



MARSHALL
REMEMBERS APOLLO

1
00:00:01,130 --> 00:00:14,360

[Music]

2
00:00:14,370 --> 00:00:17,620

you

3
00:00:25,269 --> 00:00:22,120

I got married got my BIA made a degree

4
00:00:27,700 --> 00:00:25,279

and headed out for the west coast with

5
00:00:30,100 --> 00:00:27,710

my first job offer which was working on

6
00:00:32,470 --> 00:00:30,110

the Navajo program at North American

7
00:00:35,740 --> 00:00:32,480

Aviation the Navajo program was the

8
00:00:37,869 --> 00:00:35,750

first supersonic cruise missile idea at

9
00:00:40,240 --> 00:00:37,879

the time it got canceled because it was

10
00:00:44,799 --> 00:00:40,250

having problems but while I was there I

11
00:00:47,890 --> 00:00:44,809

was working on the design of the F model

12
00:00:50,740 --> 00:00:47,900

for the wind tunnel in fact the big was

13
00:00:53,260 --> 00:00:50,750

going to be tested at L home up here so

14

00:00:55,600 --> 00:00:53,270

I got some experience working you know

15

00:00:57,850 --> 00:00:55,610

with design and that sort of thing but I

16

00:01:00,430 --> 00:00:57,860

was fresh out of college and had about a

17

00:01:03,069 --> 00:01:00,440

year experience when my fight got my

18

00:01:06,930 --> 00:01:03,079

final orders to report for duty well

19

00:01:12,430 --> 00:01:06,940

along the way Korea was burning hot and

20

00:01:15,730 --> 00:01:12,440

I decided you know I was my commission

21

00:01:17,620 --> 00:01:15,740

was a combat engineer well I'm not sure

22

00:01:20,080 --> 00:01:17,630

that I was well-suited to be a combat

23

00:01:22,240 --> 00:01:20,090

engineer all right we built a few

24

00:01:24,249 --> 00:01:22,250

bridges at night under the Starlight and

25

00:01:27,010 --> 00:01:24,259

that sort of thing it was terrible work

26
00:01:29,890 --> 00:01:27,020
you know very much manual and that sort

27
00:01:31,780 --> 00:01:29,900
of thing so I figured you know I really

28
00:01:34,120 --> 00:01:31,790
have some experience with missiles and

29
00:01:37,030 --> 00:01:34,130
is there anything the army has in that

30
00:01:37,840 --> 00:01:37,040
area and so I did put an application in

31
00:01:40,719 --> 00:01:37,850
for a transfer

32
00:01:42,399 --> 00:01:40,729
of my MOS well they transferred me the

33
00:01:45,249 --> 00:01:42,409
Ordnance had sent me the Ordnance school

34
00:01:47,109 --> 00:01:45,259
in Maryland and when I got my orders and

35
00:01:50,109 --> 00:01:47,119
I was telling a gentleman earlier about

36
00:01:52,569 --> 00:01:50,119
this when I got my orders it was in a in

37
00:01:53,830 --> 00:01:52,579
order Torian where you were you were

38
00:01:56,380 --> 00:01:53,840

sitting in the audience and you were

39

00:01:58,510 --> 00:01:56,390

called by name upon the stage and the

40

00:02:00,370 --> 00:01:58,520

major who was leading it would give you

41

00:02:02,530 --> 00:02:00,380

your your official orders as to where

42

00:02:05,499 --> 00:02:02,540

you were going and so all my friends

43

00:02:06,310 --> 00:02:05,509

that I'm in class with me it was Watson

44

00:02:10,930 --> 00:02:06,320

to Korea

45

00:02:12,759 --> 00:02:10,940

on and on they went through about 20

46

00:02:14,920 --> 00:02:12,769

names and he gets to mind all of them

47

00:02:18,550 --> 00:02:14,930

going to Korea and he gets to my name he

48

00:02:20,860 --> 00:02:18,560

says Maria to Korea yeah and then he

49

00:02:24,670 --> 00:02:20,870

said no wait a minute no you going to

50

00:02:26,530 --> 00:02:24,680

Huntsville Alabama that's how I found

51
00:02:28,150 --> 00:02:26,540
out I was going to the south somewhere I

52
00:02:30,800 --> 00:02:28,160
had never heard of Huntsville apparently

53
00:02:33,020 --> 00:02:30,810
he had neither okay I'm so high

54
00:02:35,570 --> 00:02:33,030
watered down here to general tough toy

55
00:02:38,000 --> 00:02:35,580
who was head of the commander of the

56
00:02:40,339 --> 00:02:38,010
Arsenal here and he said well you're an

57
00:02:42,920 --> 00:02:40,349
engineer you know we have a German group

58
00:02:44,960 --> 00:02:42,930
here on the front brown and they need

59
00:02:46,910 --> 00:02:44,970
mechanical engineers and I was a

60
00:02:49,670 --> 00:02:46,920
mechanical engineer is why don't you go

61
00:02:51,470 --> 00:02:49,680
over there and report to him and see if

62
00:02:53,990 --> 00:02:51,480
he could find something for you to do in

63
00:02:58,850 --> 00:02:54,000

the mechanical engineering area I said

64

00:03:00,979 --> 00:02:58,860

you know I have sir and hope I went we

65

00:03:04,250 --> 00:03:00,989

sort of had an indication on our way

66

00:03:05,690 --> 00:03:04,260

driving to Huntsville that things were

67

00:03:07,220 --> 00:03:05,700

going to be radically different I went

68

00:03:09,440 --> 00:03:07,230

from a city of seven and a half million

69

00:03:11,509 --> 00:03:09,450

to a city of about twelve and a half

70

00:03:14,120 --> 00:03:11,519

million with the surrounding areas in

71

00:03:17,809 --> 00:03:14,130

Los Angeles and then I was assigned to

72

00:03:20,120 --> 00:03:17,819

to this place and my wife was busy

73

00:03:21,820 --> 00:03:20,130

looking at the triple-a books and lo and

74

00:03:27,380 --> 00:03:21,830

behold she found Huntsville Alabama

75

00:03:30,170 --> 00:03:27,390

population 16500 okay my mouth dropped

76
00:03:31,520 --> 00:03:30,180
wide open I hope we met there were more

77
00:03:33,259 --> 00:03:31,530
people in my neighborhood that I lived

78
00:03:37,490 --> 00:03:33,269
in than that okay

79
00:03:40,610 --> 00:03:37,500
and so that was kind of a shock we

80
00:03:43,250 --> 00:03:40,620
weren't expecting it to be that small an

81
00:03:45,800 --> 00:03:43,260
area but when we got here it was very

82
00:03:49,309 --> 00:03:45,810
very impressive from the standpoint that

83
00:03:52,099 --> 00:03:49,319
it was country but it had mountains it

84
00:03:54,410 --> 00:03:52,109
had water and it was it was a very

85
00:03:56,630 --> 00:03:54,420
pretty place and in fact as we drove

86
00:03:58,940 --> 00:03:56,640
