.

1520

00:43:47,391 --> 00:43:46,123
I THINK IT'S THE MOST EXCITING

1521

00:43:49,159 --> 00:43:47,458
NIGHT THAT I CAN REMEMBER

1522

00:43:50,694 --> 00:43:49,226
FROM ANY OF THE ENCOUNTERS

1523

00:43:51,428 --> 00:43:50,761
THAT WE'VE HAD WITH VOYAGER,

1524

00:43:53,096 --> 00:43:51,495
AND THERE HAVE BEEN

1525

00:43:53,830 --> 00:43:53,163
SOME EXCITING NIGHTS.

1526
00:43:55,632 --> 00:43:53,897
WITHOUT A QUESTION,

1527
00:43:58,101 --> 00:43:55,699
THE IMAGES THAT WERE RETURNED

1528
00:43:59,536 --> 00:43:58,168
THIS MORNING REVEAL A WORLD

1529
00:44:00,771 --> 00:43:59,603
UNLIKE ANY OF THE OTHERS

1530
00:44:09,646 --> 00:44:00,838
THAT WE'VE SEEN.

1531
00:44:12,349 --> 00:44:09,713
[MUSIC]

1532
00:44:13,917 --> 00:44:12,416
>> THESE WERE ERUPTING GEYSERS

1533
00:44:20,857 --> 00:44:13,984
SHOOTING OUT MATERIAL

1534
00:44:21,858 --> 00:44:20,924
MILES INTO SPACE.

1535
00:44:24,895 --> 00:44:21,925
IN OTHER PLACES, THERE WERE

1536
00:44:25,762 --> 00:44:24,962
LAVA-LIKE FLOWS OF ICE,

1537
00:44:27,731 --> 00:44:25,829
ALL OF IT BELIEVED

1538
00:44:32,302 --> 00:44:27,798

CAUSED BY VOLCANIC PROCESSES

1539

00:44:33,470 --> 00:44:32,369

UNDERNEATH TRITON'S SURFACE.

1540

00:44:34,838 --> 00:44:33,537

>> A WORLD AT

1541

00:44:37,741 --> 00:44:34,905

THE VERY, VERY EDGE

1542

00:44:38,442 --> 00:44:37,808

OF THE SOLAR SYSTEM FROZEN.

1543

00:44:39,776 --> 00:44:38,509

WE THOUGHT WOULD BE

1544

00:44:40,677 --> 00:44:39,843

COMPLETELY GEOLOGICALLY DEAD,

1545

00:44:43,380 --> 00:44:40,744

AND IT TURNS OUT TO BE

1546

00:44:48,819 --> 00:44:43,447

GEOLOGICALLY ACTIVE.

1547

00:44:56,326 --> 00:44:48,886

THAT WAS A GREAT SURPRISE.

1548

00:44:57,627 --> 00:44:56,393

[APPLAUSE]

1549

00:45:00,464 --> 00:44:57,694

>> ONCE AGAIN, IT'S A MOON

1550

00:45:01,098 --> 00:45:00,531

THAT STEALS THE SHOW HERE.

1551
00:45:03,133 --> 00:45:01,165
>> YOU KNOW, I REALLY THINK OF

1552
00:45:04,735 --> 00:45:03,200
IO AND TRITON AS THE BOOKENDS

1553
00:45:05,702 --> 00:45:04,802
FOR THE PLANETARY ERA

1554
00:45:07,003 --> 00:45:05,769
OF VOYAGER.

1555
00:45:07,904 --> 00:45:07,070
I MEAN, THE SURPRISES

1556
00:45:09,406 --> 00:45:07,971
AT THE BEGINNING,

1557
00:45:10,040 --> 00:45:09,473
AND EVEN AT THE END.

1558
00:45:13,944 --> 00:45:10,107
THE TEMPERATURE THERE

1559
00:45:15,278 --> 00:45:14,011
WAS -390 DEGREES FAHRENHEIT.

1560
00:45:16,546 --> 00:45:15,345
NITROGEN IS FROZEN SOLID

1561
00:45:18,682 --> 00:45:16,613
IN THE ICY POLAR CAP,

1562
00:45:20,283 --> 00:45:18,749
AND YET, A LITTLE BIT OF HEAT,

1563
00:45:21,518 --> 00:45:20,350

AND PHEW-- YOU GET PLUMES.

1564

00:45:22,486 --> 00:45:21,585

IT'S JUST--

1565

00:45:24,688 --> 00:45:22,553

TOLD US THAT IN FACT,

1566

00:45:25,889 --> 00:45:24,755

NATURE IS MUCH MORE CAPABLE

1567

00:45:28,258 --> 00:45:25,956

THAN WE WOULD'VE IMAGINED,

1568

00:45:30,527 --> 00:45:28,325

GIVEN OUR TERRA-CENTRIC

1569

00:45:31,628 --> 00:45:30,594

VIEW OF PLANETS.

1570

00:45:33,463 --> 00:45:31,695

>> YOU'RE AT THE POINT NOW

1571

00:45:34,464 --> 00:45:33,530

WHERE THIS PART OF

1572

00:45:35,699 --> 00:45:34,531

THE MISSION IS ENDING.

1573

00:45:37,167 --> 00:45:35,766

AND WHEN YOU REFLECTED

1574

00:45:40,704 --> 00:45:37,234

BACK ON IT, WHAT DO YOU THINK

1575

00:45:41,438 --> 00:45:40,771

WERE THE BIGGEST TAKEAWAYS

1576
00:45:42,439 --> 00:45:41,505
TO SHARE WITH THE PUBLIC

1577
00:45:45,208 --> 00:45:42,506
ABOUT THIS

1578
00:45:46,076 --> 00:45:45,275
OUTER PLANET EXPLORATION?

1579
00:45:47,377 --> 00:45:46,143
>> I THINK THAT REALLY,

1580
00:45:48,712 --> 00:45:47,444
IT WAS JUST THE DIVERSITY

1581
00:45:49,679 --> 00:45:48,779
OF BODIES IN THE SOLAR SYSTEM.