over on highway 72 over the mountains

87
00:04:01,729 --> 00:03:58,950
and we arrived at late at night

88
00:04:03,259 --> 00:04:01,739

all the city lights were on and it was

89

00:04:05,210 --> 00:04:03,269

just like you were looking at a at a

90

00:04:08,300 --> 00:04:05,220

fairyland picked you it was really

91

00:04:10,490 --> 00:04:08,310

pretty okay then we parked that the only

92

00:04:13,160 --> 00:04:10,500

restaurant that was open and we saw the

93

00:04:16,400 --> 00:04:13,170

junebug Hospital ie and then we realized

94

00:04:18,560 --> 00:04:16,410

we were in a different community and we

95

00:04:21,440 --> 00:04:18,570

rented the only house that was available

96

00:04:24,710 --> 00:04:21,450

for rent in Huntsville at the time on

97

00:04:27,110 --> 00:04:24,720

Holmes Street and that's where we we

98

00:04:28,779 --> 00:04:27,120

housed for a little while I couldn't get

99

00:04:32,150 --> 00:04:28,789

on post at that time they didn't have

100

00:04:33,590 --> 00:04:32,160

facilities for the military here so

101

00:04:35,540 --> 00:04:33,600

that's how I got here and and that's

102

00:04:36,080 --> 00:04:35,550

what the first impression it was not a

103

00:04:39,080 --> 00:04:36,090

good one

104

00:04:40,909 --> 00:04:39,090

and it it was difficult before it became

105

00:04:42,939 --> 00:04:40,919

a good one because we had some pretty

106

00:04:45,760 --> 00:04:42,949

difficult times

107

00:04:49,089 --> 00:04:45,770

at that time huntsville was a little bit

108

00:04:51,100 --> 00:04:49,099

more racist than it is today and it was

109

00:04:52,899 --> 00:04:51,110

back in the era where they had separate

110

00:04:55,899 --> 00:04:52,909

facilities for the blacks and whites and

111

00:04:57,999 --> 00:04:55,909

try to explain that to a little girl who

112

00:04:59,230 --> 00:04:58,009

want to have drink and Isolda no you

113

00:05:00,879 --> 00:04:59,240

can't drink there you have to drink it

114

00:05:03,339 --> 00:05:00,889

this other one she wanted to know how

115

00:05:06,489 --> 00:05:03,349

come why you know how do you explained

116

00:05:09,969 --> 00:05:06,499

that to a child and it was he was tough

117

00:05:13,899 --> 00:05:09,979

making that that change but as we stayed

118

00:05:15,219 --> 00:05:13,909

here and grew the community grew and we

119

00:05:17,740 --> 00:05:15,229

brought in people from all over the

120

00:05:20,969 --> 00:05:17,750

world not just the United States and so

121

00:05:24,760 --> 00:05:20,979

it became a much more progressive and

122

00:05:26,230 --> 00:05:24,770

non racist environment although I'm sure

123

00:05:28,540 --> 00:05:26,240

there were people that was so very

124

00:05:35,500 --> 00:05:28,550

racist there still are today you know

125

00:05:40,260 --> 00:05:38,500

well I think what was going on here with

126

00:05:44,410 --> 00:05:40,270

so many scientific and engineering

127

00:05:46,960 --> 00:05:44,420

projects of eventually putting a man on

128

00:05:48,790 --> 00:05:46,970

the moon is what I finally led to but he

129

00:05:50,890 --> 00:05:48,800

was basically helping the army develop

130

00:05:54,190 --> 00:05:50,900

their intermediate range ballistic

131

00:05:57,370 --> 00:05:54,200

missile program so we had the Redstone

132

00:05:59,620 --> 00:05:57,380

with a 200 mile range followed by the

133

00:06:02,260 --> 00:05:59,630

Jupiter program which had about a

134

00:06:05,260 --> 00:06:02,270

fifteen hundred mile range so things

135

00:06:07,870 --> 00:06:05,270

were developing rapidly here and more

136

00:06:11,860 --> 00:06:07,880

and more progressive educated people

137

00:06:14,050 --> 00:06:11,870

were coming into the area and the the

138

00:06:16,840 --> 00:06:14,060

whole place changed in flavor and of

139

00:06:20,110 --> 00:06:16,850

course then we had the gentleman running

140

00:06:22,720 --> 00:06:20,120

for president none of us were happy with

141

00:06:24,730 --> 00:06:22,730

at the time or most of us were not happy

142

00:06:27,010 --> 00:06:24,740

with at the time and that was a

143

00:06:29,320 --> 00:06:27,020

difficult time and that was a time when

144

00:06:31,120 --> 00:06:29,330

as I said I'm trying to explain to my

145

00:06:32,620 --> 00:06:31,130

daughter why she couldn't drink from

146

00:06:34,390 --> 00:06:32,630

this fountain you have to drink from the

147

00:06:37,390 --> 00:06:34,400

other one it's hard to imagine those

148

00:06:38,950 --> 00:06:37,400

days now you know women huh there

149

00:06:41,680 --> 00:06:38,960

weren't any women in the engineering

150

00:06:44,050 --> 00:06:41,690

field at that time and now we have one

151
00:06:45,670 --> 00:06:44,060
who may become the center director at

152
00:06:49,240 --> 00:06:45,680
Marshall Space Flight Center I hope she

153
00:06:51,730 --> 00:06:49,250
does it was a different time the women

154
00:06:53,260 --> 00:06:51,740
in that in those days you know just

155
00:06:56,890 --> 00:06:53,270
didn't have the rights at the beginning

156
00:06:59,380 --> 00:06:56,900
to have now I had two gentlemen in my

157
00:07:02,560 --> 00:06:59,390
project office at the time and this was

158
00:07:05,140 --> 00:07:02,570
of the f1 engine project office and one

159
00:07:08,050 --> 00:07:05,150
wasn't a Muslim and the other one was a

160
00:07:09,970 --> 00:07:08,060
Jewish guy and they were they were sat

161
00:07:11,500 --> 00:07:09,980
right next to each other and they

162
00:07:13,510 --> 00:07:11,510
developed a very good relationship

163
00:07:16,540 --> 00:07:13,520

between the two of them and they would

164

00:07:19,270 --> 00:07:16,550

really needle each other in fact the

165

00:07:21,190 --> 00:07:19,280

Jewish guy said to the Muslim guy

166

00:07:22,860 --> 00:07:21,200

look you're not marriage at 30 years old

167

00:07:25,870 --> 00:07:22,870

why don't you go find yourself a woman

168

00:07:28,570 --> 00:07:25,880

okay so we had a number of conversations

169

00:07:30,760 --> 00:07:28,580

like that that ran around the office but

170

00:07:33,370 --> 00:07:30,770

they got to be great friends and one

171

00:07:37,030 --> 00:07:33,380

Christmas for instance I came into the

172

00:07:39,250 --> 00:07:37,040

office and it was a glass pane entry

173

00:07:42,040 --> 00:07:39,260

into my office and they had written on

174

00:07:45,610 --> 00:07:42,050

the thing Merry Christmas in English

175

00:07:50,710 --> 00:07:45,620

followed by being written in Hebrew

176

00:07:51,939 --> 00:07:50,720

by a Muslim language alright and I

177

00:07:53,800 --> 00:07:51,949

didn't know what they all said that

178

00:07:55,570 --> 00:07:53,810

they've told me later and I thought it

179

00:07:57,640 --> 00:07:55,580

was a great idea and we decided to take

180

00:07:59,469 --> 00:07:57,650

a picture of it and we sent it to NASA

181

00:08:01,780 --> 00:07:59,479

headquarters you know there was the

182

00:08:03,430 --> 00:08:01,790

first relationships that were developing

183

00:08:06,129 --> 00:08:03,440

because of the space program that was

184

00:08:09,460 --> 00:08:06,139

starting to develop and the people who

185

00:08:11,590 --> 00:08:09,470

had the brains to work on that and it

186

00:08:13,510 --> 00:08:11,600

was very very interesting to see how

187

00:08:15,189 --> 00:08:13,520

that worked it had very little time to

188

00:08:17,770 --> 00:08:15,199

do anything else except worked on

189

00:08:19,570 --> 00:08:17,780

problems that were developing people

190

00:08:22,150 --> 00:08:19,580

problems as well as technical problems

191

00:08:24,219 --> 00:08:22,160

you know and in fact that people problem

192

00:08:27,370 --> 00:08:24,229

I just mentioned how do you get these

193

00:08:29,439 --> 00:08:27,380

two opposing religions sitting next to

194

00:08:30,550 --> 00:08:29,449

each other working the similar kinds of

195

00:08:32,290 --> 00:08:30,560

problems they had to work together

196

00:08:34,480 --> 00:08:32,300

because they were worrying about the

197

00:08:36,550 --> 00:08:34,490

finances and where we spending the money

198

00:08:38,560 --> 00:08:36,560

at the wrong rate or we're gonna be in

199

00:08:40,089 --> 00:08:38,570

heavy overruns and that sort of thing so

200

00:08:42,310 --> 00:08:40,099

they were mutually working this thing

201
00:08:44,620 --> 00:08:42,320
together and in fact I love it because

202
00:08:46,510 --> 00:08:44,630
the Jewish guy reminded the Muslim guy

203
00:08:48,730 --> 00:08:46,520
he forgot to pray he owe him he praying

204
00:08:50,530 --> 00:08:48,740
okay because he used to pray in the

205
00:08:52,990 --> 00:08:50,540
office every day but they were so

206
00:09:01,440 --> 00:08:53,000
occupied that he forgot and this Jewish

207
00:09:07,890 --> 00:09:04,650
my first jobs involved working with

208
00:09:10,920 --> 00:09:07,900
these missiles first a redstone and then

209
00:09:14,580 --> 00:09:10,930
the Jupiter missile on the Redstone I

210
00:09:17,640 --> 00:09:14,590
had an opportunity to to do some T DT dy

211
00:09:19,550 --> 00:09:17,650
work but back up to New York because the

212
00:09:22,500 --> 00:09:19,560
contractor who was working on the

213
00:09:26,430 --> 00:09:22,510

servomechanisms of the redstone was a

214

00:09:29,220 --> 00:09:26,440

Long Island company and they were having

215

00:09:32,160 --> 00:09:29,230

troubles with them and so I was pulled

216

00:09:36,450 --> 00:09:32,170

out of where I first went and that was

217

00:09:38,940 --> 00:09:36,460

into the heat transfer area and that

218

00:09:40,950 --> 00:09:38,950

sort of thing was more of the analytical

219

00:09:44,880 --> 00:09:40,960

world well

220

00:09:47,400 --> 00:09:44,890

von Braun's deputy could see me in this

221

00:09:50,580 --> 00:09:47,410

office and he found out that I was from

222

00:09:51,750 --> 00:09:50,590

New York so he approached me he said do

223

00:09:55,050 --> 00:09:51,760

you think you might be interested in

224

00:09:58,500 --> 00:09:55,060

doing some liaison work with the project

225

00:10:01,560 --> 00:09:58,510

office with this company in Long Island

226

00:10:06,510 --> 00:10:01,570

City and I think oh yeah try it it

227

00:10:08,760 --> 00:10:06,520

sounded good that job made me more

228

00:10:10,740 --> 00:10:08,770

visible to top management around the

229

00:10:12,630 --> 00:10:10,750

center including von Braun because I

230

00:10:15,240 --> 00:10:12,640

gave some presentations now and then and

231

00:10:17,960 --> 00:10:15,250

and but I was not happy it was not my

232

00:10:20,400 --> 00:10:17,970

field it was not propulsion it was

233

00:10:23,070 --> 00:10:20,410

servomechanisms okay I knew knew nothing

234

00:10:24,720 --> 00:10:23,080

about several mechanisms but I would sit

235

00:10:26,490 --> 00:10:24,730

down with a contract and find out where

236

00:10:28,050 --> 00:10:26,500

the problems were and what they were

237

00:10:30,140 --> 00:10:28,060

doing about them and that sort of thing

238

00:10:32,100 --> 00:10:30,150

so it was more of a project management

239

00:10:34,260 --> 00:10:32,110

involvement rather than an engineering

240

00:10:37,560 --> 00:10:34,270

involvement things went fairly well

241

00:10:40,260 --> 00:10:37,570

there and I spent most of my career as a

242

00:10:43,650 --> 00:10:40,270

second lieutenant doing that kind of

243

00:10:47,310 --> 00:10:43,660

work and then of course the famous

244

00:10:51,300 --> 00:10:47,320

general took over and we became a BMA

245

00:10:53,520 --> 00:10:51,310

army ballistic missile agency and I feel

246

00:10:55,710 --> 00:10:53,530

you know I'd be carrying his suitcase as

247

00:10:57,960 --> 00:10:55,720

soon as a second lieutenant well I got

248

00:11:00,120 --> 00:10:57,970

promoted to my first lieutenant ship and

249

00:11:04,410 --> 00:11:00,130

he kept me going in the engineering

250

00:11:05,840 --> 00:11:04,420

world I guess I had some exposure to von

251

00:11:08,310 --> 00:11:05,850

Braun strictly because I had

252

00:11:10,590 --> 00:11:08,320