1582
00:45:50,747 --> 00:45:49,746
I THINK THAT'S WHAT--

1583
00:45:51,848 --> 00:45:50,814
THEY COULD'VE ALL BEEN

1584
00:45:53,316 --> 00:45:51,915
HEAVILY CRATERED,

1585
00:45:55,118 --> 00:45:53,383
ANCIENT BODIES, BUT IN FACT,

1586
00:45:55,852 --> 00:45:55,185
THAT'S NOT THE WAY IT IS.

1587
00:45:58,221 --> 00:45:55,919
AND TODAY WE KNOW THAT

1588
00:45:59,022 --> 00:45:58,288

THERE ARE OTHER STELLAR

1589

00:46:00,590 --> 00:45:59,089

PLANETARY SYSTEMS, AND THEY'RE

1590

00:46:01,925 --> 00:46:00,657

ALL DIFFERENT THAN OUR SYSTEM.

1591

00:46:03,026 --> 00:46:01,992

SO IT JUST SAYS THAT FROM

1592

00:46:04,227 --> 00:46:03,093

A SCIENCE POINT OF VIEW,

1593

00:46:06,263 --> 00:46:04,294

THERE'S AN ENORMOUS AMOUNT

1594

00:46:07,531 --> 00:46:06,330

TO BE LEARNED ABOUT

1595

00:46:09,232 --> 00:46:07,598

PLANETS, MOONS, RINGS,

1596

00:46:09,933 --> 00:46:09,299

AND MAGNETIC FIELDS.

1597

00:46:10,801 --> 00:46:10,000

THEY WERE ALL DIFFERENT,

1598

00:46:13,303 --> 00:46:10,868

AND WERE DIFFERENT

1599

00:46:13,970 --> 00:46:13,370

THAN WE EXPECTED.

1600

00:46:14,571 --> 00:46:14,037

WE LEARNED A LOT,

1601
00:46:16,006 --> 00:46:14,638
AND THERE'S STILL

1602
00:46:16,773 --> 00:46:16,073
MORE TO BE LEARNED.

1603
00:46:18,608 --> 00:46:16,840
>> AND SUZY, I'M GLAD

1604
00:46:19,376 --> 00:46:18,675
THAT IT WENT WELL,

1605
00:46:20,410 --> 00:46:19,443
YOUR SEQUENCE THERE.

1606
00:46:21,144 --> 00:46:20,477
>> YEAH, I WOULDN'T

1607
00:46:21,978 --> 00:46:21,211
BE SITTING HERE TODAY

1608
00:46:23,647 --> 00:46:22,045
IF IT DIDN'T GO WELL.

1609
00:46:24,815 --> 00:46:23,714
[LAUGHTER]

1610
00:46:26,316 --> 00:46:24,882
YEAH, YEAH, BUT IT WAS--

1611
00:46:27,551 --> 00:46:26,383
YOU KNOW, VOYAGER,

1612
00:46:29,219 --> 00:46:27,618
I THINK MOST PEOPLE

1613
00:46:30,687 --> 00:46:29,286

WHO WORKED ON IT WOULD SAY

1614

00:46:35,025 --> 00:46:30,754

THAT IT'S DEFINITELY UP THERE

1615

00:46:35,926 --> 00:46:35,092

AS A CAREER HIGHLIGHT FOR THEM.

1616

00:46:37,394 --> 00:46:35,993

IT IS FOR ME PERSONALLY,

1617

00:46:39,296 --> 00:46:37,461

AND I JUST FEEL SO FORTUNATE

1618

00:46:40,397 --> 00:46:39,363

THAT I WAS ABLE TO WORK IT

1619

00:46:41,531 --> 00:46:40,464

AT THE BEGINNING OF MY CAREER,

1620

00:46:43,266 --> 00:46:41,598

AND I'M WORKING

1621

00:46:45,802 --> 00:46:43,333

ON THE PROJECT NOW.

1622

00:46:47,704 --> 00:46:45,869

IT MIGHT MAKE IT TO THE END

1623

00:46:48,471 --> 00:46:47,771

OF MY CAREER-- I DON'T KNOW.

1624

00:46:50,040 --> 00:46:48,538

AS I ALWAYS SAY, I'D LIKE

1625

00:46:51,308 --> 00:46:50,107

TO GET VOYAGER TO 50 YEARS.

1626
00:46:52,776 --> 00:46:51,375
PLEASE COME BACK

1627
00:46:53,643 --> 00:46:52,843
IN 10 MORE YEARS.

1628
00:46:54,344 --> 00:46:53,710
[LAUGHTER]

1629
00:46:55,378 --> 00:46:54,411
IT'LL BE HARD,

1630
00:46:57,781 --> 00:46:55,445
BUT CHRIS'LL BE AROUND

1631
00:46:59,015 --> 00:46:57,848
HELPING ME OUT, REMEMBERING

1632
00:47:00,617 --> 00:46:59,082
WHAT MEMOS HE WROTE DOWN

1633
00:47:02,219 --> 00:47:00,684
AND THINGS LIKE THAT.

1634
00:47:03,553 --> 00:47:02,286
BUT VOYAGER'S A GREAT MISSION,

1635
00:47:04,821 --> 00:47:03,620
AND I THINK MOST OF THE PEOPLE

1636
00:47:05,622 --> 00:47:04,888
THAT HAVE WORKED ON IT,

1637
00:47:06,690 --> 00:47:05,689
AND THE ONES THAT ARE

1638
00:47:07,490 --> 00:47:06,757

STILL WORKING ON IT TODAY,

1639

00:47:09,559 --> 00:47:07,557

FEEL VERY FORTUNATE

1640

00:47:10,493 --> 00:47:09,626

TO HAVE BEEN INVOLVED WITH IT,

1641

00:47:13,230 --> 00:47:10,560

AND TO BE INVOLVED

1642

00:47:16,233 --> 00:47:13,297

WITH DR. STONE.

1643

00:47:17,100 --> 00:47:16,300

>> AND APPRECIATE YOUR TIME

1644

00:47:18,501 --> 00:47:17,167

IN FRONT OF THE MEDIA THERE,

1645

00:47:19,636 --> 00:47:18,568

BEING A BROADCASTER.