presentations I had to give plus I had

253

00:11:11,340 --> 00:11:10,600

an immediate supervisor who had a lot of

254

00:11:14,010 --> 00:11:11,350

contact with

255

00:11:16,530 --> 00:11:14,020

Brown so I had some exposure there not

256

00:11:19,740 --> 00:11:16,540

much but enough that one Brown knew me

257

00:11:21,810 --> 00:11:19,750

by name in fact when we reported Ford

258

00:11:25,410 --> 00:11:21,820

active duty they were having a special

259

00:11:26,790 --> 00:11:25,420

reunion and my wife and I got invited to

260

00:11:28,500 --> 00:11:26,800

the reunion and I was sitting right at

261

00:11:30,480 --> 00:11:28,510

the head table with von Braun as a

262

00:11:32,340 --> 00:11:30,490

second lieutenant yeah so he was

263

00:11:34,380 --> 00:11:32,350

impressive from that standpoint he

264

00:11:36,210 --> 00:11:34,390

didn't feel like he was the leader of

265

00:11:39,450 --> 00:11:36,220

the singing you couldn't talk to him you

266

00:11:41,760 --> 00:11:39,460

know he was very very approachable so we

267

00:11:43,890 --> 00:11:41,770

had a good relationship and then along

268

00:11:47,880 --> 00:11:43,900

came the space program to go to the moon

269

00:11:52,830 --> 00:11:47,890

and my immediate boss was head of the

270

00:11:55,140 --> 00:11:52,840

propulsion project areas and so he

271

00:11:57,300 --> 00:11:55,150

needed a number of people in key project

272

00:12:01,490 --> 00:11:57,310

positions and he had very few to choose

273

00:12:04,830 --> 00:12:01,500

from and von Braun had a point at that

274

00:12:07,680 --> 00:12:04,840

part in our career that said you know

275

00:12:09,510 --> 00:12:07,690

this place is full of Germans running

276

00:12:10,760 --> 00:12:09,520

everything he said we're not going to be

277

00:12:13,830 --> 00:12:10,770

around very long

278

00:12:16,980 --> 00:12:13,840

okay and if this thing is ever to

279

00:12:19,440 --> 00:12:16,990

succeed we need some smart American kids

280

00:12:22,470 --> 00:12:19,450

that we can train and put in key

281

00:12:24,960 --> 00:12:22,480

positions at the center here and so he

282

00:12:26,340 --> 00:12:24,970

was pushing that very strongly and so I

283

00:12:29,070 --> 00:12:26,350

happened to come along at the right time

284

00:12:31,500 --> 00:12:29,080

and I guess he had seen me a little bit

285

00:12:33,570 --> 00:12:31,510

and so he approved the fact that well

286

00:12:36,150 --> 00:12:33,580

they needed a project manager for this

287

00:12:37,860 --> 00:12:36,160

big development called the f1 engine and

288

00:12:41,910 --> 00:12:37,870

he was willing to take a chance mainly

289

00:12:43,560 --> 00:12:41,920

because my immediate supervisor gave him

290

00:12:45,540 --> 00:12:43,570

the recommendation he gave

291

00:12:47,490 --> 00:12:45,550

recommendation for me to head up the

292

00:12:49,770 --> 00:12:47,500

project of the f1 engine development and

293

00:12:52,710 --> 00:12:49,780

but Drummond got the one for the j2

294

00:12:55,560 --> 00:12:52,720

engine ok and we both you know we were

295

00:12:57,960 --> 00:12:55,570

in our 20s still I was 28 years old and

296

00:13:01,980 --> 00:12:57,970

I was given this project to manage that

297

00:13:04,200 --> 00:13:01,990

had a 1 billion dollar funding program

298

00:13:06,990 --> 00:13:04,210

associated with it part of it was for

299

00:13:09,150 --> 00:13:07,000

facilities but nevertheless I had a 1

300

00:13:10,100 --> 00:13:09,160

billion dollar budget I was 28 years old

301

00:13:13,850 --> 00:13:10,110

ok

302

00:13:19,100 --> 00:13:16,790

well the biggest problem of all that

303

00:13:21,320 --> 00:13:19,110

came about in that program was a problem

304

00:13:23,810 --> 00:13:21,330

called combustion and stability at the

305

00:13:26,690 --> 00:13:23,820

time not much was known about it we were

306

00:13:29,900 --> 00:13:26,700

hit with it fairly consistently once we

307

00:13:31,760 --> 00:13:29,910

got to the system's level testing and

308

00:13:34,250 --> 00:13:31,770

what combustion instability isn't I tell

309

00:13:37,220 --> 00:13:34,260

people that's a highfalutin term you

310

00:13:38,510 --> 00:13:37,230

know but what it is is give them an

311

00:13:40,460 --> 00:13:38,520

example which probably isn't very

312

00:13:42,380 --> 00:13:40,470

accurate but it gives you the idea

313

00:13:44,690 --> 00:13:42,390

anyway and that is if you're in a room a

314

00:13:47,060 --> 00:13:44,700

dark room with a single candle light

315

00:13:49,220 --> 00:13:47,070

candle lit all right and there's no

316

00:13:51,110 --> 00:13:49,230

motion of there no people moving around

317

00:13:54,050 --> 00:13:51,120

the doors are closed and that sort of

318

00:13:56,630 --> 00:13:54,060

thing the heat system is off you would

319

00:13:59,840 --> 00:13:56,640

expect the flame to remain very

320

00:14:00,530 --> 00:13:59,850

symmetrical but it doesn't it flips back

321

00:14:02,540 --> 00:14:00,540

and forth

322

00:14:04,880 --> 00:14:02,550

well that's a form of instability

323

00:14:08,210 --> 00:14:04,890

combustion instability because what

324

00:14:10,190 --> 00:14:08,220

happens is the flame sees a little more

325

00:14:12,440 --> 00:14:10,200

oxygen on the right side that it does on

326

00:14:15,050 --> 00:14:12,450

the left so it burns hotter and it kicks

327

00:14:16,940 --> 00:14:15,060

the flame of a-- and now the part that's

328

00:14:19,130 --> 00:14:16,950

overseas more oxygen than the part that

329

00:14:21,470 --> 00:14:19,140

had just left and so it kicks it back

330

00:14:24,110 --> 00:14:21,480

well that oscillation goes on and that's

331

00:14:26,750 --> 00:14:24,120

an instability all right well but with a

332

00:14:29,090 --> 00:14:26,760

candle it goes on maybe five or six

333

00:14:31,910 --> 00:14:29,100

times a minute or five or six times a

334

00:14:35,210 --> 00:14:31,920

second right well that phenomena occurs

335

00:14:37,460 --> 00:14:35,220

in the rocket engine of the f1 except it

336

00:14:40,130 --> 00:14:37,470

doesn't oscillate at five or six times a

337

00:14:43,190 --> 00:14:40,140

second it oscillates at 2,000 times a

338

00:14:44,810 --> 00:14:43,200

second and picture that and it doesn't

339

00:14:48,260 --> 00:14:44,820

just oscillate back and forth but it

340

00:14:51,050 --> 00:14:48,270

goes back and around this sorta way so

341

00:14:53,330 --> 00:14:51,060

it was highly destructive and it was

342

00:14:54,710 --> 00:14:53,340

definitely a program stopper and it was

343

00:14:58,370 --> 00:14:54,720

the biggest problem I ever had in my

344

00:15:00,260 --> 00:14:58,380

entire career and the only way we would

345

00:15:02,630 --> 00:15:00,270

find ourselves out of it is that you

346

00:15:04,940 --> 00:15:02,640

know we need to go find out where

347

00:15:09,230 --> 00:15:04,950

expertise might be in the country in

348

00:15:12,490 --> 00:15:09,240

this area so we put together an ad hoc

349

00:15:15,650 --> 00:15:12,500

team which consisted of a professor from

350

00:15:18,980 --> 00:15:15,660

Princeton University who was in a field

351
00:15:21,620 --> 00:15:18,990
of combustion luigi via croco yeah so we

352
00:15:24,560 --> 00:15:21,630
put him on this team we put an engineer

353
00:15:27,090 --> 00:15:24,570
or two from Marshall on the team in fact

354
00:15:29,520 --> 00:15:27,100
the head of the team was a Marshall

355
00:15:30,090 --> 00:15:29,530
employee who's now deceased jerry

356
00:15:34,320 --> 00:15:30,100
thompson

357
00:15:36,150 --> 00:15:34,330
and we went to Rocketdyne because they

358
00:15:39,810 --> 00:15:36,160
were the prime contract at that time and

359
00:15:41,700 --> 00:15:39,820
we gave them the lead from a contractor

360
00:15:43,260 --> 00:15:41,710
point-of-view we needed someone who

361
00:15:45,150 --> 00:15:43,270
could direct the efforts of the

362
00:15:47,550 --> 00:15:45,160
contractor without having to go through

363
00:15:50,460 --> 00:15:47,560

their top management so we got a pretty

364

00:15:53,040 --> 00:15:50,470

high smart guide to work that his name

365

00:15:55,560 --> 00:15:53,050

was Paul Caston holes and we had someone

366

00:15:56,820 --> 00:15:55,570

from the Lewis Research Center and we

367

00:16:00,600 --> 00:15:56,830

had a couple of others in fact we even

368

00:16:03,740 --> 00:16:00,610

had a man from the competing contractor

369

00:16:07,230 --> 00:16:03,750

for that f1 engine development Aerojet

370

00:16:10,110 --> 00:16:07,240

we got one of their top people in it so

371

00:16:12,810 --> 00:16:10,120

we had this team of about 10 15 would

372

00:16:15,180 --> 00:16:12,820

which represented the best brains that

373

00:16:18,300 --> 00:16:15,190

we had I gave him a budget of up to 40

374

00:16:20,160 --> 00:16:18,310

million dollars right 40 million dollars

375

00:16:21,870 --> 00:16:20,170

to solve that problem because if we

376

00:16:24,060 --> 00:16:21,880

didn't solve it we would not have gone

377

00:16:26,940 --> 00:16:24,070

to the moon it was impossible it was

378

00:16:28,620 --> 00:16:26,950

that much of a of a risk and Ron Brown

379

00:16:30,540 --> 00:16:28,630

gave me complete support during that

380

00:16:33,780 --> 00:16:30,550

whole phase and we had some tough times

381

00:16:35,700 --> 00:16:33,790

who blew a lot of hardware apart but it

382

00:16:38,250 --> 00:16:35,710

was interesting how they finally

383

00:16:40,620 --> 00:16:38,260

developed a solution to this thing they

384

00:16:42,390 --> 00:16:40,630

never fully understood the combustion we

385

00:16:44,430 --> 00:16:42,400

didn't have computers in those days you

386

00:16:46,080 --> 00:16:44,440

know they were just starting to come

387

00:16:48,660 --> 00:16:46,090

online and they were basically for

388

00:16:50,420 --> 00:16:48,670

payroll purposes you know you had a car

389

00:16:52,500 --> 00:16:50,430

that she punched in and punched out

390

00:16:55,260 --> 00:16:52,510

computers had whirring around we had

391

00:16:58,320 --> 00:16:55,270

slide rules and and even pocket

392

00:17:00,960 --> 00:16:58,330

calculators were barely coming on to be

393

00:17:02,790 --> 00:17:00,970

existing in our programs we had a couple

394

00:17:05,220 --> 00:17:02,800

of smart guys on that committee we put

395

00:17:07,020 --> 00:17:05,230

together one of them asked the question

396

00:17:09,000 --> 00:17:07,030

and I wasn't in the meeting to find out

397

00:17:11,100 --> 00:17:09,010

which one said that but he says how come

398

00:17:11,880 --> 00:17:11,110

the v-2 didn't have combustion

399

00:17:13,530 --> 00:17:11,890

instability

400

00:17:15,750 --> 00:17:13,540

you know von braun's group developed the

401
00:17:17,370 --> 00:17:15,760
v2 in Germany and no time at all and

402
00:17:19,950 --> 00:17:17,380
they didn't have combustion instability

403
00:17:22,530 --> 00:17:19,960
well lo and behold they had different

404
00:17:26,550 --> 00:17:22,540
propellant okay and then if you look at

405
00:17:28,890 --> 00:17:26,560
the design of the v2 engine it's a semi

406
00:17:31,530 --> 00:17:28,900
sphere all right and there are pockets

407
00:17:34,860 --> 00:17:31,540
of little rocket engines in that semi

408
00:17:36,330 --> 00:17:34,870
felis fear and they burn and then they

409
00:17:38,610 --> 00:17:36,340
interact with each other and then the

410
00:17:38,990 --> 00:17:38,620
exhaust comes out the tail end of the

411
00:17:41,840 --> 00:17:39,000
rocket

412
00:17:45,529 --> 00:17:41,850
well the f1 engine had a flat plate

413
00:17:48,260 --> 00:17:45,539

injector where we mixed oxidizer and and

414

00:17:52,549 --> 00:17:48,270

fuel and it was not the fuel that they

415

00:17:55,130 --> 00:17:52,559

used on the J on the v2 so was liquid

416

00:17:57,830 --> 00:17:55,140

oxygen and a form of kerosene which was

417

00:18:00,799 --> 00:17:57,840

an available fuel because it was used in

418

00:18:04,460 --> 00:18:00,809

all of the jet airplanes of the time so

419

00:18:06,289 --> 00:18:04,470