1646

00:47:20,237 --> 00:47:19,703

[LAUGHTER]

1647

00:47:21,104 --> 00:47:20,304

AND I WANTED TO

1648

00:47:23,139 --> 00:47:21,171

TALK A LITTLE BIT

1649

00:47:23,874 --> 00:47:23,206

ABOUT THE PUBLIC AND THE MEDIA.

1650

00:47:25,375 --> 00:47:23,941

I WAS READING TODAY IN

1651
00:47:27,444 --> 00:47:25,442
THE "NEW YORK TIMES" AN ARTICLE

1652
00:47:30,013 --> 00:47:27,511
BY ONE OF THESE REPORTERS

1653
00:47:30,981 --> 00:47:30,080
WHO CAME OUT HERE-- WE LIVE

1654
00:47:32,649 --> 00:47:31,048
IN A DIFFERENT WORLD NOW,

1655
00:47:33,550 --> 00:47:32,716
BUT BACK THEN,

1656
00:47:35,785 --> 00:47:33,617
THEY WOULD COME TOGETHER,

1657
00:47:37,754 --> 00:47:35,852
AND BECAME ALMOST LIKE

1658
00:47:38,555 --> 00:47:37,821
A VETERANS GROUP

1659
00:47:39,589 --> 00:47:38,622
THAT WOULD GET TOGETHER

1660
00:47:41,625 --> 00:47:39,656
EVERY FEW YEARS

1661
00:47:43,727 --> 00:47:41,692
TO HAVE THESE REUNIONS.

1662
00:47:45,328 --> 00:47:43,794
AND FOR THE PUBLIC ITSELF,

1663
00:47:46,963 --> 00:47:45,395

I THINK THE VOYAGER RECORD,

1664

00:47:49,799 --> 00:47:47,030

JOHN, THAT I KNOW

1665

00:47:51,801 --> 00:47:49,866

YOU WERE INSPIRED BY WHAT

1666

00:47:52,836 --> 00:47:51,868

THE PIONEER MISSION HAD DONE--

1667

00:47:54,271 --> 00:47:52,903

THEY'D STARTED THAT OFF.

1668

00:47:55,538 --> 00:47:54,338

BUT TELL US A LITTLE BIT

1669

00:47:58,375 --> 00:47:55,605

ABOUT WHY YOU DECIDED

1670

00:47:59,976 --> 00:47:58,442

TO HAVE SOMETHING DONE

1671

00:48:01,978 --> 00:48:00,043

ON THIS SPACECRAFT THAT ENDED UP

1672

00:48:02,779 --> 00:48:02,045

BEING THE VOYAGER RECORD.

1673

00:48:03,647 --> 00:48:02,846

THAT'S-- THAT'S JOHN,

1674

00:48:06,016 --> 00:48:03,714

BY THE WAY.

1675

00:48:07,784 --> 00:48:06,083

[LAUGHING]

1676
00:48:08,852 --> 00:48:07,851
>> YEAH, THAT IS JOHN.

1677
00:48:11,554 --> 00:48:08,919
WELL, I--

1678
00:48:13,623 --> 00:48:11,621
[LAUGHTER]

1679
00:48:16,726 --> 00:48:13,690
I REMEMBER VERY CLEARLY

1680
00:48:18,361 --> 00:48:16,793
THE EVENT THAT HAPPENED

1681
00:48:19,696 --> 00:48:18,428
WITH PIONEER-10,

1682
00:48:21,298 --> 00:48:19,763
WHERE CARL AND SOME OTHERS

1683
00:48:22,399 --> 00:48:21,365
HAD PUT A PLAQUE--

1684
00:48:23,600 --> 00:48:22,466
CARL SAGAN HAD PUT A PLAQUE

1685
00:48:25,435 --> 00:48:23,667
ON THE SIDE OF THE SPACECRAFT

1686
00:48:26,937 --> 00:48:25,502
THAT SHOWED THE OUTLINE--

1687
00:48:29,639 --> 00:48:27,004
JUST THE OUTLINE FORM OF HUMANS,

1688
00:48:30,607 --> 00:48:29,706

MALE AND FEMALE--

1689

00:48:32,309 --> 00:48:30,674
NAKED, BUT THERE WASN'T

1690

00:48:34,911 --> 00:48:32,376
ANY MUCH TO SEE, BUT--

1691

00:48:36,413 --> 00:48:34,978
[LAUGHTER]

1692

00:48:38,581 --> 00:48:36,480
>> [INDISTINCT].

1693

00:48:40,684 --> 00:48:38,648
>> YEAH.

1694

00:48:42,719 --> 00:48:40,751
SO ANYHOW, BUT IT CREATED

1695

00:48:43,586 --> 00:48:42,786
SUCH A STIR AMONG THE PUBLIC

1696

00:48:45,422 --> 00:48:43,653
AND IN THE PRESS,

1697

00:48:46,690 --> 00:48:45,489
AND, YOU KNOW, THE COMMENT

1698

00:48:48,558 --> 00:48:46,757
WITH SOMEBODY SAID NASA

1699

00:48:49,793 --> 00:48:48,625
WAS SENDING SMUT INTO SPACE,

1700

00:48:51,361 --> 00:48:49,860
AND ALL THAT KIND OF STUFF.

1701
00:48:53,363 --> 00:48:51,428
BUT YOU KNOW, TO ME,

1702
00:48:54,564 --> 00:48:53,430
IT REPRESENTED

1703
00:48:56,533 --> 00:48:54,631
A REAL CONNECTION BETWEEN

1704
00:48:57,167 --> 00:48:56,600
THE PROJECT AND THE PUBLIC.

1705
00:48:58,268 --> 00:48:57,234
AND AFTER ALL,

1706
00:49:00,337 --> 00:48:58,335
THE PUBLIC IS THE PEOPLE

1707
00:49:01,171 --> 00:49:00,404
THAT PAY FOR THIS, RIGHT?

1708
00:49:02,238 --> 00:49:01,238
ED ALWAYS USED TO SAY,

1709
00:49:03,540 --> 00:49:02,305
"WE'VE GOT TO HAVE MISSIONS

1710
00:49:04,574 --> 00:49:03,607
"THAT ARE PUBLICLY ENGAGING,

1711
00:49:06,710 --> 00:49:04,641
"NOT JUST SCIENTIFICALLY

1712
00:49:07,344 --> 00:49:06,777
"WORTHWHILE."

1713
00:49:09,245 --> 00:49:07,411

I REMEMBER WHEN I WAS

1714

00:49:10,513 --> 00:49:09,312
MANAGING DIVISION 34,

1715

00:49:11,381 --> 00:49:10,580
THERE WAS A--

1716

00:49:12,549 --> 00:49:11,448
I WASN'T ON THE PROJECT YET,

1717

00:49:13,950 --> 00:49:12,616
BUT WE WERE PROVIDING

1718

00:49:16,019 --> 00:49:14,017
HARDWARE FOR THE PROJECT,

1719

00:49:16,753 --> 00:49:16,086
AND THERE WAS SOME REVIEW

1720

00:49:18,888 --> 00:49:16,820
I WAS SETTING UP,

1721

00:49:19,723 --> 00:49:18,955
AND I ASKED THE QUESTION,

1722

00:49:20,957 --> 00:49:19,790
"ARE YOU GUYS GOING TO PUT

1723

00:49:22,559 --> 00:49:21,024
"ANYTHING ON THE SPACECRAFT?"

1724

00:49:23,760 --> 00:49:22,626
AND THEY SAID, "WHAT?"

1725

00:49:24,427 --> 00:49:23,827
THEY SAID, "WHAT FOR?"

1726
00:49:25,161 --> 00:49:24,494
I SAID, "WELL,

1727
00:49:26,763 --> 00:49:25,228
"TO SEND A MESSAGE."

1728
00:49:27,464 --> 00:49:26,830
AND THEY SAID, "NO."

1729
00:49:28,631 --> 00:49:27,531
BUT THEN I GOT TO BE

1730
00:49:31,368 --> 00:49:28,698
PROJECT MANAGER.

1731
00:49:33,169 --> 00:49:31,435
[LAUGHTER]

1732
00:49:33,970 --> 00:49:33,236
AND SO REMEMBERING

1733
00:49:35,405 --> 00:49:34,037
THE PIONEER THING,

1734
00:49:36,940 --> 00:49:35,472
CARL SAGAN WAS ON THE PROJECT

1735
00:49:37,874 --> 00:49:37,007
AT THAT TIME.

1736
00:49:38,775 --> 00:49:37,941
AND HE WAS A PRETTY GOOD

1737
00:49:39,976 --> 00:49:38,842
FRIEND OF MINE, AND SO

1738
00:49:42,746 --> 00:49:40,043

I CALLED HIM UP ONE DAY

1739

00:49:43,413 --> 00:49:42,813

AND SAID, "HEY, CARL, YOU KNOW,

1740

00:49:44,381 --> 00:49:43,480

"WE NEED TO HAVE SOMETHING

1741

00:49:44,948 --> 00:49:44,448

"ON THIS SPACECRAFT.

1742

00:49:46,249 --> 00:49:45,015

"ARE YOU WILLING TO

1743

00:49:48,118 --> 00:49:46,316

"TAKE A CRACK AT IT?"

1744

00:49:48,852 --> 00:49:48,185

HE SAID, "ABSOLUTELY, YES."

1745

00:49:50,720 --> 00:49:48,919

I SAID, "GIVE ME A PROPOSAL."

1746

00:49:51,788 --> 00:49:50,787

HE CAME BACK WITH 25K

1747

00:49:52,756 --> 00:49:51,855

AND THREE OR FOUR PEOPLE THAT

1748

00:49:53,823 --> 00:49:52,823

HE WAS GOING TO PUT TOGETHER

1749

00:49:55,492 --> 00:49:53,890

AS A TEAM, AND THEY HAD SORT OF

1750

00:49:56,459 --> 00:49:55,559

A GENERAL OUTLINE.

1751
00:49:57,660 --> 00:49:56,526
AND I SAID,

1752
00:50:00,096 --> 00:49:57,727
"GOOD, GO AHEAD WITH IT."

1753
00:50:00,964 --> 00:50:00,163
AND SO OUT OF THAT

1754
00:50:02,065 --> 00:50:01,031
CAME THE RECORD.

1755
00:50:02,766 --> 00:50:02,132
AND I THINK THE RECORD

1756
00:50:03,500 --> 00:50:02,833
IS TREMENDOUS.

1757
00:50:04,801 --> 00:50:03,567
WE HAD THREE THINGS

1758
00:50:05,835 --> 00:50:04,868
ON THAT SPACECRAFT THAT WERE

1759
00:50:07,370 --> 00:50:05,902
ALL MESSAGES TO THREE DIFFERENT

1760
00:50:08,171 --> 00:50:07,437
GROUPS OF PEOPLE.

1761
00:50:09,539 --> 00:50:08,238
ONE, WE GOT EVERYBODY

1762
00:50:10,540 --> 00:50:09,606
WHO WAS WORKING ON THE PROJECT,

1763
00:50:12,042 --> 00:50:10,607

AND ALL OF OUR FAMILIES

1764

00:50:13,610 --> 00:50:12,109

AND SIGNIFICANT OTHERS--

1765

00:50:16,079 --> 00:50:13,677

THERE WERE 6,000.

1766

00:50:17,013 --> 00:50:16,146

WE HAD A BIG FAMILY DAY.

1767

00:50:18,415 --> 00:50:17,080

SPACECRAFT WAS IN

1768

00:50:20,250 --> 00:50:18,482

THE THERMAL VAC CHAMBER.

1769

00:50:20,950 --> 00:50:20,317

WE HAD TABLES SET UP OUTSIDE

1770

00:50:22,519 --> 00:50:21,017

WHERE PEOPLE COULD

1771

00:50:24,554 --> 00:50:22,586

WRITE THEIR NAME.