it was very readily available fuel so we

420

00:18:10,310 --> 00:18:06,299

were using that and we had a flat plate

421

00:18:12,740 --> 00:18:10,320

injector where we drilled holes of fuel

422

00:18:15,620 --> 00:18:12,750

and oxidizers of the fuel and oxidizer

423

00:18:17,750 --> 00:18:15,630

wooden pins on each other and then we

424

00:18:19,909 --> 00:18:17,760

would ignite that so we had a flame

425

00:18:22,580 --> 00:18:19,919

front that gonna go back and forth or

426

00:18:24,620 --> 00:18:22,590

twist around the way it so wanted all

427

00:18:26,990 --> 00:18:24,630

right that's wasn't desirable as it

428

00:18:29,210 --> 00:18:27,000

turned out these smart guys that were on

429

00:18:31,430 --> 00:18:29,220

this ad hoc committee figured out well

430

00:18:32,899 --> 00:18:31,440

how come the v2 didn't have that well

431

00:18:35,570 --> 00:18:32,909

they looked at the v2 and part of the

432

00:18:37,310 --> 00:18:35,580

problem was they had a semi sphere for

433

00:18:38,960 --> 00:18:37,320

an injector alright and in that

434

00:18:40,730 --> 00:18:38,970

semi-sphere they had all these little

435

00:18:43,270 --> 00:18:40,740

rocket engines that had their own little

436

00:18:45,350 --> 00:18:43,280

injectors and started their ignition

437

00:18:48,440 --> 00:18:45,360

well there was no way we were gonna be

438

00:18:50,600 --> 00:18:48,450

able to meet that mission to the moon if

439

00:18:53,419 --> 00:18:50,610

we were going to go that route and

440

00:18:56,120 --> 00:18:53,429

redesign that whole sphere where the

441

00:18:58,580 --> 00:18:56,130

combustion takes place so someone said

442

00:19:01,580 --> 00:18:58,590

well I wonder if we could put baffles in

443

00:19:03,320 --> 00:19:01,590

there just walls that would prevent this

444

00:19:04,970 --> 00:19:03,330

oscillation from going back and forth

445

00:19:07,580 --> 00:19:04,980

and I said you know let's give that a

446

00:19:09,919 --> 00:19:07,590

try so they started looking at different

447

00:19:11,630 --> 00:19:09,929

designs of baffles that they could use

448

00:19:13,340 --> 00:19:11,640

and sure enough they came up with a

449

00:19:15,830 --> 00:19:13,350

configuration that seemed to work pretty

450

00:19:17,360 --> 00:19:15,840

well and then the next question was well

451

00:19:20,090 --> 00:19:17,370

it worked this time would work the next

452

00:19:21,770 --> 00:19:20,100

time someone said well you know maybe we

453

00:19:24,260 --> 00:19:21,780

can perturb a tin and force it to go

454

00:19:26,779 --> 00:19:24,270

unstable and see whether those fences

455

00:19:28,760 --> 00:19:26,789

we've put in their memory rates the the

456

00:19:31,549 --> 00:19:28,770

instability so they came up with a

457

00:19:35,390 --> 00:19:31,559

copper baffle configuration of about 13

458

00:19:37,669 --> 00:19:35,400

compartments where fuel and oxidizer

459

00:19:40,250 --> 00:19:37,679

would mix and burn sure enough that

460

00:19:43,100 --> 00:19:40,260

seemed to stop any of the oscillations

461

00:19:44,810 --> 00:19:43,110

and then the next question was yeah but

462

00:19:47,779 --> 00:19:44,820

what happened on the hundredth test if

463

00:19:50,090 --> 00:19:47,789

it suddenly goes unstable so we had to

464

00:19:52,240 --> 00:19:50,100

figure out well how can we drive the

465

00:19:54,520 --> 00:19:52,250

thing deliberately unstable and see

466

00:19:56,020 --> 00:19:54,530

would attenuate so we had a little bomb

467

00:19:58,540 --> 00:19:56,030

that we put we screwed right in the

468

00:20:01,240 --> 00:19:58,550

center of the injector and as soon as we

469

00:20:03,480 --> 00:20:01,250

ignited the rocket engine we ignited the

470

00:20:06,160 --> 00:20:03,490

bomb that would go off it would initiate

471

00:20:11,110 --> 00:20:06,170

instability but the baffles immediately

472

00:20:12,250 --> 00:20:11,120

dampened it out ok so so that's how we

473

00:20:15,070 --> 00:20:12,260

solve that problem

474

00:20:17,920 --> 00:20:15,080

however you know it always came time to

475

00:20:20,200 --> 00:20:17,930

stand up to top management when you were

476

00:20:22,420 --> 00:20:20,210

ready to fly a man on it to tell him

477

00:20:24,820 --> 00:20:22,430

what testing you've done what issues you

478

00:20:25,270 --> 00:20:24,830

had and what concerns you might have at

479

00:20:30,040 --> 00:20:25,280

this time

480

00:20:31,390 --> 00:20:30,050

well I painted a rosy picture and as I

481

00:20:33,190 --> 00:20:31,400

was painting that rosy picture by the

482

00:20:35,290 --> 00:20:33,200

way the astronauts were in the room at

483

00:20:36,580 --> 00:20:35,300

the time as I was painting that rosy

484

00:20:41,140 --> 00:20:36,590

picture that yeah we've done a lot of

485

00:20:43,300 --> 00:20:41,150

testing and things look good I said

486

00:20:46,090 --> 00:20:43,310

however you know we've tested this thing

487

00:20:48,160 --> 00:20:46,100

several hundred times with a bomb and it

488

00:20:50,860 --> 00:20:48,170

10.you weights every time will it still

489

00:20:53,380 --> 00:20:50,870

work on the 700th in the first test when

490

00:20:55,990 --> 00:20:53,390

we fly I can't say that for sure you

491

00:20:58,240 --> 00:20:56,000

know and I said but what we're pretty

492

00:20:59,650 --> 00:20:58,250

sure and we've got a lot of confidence

493

00:21:03,040 --> 00:20:59,660

because of the amount of testing we did

494

00:21:06,700 --> 00:21:03,050

where we deliberately bombed the engine

495

00:21:08,200 --> 00:21:06,710

into instabilities so everything went

496

00:21:10,390 --> 00:21:08,210

well and the meeting was over and we

497

00:21:12,430 --> 00:21:10,400

were breaking out for lunch and one of

498

00:21:14,290 --> 00:21:12,440

the astronauts came over to me put his

499

00:21:16,540 --> 00:21:14,300

arm around my shoulder and he said Sonny

500

00:21:18,760 --> 00:21:16,550

says you know we know that you guys have

501
00:21:21,550 --> 00:21:18,770
done everything you humanly could do on