1772

00:50:25,989 --> 00:50:24,621

AND WE HAD 6,000 SIGNATURES,

1773

00:50:28,324 --> 00:50:26,056

AND WE PHOTOGRAPHICALLY

1774

00:50:29,592 --> 00:50:28,391

REDUCED THEM TO A LITTLE 6 X 9

1775

00:50:31,394 --> 00:50:29,659

ALUMINUM FOIL, AND THEY WENT

1776
00:50:32,762 --> 00:50:31,461
INTO THE THERMAL BLANKET.

1777
00:50:33,430 --> 00:50:32,829
SO THAT WAS A MESSAGE,

1778
00:50:35,698 --> 00:50:33,497
AND IT WAS A MESSAGE

1779
00:50:37,400 --> 00:50:35,765
TO THE PEOPLE THAT WE'RE

1780
00:50:38,968 --> 00:50:37,467
ACKNOWLEDGING YOUR CONTRIBUTION

1781
00:50:40,370 --> 00:50:39,035
BY PUTTING YOUR NAME

1782
00:50:41,337 --> 00:50:40,437
OR THE NAME OF YOUR FAMILY

1783
00:50:42,338 --> 00:50:41,404
AND FRIENDS ON IT.

1784
00:50:42,972 --> 00:50:42,405
SO THAT WAS ONE.

1785
00:50:43,740 --> 00:50:43,039
THE OTHER ONE

1786
00:50:44,541 --> 00:50:43,807
WAS THE AMERICAN FLAG.

1787
00:50:45,341 --> 00:50:44,608
THE AMERICAN FLAG

1788
00:50:47,010 --> 00:50:45,408

WAS ACKNOWLEDGEMENT

1789

00:50:47,811 --> 00:50:47,077
TO THE TAXPAYERS.

1790

00:50:49,913 --> 00:50:47,878
WE RECOGNIZE YOU,

1791

00:50:51,214 --> 00:50:49,980
WE RECOGNIZE THIS COUNTRY

1792

00:50:52,816 --> 00:50:51,281
AND THE DEDICATION OF EVERYBODY

1793

00:50:54,084 --> 00:50:52,883
IN THE COUNTRY WHO SUPPORTED IT.

1794

00:50:55,752 --> 00:50:54,151
AND THE THIRD MESSAGE

1795

00:50:57,087 --> 00:50:55,819
WAS THE MESSAGE THAT CARL SENT,

1796

00:50:58,655 --> 00:50:57,154
YOU KNOW, WHICH WAS NOT ONLY

1797

00:51:00,123 --> 00:50:58,722
A MESSAGE TO THE ALIENS,

1798

00:51:02,659 --> 00:51:00,190
IF THERE EVER WERE ANY,

1799

00:51:03,493 --> 00:51:02,726
BUT IT WAS ALSO A MESSAGE--

1800

00:51:04,461 --> 00:51:03,560
HE WAS, I THINK,

1801
00:51:05,995 --> 00:51:04,528
TRYING TO STIMULATE

1802
00:51:07,163 --> 00:51:06,062
PEOPLE ON THE EARTH

1803
00:51:08,565 --> 00:51:07,230
TO THINK ABOUT HOW YOU WOULD

1804
00:51:11,067 --> 00:51:08,632
GO ABOUT COMMUNICATING

1805
00:51:13,770 --> 00:51:11,134
WITH A TOTALLY FOREIGN SOCIETY

1806
00:51:14,504 --> 00:51:13,837
OR A TOTALLY ALIEN CULTURE.

1807
00:51:15,638 --> 00:51:14,571
AND THERE WAS-- A LOT OF THAT

1808
00:51:16,339 --> 00:51:15,705
WAS EMBEDDED IN THE MESSAGE.

1809
00:51:17,440 --> 00:51:16,406
>> HOW WE DEFINE OURSELVES.

1810
00:51:18,308 --> 00:51:17,507
>> AND HOW WE DEFINE

1811
00:51:20,009 --> 00:51:18,375
OURSELVES, YEAH.

1812
00:51:21,144 --> 00:51:20,076
>> I WAS GOING TO ADD THAT

1813
00:51:22,579 --> 00:51:21,211

AS A PROJECT MANAGER TODAY,

1814

00:51:23,480 --> 00:51:22,646

WE GET LOTS--

1815

00:51:24,547 --> 00:51:23,547

AND I'M SURE ED DOES, TOO--

1816

00:51:26,116 --> 00:51:24,614

GET LOTS OF EMAILS

1817

00:51:27,417 --> 00:51:26,183

FROM ALL OVER THE WORLD--

1818

00:51:28,585 --> 00:51:27,484

BOTH CONGRATULATIONS

1819

00:51:29,385 --> 00:51:28,652

ABOUT THE GREAT SCIENCE

1820

00:51:31,254 --> 00:51:29,452

THAT VOYAGER DOES,

1821

00:51:32,455 --> 00:51:31,321

BUT ALSO CONGRATULATIONS

1822

00:51:34,357 --> 00:51:32,522

THAT THERE'S THIS GOLD RECORD,

1823

00:51:36,926 --> 00:51:34,424

THAT THERE'S THIS TIME CAPSULE

1824

00:51:37,727 --> 00:51:36,993

WE'RE SENDING OUT THERE.

1825

00:51:38,862 --> 00:51:37,794

THAT REALLY RESONATES

1826
00:51:41,831 --> 00:51:38,929
WITH THE GENERAL PUBLIC,

1827
00:51:44,000 --> 00:51:41,898
AND I THINK THAT'S WHAT MAKES

1828
00:51:45,969 --> 00:51:44,067
VOYAGER SO WORLD-RENOWNED

1829
00:51:47,871 --> 00:51:46,036
AND KNOWN BY EVERYBODY.

1830
00:51:50,140 --> 00:51:47,938
>> YEAH, I ALWAYS LIKE TO SAY

1831
00:51:51,708 --> 00:51:50,207
THAT THE TWO VOYAGERS,

1832
00:51:53,076 --> 00:51:51,775
AFTER THEY FINISH THEIR CURRENT

1833
00:51:53,943 --> 00:51:53,143
INTERSTELLAR MISSION,

1834
00:51:55,078 --> 00:51:54,010
WILL BE ORBITING

1835
00:51:56,779 --> 00:51:55,145
THE MILKY WAY GALAXY

1836
00:51:57,780 --> 00:51:56,846
FOR BILLIONS OF YEARS.

1837
00:51:58,448 --> 00:51:57,847
AND THEY'LL BE OUR--

1838
00:52:00,850 --> 00:51:58,515

THEY'LL BE EARTH'S

1839

00:52:02,986 --> 00:52:00,917

SILENT AMBASSADORS,

1840

00:52:04,320 --> 00:52:03,053

AND THE GOLDEN RECORD IS SORT OF

1841

00:52:05,955 --> 00:52:04,387

THE CALLING CARD CARRIED BY

1842

00:52:06,623 --> 00:52:06,022

THOSE SILENT AMBASSADORS.

1843

00:52:07,557 --> 00:52:06,690

SO THIS IS

1844

00:52:08,691 --> 00:52:07,624

A VERY INSPIRING THING

1845

00:52:09,559 --> 00:52:08,758

FOR THE PUBLIC AT LARGE,

1846

00:52:10,527 --> 00:52:09,626

IT TURNS OUT.

1847

00:52:11,628 --> 00:52:10,594

>> YEAH, THE SPACECRAFT

1848

00:52:13,563 --> 00:52:11,695

WILL WATCH-- THEY'LL LAST

1849

00:52:15,632 --> 00:52:13,630

LONGER THAN OUR PLANET

1850

00:52:17,200 --> 00:52:15,699

AND OUR STAR, SO...

1851
00:52:18,568 --> 00:52:17,267
>> IT'S JUST LIKE THE FINAL

1852
00:52:20,203 --> 00:52:18,635
PICTURE OF LOOKING BACK

1853
00:52:21,171 --> 00:52:20,270
ON THE SOLAR SYSTEM.

1854
00:52:22,906 --> 00:52:21,238
IT HAS ABSOLUTELY

1855
00:52:24,474 --> 00:52:22,973
NO SCIENTIFIC VALUE, BUT IT IS

1856
00:52:26,809 --> 00:52:24,541
A TREMENDOUS SIGNIFICANCE,

1857
00:52:28,811 --> 00:52:26,876
YOU KNOW, OF PERSPECTIVE.

1858
00:52:29,646 --> 00:52:28,878
AND THEY-- THE GOLDEN RECORD

1859
00:52:30,380 --> 00:52:29,713
IS THE SAME WAY.

1860
00:52:32,015 --> 00:52:30,447
THERE'S NO SCIENCE VALUE

1861
00:52:34,384 --> 00:52:32,082
IN THAT, BUT IT'S A CONNECTION

1862
00:52:35,118 --> 00:52:34,451
TO PEOPLE.

1863
00:52:36,519 --> 00:52:35,185

YOU KNOW, UNDERNEATH IT ALL

1864

00:52:38,821 --> 00:52:36,586

IS THE PEOPLE IN THIS ROOM,

1865

00:52:39,589 --> 00:52:38,888

AND THE THOUSANDS BEHIND THEM.

1866

00:52:41,224 --> 00:52:39,656

>> THAT'S THE GREAT ENGINEERING.

1867

00:52:41,958 --> 00:52:41,291

>> YES, AND IT'S

1868

00:52:42,559 --> 00:52:42,025

NOT ONLY ENGINEERING.

1869

00:52:43,359 --> 00:52:42,626

IT'S COMMITMENT,

1870

00:52:45,528 --> 00:52:43,426

AND DEDICATION,

1871

00:52:46,229 --> 00:52:45,595

AND PERSEVERANCE, AND--

1872

00:52:46,896 --> 00:52:46,296

I WAS THINKING

1873

00:52:47,897 --> 00:52:46,963

WHEN YOU WERE ASKING

1874

00:52:49,065 --> 00:52:47,964

ONE OF THE LAST SENTENCE--

1875

00:52:51,901 --> 00:52:49,132

WE HAD ANOTHER KIND OF

1876
00:52:52,735 --> 00:52:51,968
A MASCOT MOTTO ON VOYAGER.

1877
00:52:55,004 --> 00:52:52,802
IT WAS AN IMAGE,

1878
00:52:56,139 --> 00:52:55,071
A CARTOON IMAGE OF A BIRD.

1879
00:52:57,173 --> 00:52:56,206
I THINK IT WAS A PELICAN,

1880
00:52:58,741 --> 00:52:57,240
OR SOMETHING, AND IN FRONT

1881
00:52:59,842 --> 00:52:58,808
OF THE PELICAN WAS A FROG.

1882
00:53:01,311 --> 00:52:59,909
AND THE FROG HAD ITS FRONT LEGS

1883
00:53:02,145 --> 00:53:01,378
AROUND THE NECK OF THE PELICAN,

1884
00:53:03,880 --> 00:53:02,212
AND THE PELICAN HAD

1885
00:53:06,015 --> 00:53:03,947
THE FROG'S HEAD IN ITS MOUTH.

1886
00:53:07,317 --> 00:53:06,082
AND THE CAPTION WAS,

1887
00:53:09,018 --> 00:53:07,384
"DON'T EVER GIVE UP."

1888
00:53:10,019 --> 00:53:09,085

[LAUGHTER]

1889

00:53:10,987 --> 00:53:10,086

AND THAT WAS

1890

00:53:13,289 --> 00:53:11,054

A REMINDER TO ALL OF US,

1891

00:53:15,091 --> 00:53:13,356

YOU KNOW, BUT THERE WERE

1892

00:53:16,259 --> 00:53:15,158

EXAMPLES OF THAT.

1893

00:53:17,293 --> 00:53:16,326

THE UNSTICKING

1894

00:53:18,061 --> 00:53:17,360

OF THE SCAN PLATFORM.