502
00:21:22,930 --> 00:21:21,560
this program we're ready to fly and

503
00:21:28,890 --> 00:21:22,940
don't worry about it

504
00:21:34,110 --> 00:21:31,860
that the f1 engine never had a flight

505
00:21:37,049 --> 00:21:34,120
failure of any type was a failure a

506
00:21:40,950 --> 00:21:37,059
double failure of the j2 engine on one

507
00:21:42,600 --> 00:21:40,960
of our flights was a test flight and

508
00:21:46,049 --> 00:21:42,610
what it was is that we have five

509
00:21:48,540 --> 00:21:46,059
j2 engines in this in the s2 stage all

510
00:21:50,790 --> 00:21:48,550
right which is the second stage we drop

511
00:21:52,950 --> 00:21:50,800
off the first stage with the f1 engines

512
00:21:55,680 --> 00:21:52,960
and it dumps into the Atlantic Ocean on

513
00:21:58,020 --> 00:21:55,690

flight and the second stage lights up

514

00:21:59,850 --> 00:21:58,030

with five J two engines well there's a

515

00:22:01,740 --> 00:21:59,860

difference in the j2 engine and the f1

516

00:22:04,020 --> 00:22:01,750

and that they use different combination

517

00:22:06,630 --> 00:22:04,030

of fuel it uses liquid oxygen and liquid

518

00:22:08,960 --> 00:22:06,640

hydrogen not kerosene like we did in

519

00:22:13,740 --> 00:22:08,970

ours liquid hydrogen and liquid oxygen

520

00:22:17,370 --> 00:22:13,750

and it burns beautifully and in fact the

521

00:22:19,710 --> 00:22:17,380

output of that is it's none toxic it's

522

00:22:22,110 --> 00:22:19,720

nothing but steam it's hydrogen and

523

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

oxygen produce water so it comes out as

524

00:22:26,160 --> 00:22:24,130

hot steam and that gives us our

525

00:22:28,890 --> 00:22:26,170

propulsion and then that's a great

526

00:22:30,600 --> 00:22:28,900

design from that standpoint the nature

527

00:22:33,090 --> 00:22:30,610

of the failure that they had was one of

528

00:22:36,150 --> 00:22:33,100

those five engines indicated to the

529

00:22:39,810 --> 00:22:36,160

operator at Houston who was monitoring

530

00:22:42,330 --> 00:22:39,820

the flight in the control room and he

531

00:22:46,380 --> 00:22:42,340

saw one of the engines it was exhibiting

532

00:22:48,810 --> 00:22:46,390

some heat fire and they were concerned

533

00:22:50,640 --> 00:22:48,820

that they might have an in a major blow

534

00:22:55,710 --> 00:22:50,650

with it so they gave a cutoff to the

535

00:22:59,430 --> 00:22:55,720

engine unbeknownst to us at the time it

536

00:23:02,250 --> 00:22:59,440

was miswired in the instrument unit of

537

00:23:04,140 --> 00:23:02,260

the Apollo program and it gave a cutoff

538

00:23:07,950 --> 00:23:04,150

to a good engine instead of the one that

539

00:23:10,290 --> 00:23:07,960

was the on fire so now we had one engine

540

00:23:12,510 --> 00:23:10,300

that we had cut off another engine that

541

00:23:15,000 --> 00:23:12,520

we were afraid was going to blow up

542

00:23:17,190 --> 00:23:15,010

which it didn't it shut itself off it

543

00:23:19,500 --> 00:23:17,200

was out of the atmosphere and apparently

544

00:23:22,160 --> 00:23:19,510

the fire extinguishers extinguished

545

00:23:24,660 --> 00:23:22,170

itself okay which was fortunate for us

546

00:23:28,169 --> 00:23:24,670

well the next stage is the third stage

547

00:23:29,940 --> 00:23:28,179

called the s4b and it has a single one

548

00:23:32,910 --> 00:23:29,950

of those same type of engines who had a

549

00:23:36,060 --> 00:23:32,920

single j2 engine in its function is to

550

00:23:36,990 --> 00:23:36,070

circularize the orbit of the payload

551
00:23:40,230 --> 00:23:37,000
that we're going to send to the moon

552
00:23:42,330 --> 00:23:40,240
around the earth okay so once they know

553
00:23:43,380 --> 00:23:42,340
the position exactly that they wanted to

554
00:23:45,410 --> 00:23:43,390
refire that

555
00:23:47,910 --> 00:23:45,420
to send it on a trajectory to the moon

556
00:23:48,539 --> 00:23:47,920
they gave the command to refire the

557
00:23:51,419 --> 00:23:48,549
engine

558
00:23:52,680 --> 00:23:51,429
it didn't refire so we would not have

559
00:23:55,230 --> 00:23:52,690
been able to go to the moon with that

560
00:23:56,910 --> 00:23:55,240
although the re-entry would have been

561
00:23:59,250 --> 00:23:56,920
safe for the astronauts and that sort of

562
00:24:02,130 --> 00:23:59,260
thing but nevertheless it was double

563
00:24:03,900 --> 00:24:02,140

failure at that same engine so I'm

564

00:24:06,390 --> 00:24:03,910

coming off the f1 engine with all this

565

00:24:08,280 --> 00:24:06,400

great stuff that was happening in von

566

00:24:11,190 --> 00:24:08,290

Browns office calls and says you know

567

00:24:13,710 --> 00:24:11,200

we've had a major double failure of that

568

00:24:17,100 --> 00:24:13,720

engine we need someone with experience

569

00:24:20,669 --> 00:24:17,110

to pick up and help solve that problem

570

00:24:23,340 --> 00:24:20,679

and manage the program and that was an

571

00:24:26,159 --> 00:24:23,350

interesting development of testing and

572

00:24:31,020 --> 00:24:26,169

that sort of thing we were taking movies

573

00:24:33,230 --> 00:24:31,030

of firing that engine and seeing what we

574

00:24:36,990 --> 00:24:33,240

could observe just from the movies and

575

00:24:41,070 --> 00:24:37,000

one of the engineers noticed that one of

576

00:24:44,549 --> 00:24:41,080

the lines that goes into the little

577

00:24:47,130 --> 00:24:44,559

rocket motor on board that drives the

578

00:24:48,830 --> 00:24:47,140

turbopump machinery all right that

579

00:24:50,820 --> 00:24:48,840

drives that propellants to high-pressure

580

00:24:54,270 --> 00:24:50,830

before they go into the thrust chamber

581

00:24:56,039 --> 00:24:54,280

for burning well that little rocket

582

00:25:00,930 --> 00:24:56,049

engine we have there that provides that

583

00:25:04,140 --> 00:25:00,940

energy to turn that turbo machinery they

584

00:25:07,409 --> 00:25:04,150

saw some evidence of liquid dropping off