1895

00:53:19,062 --> 00:53:18,128

IT LOOKED LIKE IT WAS

1896

00:53:20,230 --> 00:53:19,129

OVER THERE FOR A WHILE,

1897

00:53:21,297 --> 00:53:20,297

BUT A COUPLE OF GUYS SAID, "NO,

1898

00:53:22,699 --> 00:53:21,364

"LET'S KEEP WORKING ON THIS."

1899

00:53:24,234 --> 00:53:22,766

AND THEN THE RECOVERY

1900

00:53:25,568 --> 00:53:24,301

FROM THE FAILED TRACKING

1901
00:53:27,570 --> 00:53:25,635
LOOP CAPACITOR ON ONE OF

1902
00:53:28,871 --> 00:53:27,637
THE RADIO, WHERE THE DSN GUYS

1903
00:53:30,373 --> 00:53:28,938
CAME IN WITH A PROGRAMMABLE

1904
00:53:31,975 --> 00:53:30,440
VCO OR SOMETHING

1905
00:53:33,476 --> 00:53:32,042
THAT WE COULD MATCH THE--

1906
00:53:35,078 --> 00:53:33,543
WHATEVER THE RECEIVER WAS DOING

1907
00:53:36,913 --> 00:53:35,145
FROM THE GROUND BASED ON,

1908
00:53:39,816 --> 00:53:36,980
YOU KNOW, TRAJECTORY ANALYSIS

1909
00:53:41,884 --> 00:53:39,883
AND EVERYTHING LIKE THAT.

1910
00:53:43,186 --> 00:53:41,951
>> WELL, WE NEED TO MOVE INTO

1911
00:53:45,455 --> 00:53:43,253
THE NEXT PHASE OF THE MISSION,

1912
00:53:46,322 --> 00:53:45,522
WHICH IS HISTORIC ALSO,

1913
00:53:50,927 --> 00:53:46,389

AND THE FIRST

1914

00:53:52,895 --> 00:53:50,994

INTERSTELLAR OBJECT EVER

1915

00:53:53,663 --> 00:53:52,962

IN THE HISTORY OF HUMANKIND.

1916

00:53:54,897 --> 00:53:53,730

>> YES, THE SUN

1917

00:53:56,699 --> 00:53:54,964

PROTECTS ALL THE PLANETS

1918

00:53:57,567 --> 00:53:56,766

WITH THAT SOLAR WIND--

1919

00:53:59,469 --> 00:53:57,634

A MILLION MILE PER HOUR WIND

1920

00:54:01,170 --> 00:53:59,536

CREATES A HUGE PLASMA BUBBLE

1921

00:54:02,739 --> 00:54:01,237

AROUND THE SUN ITSELF.

1922

00:54:04,741 --> 00:54:02,806

AND THE BUBBLE ENVELOPS

1923

00:54:06,476 --> 00:54:04,808

ALL OF THE PLANETS WE FLEW BY,

1924

00:54:07,543 --> 00:54:06,543

AND WE HAD NO IDEA

1925

00:54:08,344 --> 00:54:07,610

HOW BIG THE BUBBLE WAS.

1926
00:54:10,246 --> 00:54:08,411
WE HAD AN IDEA, BUT WE DIDN'T

1927
00:54:11,814 --> 00:54:10,313
HAVE VERY ACCURATE--

1928
00:54:12,582 --> 00:54:11,881
SO WE DIDN'T KNOW HOW LONG

1929
00:54:13,616 --> 00:54:12,649
IT WOULD TAKE TO GET THERE,

1930
00:54:14,851 --> 00:54:13,683
WE DIDN'T KNOW HOW LONG

1931
00:54:16,286 --> 00:54:14,918
SPACECRAFT COULD LAUNCH.

1932
00:54:17,520 --> 00:54:16,353
AFTER ALL, THE SPACE AGE ITSELF

1933
00:54:18,521 --> 00:54:17,587
WAS ONLY 20 YEARS OLD

1934
00:54:19,656 --> 00:54:18,588
WHEN VOYAGER LAUNCHED.

1935
00:54:20,556 --> 00:54:19,723
SO THERE WAS

1936
00:54:21,357 --> 00:54:20,623
NO EMPIRICAL EVIDENCE

1937
00:54:23,226 --> 00:54:21,424
THAT ANYTHING COULD LAST

1938
00:54:24,360 --> 00:54:23,293

30 OR 40 YEARS.

1939

00:54:26,296 --> 00:54:24,427

BUT IN FACT, VOYAGER 1

1940

00:54:27,030 --> 00:54:26,363

DID LEAVE THE SOLAR BUBBLE,

1941

00:54:28,898 --> 00:54:27,097

THE HELIOSPHERE,

1942

00:54:30,366 --> 00:54:28,965

IN AUGUST OF 2012

1943

00:54:32,035 --> 00:54:30,433

AND IS NOW EXPLORING

1944

00:54:32,902 --> 00:54:32,102

NEARBY INTERSTELLAR SPACE,

1945

00:54:34,437 --> 00:54:32,969

WHERE THE MATERIAL

1946

00:54:35,838 --> 00:54:34,504

COMES FROM OTHER STARS

1947

00:54:36,806 --> 00:54:35,905

THAN OUR SUN

1948

00:54:37,740 --> 00:54:36,873

AND WHERE THE MAGNETIC FIELD

1949

00:54:39,008 --> 00:54:37,807

IS THE MAGNETIC FIELD

1950

00:54:40,143 --> 00:54:39,075

OF THE MILKY WAY GALAXY,

1951

00:54:41,210 --> 00:54:40,210

WHICH IS BEING WRAPPED

1952

00:54:43,146 --> 00:54:41,277

AROUND THE OUTSIDE OF

1953

00:54:44,247 --> 00:54:43,213

THE HELIOSPHERIC BUBBLE.

1954

00:54:45,682 --> 00:54:44,314

SO-- AND WHAT WE'VE

1955

00:54:46,649 --> 00:54:45,749

DISCOVERED OUT THERE IS THAT

1956

00:54:47,784 --> 00:54:46,716

THE COSMIC RAYS,

1957

00:54:49,852 --> 00:54:47,851

WHICH WE MEASURE HERE ON EARTH,

1958

00:54:51,888 --> 00:54:49,919

ARE MORE THAN FOUR TIMES

1959

00:54:52,755 --> 00:54:51,955

MORE INTENSE OUTSIDE.

1960

00:54:54,057 --> 00:54:52,822

WE DIDN'T KNOW HOW MANY WERE--

1961

00:54:54,824 --> 00:54:54,124

WHAT THE RADIATION

1962

00:54:55,892 --> 00:54:54,891

ENVIRONMENT WAS LIKE.

1963

00:54:57,160 --> 00:54:55,959

IT COULD'VE BEEN HUNDREDS

1964

00:54:58,328 --> 00:54:57,227

OF THOUSANDS OF TIMES WORSE.

1965

00:54:59,462 --> 00:54:58,395

TURNS OUT IT'S ONLY

1966

00:55:01,497 --> 00:54:59,529

FOUR TIMES WORSE THAN IT IS

1967

00:55:04,534 --> 00:55:01,564

HERE ON EARTH.

1968

00:55:05,768 --> 00:55:04,601

AND WE WILL BE STUDYING THAT

1969

00:55:07,970 --> 00:55:05,835

ASPECT OF INTERSTELLAR SPACE

1970

00:55:09,806 --> 00:55:08,037

AS WELL IN THE REMAINING LIFE

1971

00:55:11,040 --> 00:55:09,873

THAT VOYAGER HAS

1972

00:55:13,476 --> 00:55:11,107

WITH ITS RADIOISOTOPE

1973

00:55:14,377 --> 00:55:13,543

THERMOELECTRIC GENERATORS.

1974

00:55:17,447 --> 00:55:14,444

>> I'D LIKE TO CLOSE OUT

1975

00:55:19,749 --> 00:55:17,514

BY ACTUALLY HAVING A SENSE

1976
00:55:22,085 --> 00:55:19,816
OF WHERE-- WHAT IT WOULD BE LIKE

1977
00:55:24,821 --> 00:55:22,152
IF WE WERE ON VOYAGER,

1978
00:55:26,789 --> 00:55:24,888
AND LOOKING BACK AT US.

1979
00:55:27,724 --> 00:55:26,856
AND I ALWAYS WONDERED ABOUT

1980
00:55:28,725 --> 00:55:27,791
HOW CAN WE DO THAT

1981
00:55:31,227 --> 00:55:28,792
AND WHAT WOULD THAT BE,

1982
00:55:34,030 --> 00:55:31,294
BUT WE NOW HAVE,

1983
00:55:36,399 --> 00:55:34,097
THANKS TO OUR JPL CREATED

1984
00:55:38,868 --> 00:55:36,466
EYES ON THE SOLAR SYSTEM,

1985
00:55:39,702 --> 00:55:38,935
A WAY OF LOOKING AND SEEING

1986
00:55:40,770 --> 00:55:39,769
WHERE THE VOYAGERS ARE,

1987
00:55:42,205 --> 00:55:40,837
AND LOOKING BACK.

1988
00:55:44,507 --> 00:55:42,272

AND THERE YOU HAVE IT.

1989

00:55:48,478 --> 00:55:44,574

THIS IS AVAILABLE ONLINE

1990

00:55:49,912 --> 00:55:48,545

AT EYES ON THE SOLAR SYSTEM.

1991

00:55:54,817 --> 00:55:49,979

YOU CAN JUST GOOGLE IT,

1992

00:55:55,685 --> 00:55:54,884

AND THERE IT IS.

1993

00:55:59,288 --> 00:55:55,752

WAVE.

1994

00:55:59,989 --> 00:55:59,355

[LAUGHTER]

1995

00:56:02,225 --> 00:56:00,056

>> YOU KNOW, I THINK PART OF

1996

00:56:04,994 --> 00:56:02,292

WHAT MAKES VOYAGER WHAT IT IS

1997

00:56:06,429 --> 00:56:05,061

IS ITS GREAT ENGINEERING,

1998

00:56:08,564 --> 00:56:06,496

ITS GREAT SCIENCE,

1999

00:56:09,699 --> 00:56:08,631

AND ITS REMARKABLE INSPIRATION.

2000

00:56:11,401 --> 00:56:09,766

I THINK THOSE THREE ELEMENTS

2001

00:56:13,102 --> 00:56:11,468

ALL CAME TOGETHER

2002

00:56:16,472 --> 00:56:13,169

AND MADE A JOURNEY

2003

00:56:17,974 --> 00:56:16,539

THAT'S REALLY UNEQUALLED.

2004

00:56:21,644 --> 00:56:18,041

>> WHAT AN INSPIRATION

2005

00:56:23,212 --> 00:56:21,711

ALL OF YOU ARE TO ALL OF US,

2006

00:56:25,081 --> 00:56:23,279

AND WE JUST THANK YOU SO MUCH,

2007

00:56:26,983 --> 00:56:25,148

AND ALL OF YOU THAT

2008

00:56:27,984 --> 00:56:27,050

HAVE WORKED ON THIS MISSION.

2009

00:56:30,052 --> 00:56:28,051

IT IS TRULY OF

2010

00:56:31,320 --> 00:56:30,119

HISTORIC PROPORTIONS,

2011

00:56:33,556 --> 00:56:31,387

AND HOW PRIVILEGED

2012

00:56:35,358 --> 00:56:33,623

AND SPECIAL IT IS.

2013

00:56:36,893 --> 00:56:35,425

AND WITH THAT, I WANT TO

2014

00:56:38,027 --> 00:56:36,960

THANK YOU FOR COMING,

2015

00:56:39,495 --> 00:56:38,094

AND THANK OUR AUDIENCE--

2016

00:56:41,731 --> 00:56:39,562

YOU'VE BEEN TERRIFIC.

2017

00:57:00,817 --> 00:56:41,798

AND SAIL ON, VOYAGER.

2018

00:58:04,380 --> 00:57:00,884

[APPLAUSE]