585

00:25:10,590 --> 00:25:07,419

the liquid hydrogen line and the liquid

586

00:25:14,220 --> 00:25:10,600

hydrogen temperature is so cold that air

587

00:25:16,740 --> 00:25:14,230

around that it was a braided hose air

588

00:25:20,400 --> 00:25:16,750

around that braided hose would begin to

589

00:25:23,159 --> 00:25:20,410

solidify or actually they saw a lot of

590

00:25:25,680 --> 00:25:23,169

liquid dropping off from the braided

591

00:25:28,080 --> 00:25:25,690

hose in the movies and that's when the

592

00:25:30,000 --> 00:25:28,090

light bulb came on that hey this is a

593

00:25:32,490 --> 00:25:30,010

different atmosphere when they're out in

594

00:25:34,919 --> 00:25:32,500

space there is no atmosphere there is

595

00:25:38,130 --> 00:25:34,929

nothing that is producing ice on that on

596

00:25:40,560 --> 00:25:38,140

that hose or a liquid that would dampen

597

00:25:43,500 --> 00:25:40,570

a vibration so it vibrates differently

598

00:25:45,630 --> 00:25:43,510

okay so they changed the design and that

599

00:25:48,390 --> 00:25:45,640

sort of thing and solve that problem and

600

00:25:51,000 --> 00:25:48,400

sure enough that's what it was something

601
00:25:51,659 --> 00:25:51,010
as simple as that but it almost cost us

602
00:25:54,450 --> 00:25:51,669
a mission

603
00:25:56,160 --> 00:25:54,460
why von Braun's theory was he got a test

604
00:25:58,860 --> 00:25:56,170
test test test all the time

605
00:26:00,510 --> 00:25:58,870
so if you're gonna do something for ten

606
00:26:00,900 --> 00:26:00,520
times like a valve operated for ten

607
00:26:03,180 --> 00:26:00,910
times

608
00:26:04,950 --> 00:26:03,190
prove it on the ground by operating it

609
00:26:06,990 --> 00:26:04,960
to ten thousand times that it's not

610
00:26:14,020 --> 00:26:07,000
gonna fall apart on you all right that

611
00:26:18,700 --> 00:26:15,910
I was in bed watching it on my

612
00:26:20,530 --> 00:26:18,710
black-and-white TV when it happened now

613
00:26:24,340 --> 00:26:20,540

I saw the launch I was down for that

614

00:26:26,410 --> 00:26:24,350

just as a spectator but then I drove and

615

00:26:28,270 --> 00:26:26,420

came back on home and by the time they

616

00:26:30,490 --> 00:26:28,280

got to the mood and then I could see the

617

00:26:33,940 --> 00:26:30,500

landing and it was just such a wonderful

618

00:26:36,100 --> 00:26:33,950

feeling just wonderful relief so happy

619

00:26:38,200 --> 00:26:36,110

for those astronauts that we now saw

620

00:26:43,860 --> 00:26:38,210

them alive walking on the moon and now

621

00:26:49,410 --> 00:26:46,080

while all of this was going on all this

622

00:26:51,800 --> 00:26:49,420

wonderful spectacular stuff I guess

623

00:26:56,940 --> 00:26:51,810

there was some engineers somewhere in

624

00:26:58,710 --> 00:26:56,950

advanced design that said you know the

625

00:27:01,200 --> 00:26:58,720

astronauts are going to experience some

626

00:27:03,270 --> 00:27:01,210

tough walking on the moon because

627

00:27:04,980 --> 00:27:03,280

they're in a balloon where they've got

628

00:27:08,190 --> 00:27:04,990

to physically move the parts of that

629

00:27:11,700 --> 00:27:08,200

balloon in order to even walk and they

630

00:27:14,190 --> 00:27:11,710

would get hot perspire oxygen was

631

00:27:16,080 --> 00:27:14,200

critical they had to have radio gear on

632

00:27:18,270 --> 00:27:16,090

and they're walking around on earth an

633

00:27:20,580 --> 00:27:18,280

astronaut would weigh about 800 pounds

634

00:27:23,190 --> 00:27:20,590

with all of his equipment you know he

635

00:27:25,530 --> 00:27:23,200

couldn't walk on earth he just be rigid

636

00:27:28,650 --> 00:27:25,540

in his suit type of thing if it was

637

00:27:30,360 --> 00:27:28,660

pressurized okay so on the moon here it

638

00:27:32,730 --> 00:27:30,370

is pressurized yeah he doesn't weigh

639

00:27:36,120 --> 00:27:32,740

that much but nevertheless it's like

640

00:27:38,760 --> 00:27:36,130

trying to take that weeny balloon and

641

00:27:40,200 --> 00:27:38,770

bending it it doesn't Bend easily and

642

00:27:42,030 --> 00:27:40,210

he's got one leg in one part of that

643

00:27:44,250 --> 00:27:42,040

balloon another leg and the other in the

644

00:27:46,680 --> 00:27:44,260

arms and he's trying to move so he

645

00:27:48,660 --> 00:27:46,690

wasn't going very far as the message and

646

00:27:50,070 --> 00:27:48,670

we didn't realize that until we were

647

00:27:52,710 --> 00:27:50,080

fairly late in the development of

648

00:27:56,310 --> 00:27:52,720

vehicle someone finally came up with the

649

00:27:57,600 --> 00:27:56,320

idea that well maybe we need to change

650

00:28:01,020 --> 00:27:57,610

things a little bit and give them

651

00:28:03,330 --> 00:28:01,030

vehicle to get along with and so they

652

00:28:05,790 --> 00:28:03,340

had been doing some early design work in

653

00:28:07,410 --> 00:28:05,800

our preliminary design area some of the

654

00:28:09,390 --> 00:28:07,420

contractors have been doing some special

655

00:28:12,330 --> 00:28:09,400

studies in that area

656

00:28:16,800 --> 00:28:12,340

Bendix in particular Grumman had been

657

00:28:20,310 --> 00:28:16,810

looking at something but we decided you

658

00:28:22,670 --> 00:28:20,320

know they need a car I mean they looked

659

00:28:25,980 --> 00:28:22,680

at pogo sticks for the yes or no that's

660

00:28:28,100 --> 00:28:25,990

and they looked at all sorts of

661

00:28:30,570 --> 00:28:28,110

contraptions to help them and

662

00:28:32,070 --> 00:28:30,580

fortunately they were right that

663

00:28:34,830 --> 00:28:32,080

astronaut would not be able to walk very

664

00:28:35,810 --> 00:28:34,840

far we found that out immediately on

665

00:28:39,030 --> 00:28:35,820

Apollo 11

666

00:28:44,030 --> 00:28:39,040

you know that Neil Neil Armstrong didn't

667

00:28:46,330 --> 00:28:44,040

go very far and he was totally exhausted

668

00:28:53,979 --> 00:28:46,340

so

669

00:28:56,440 --> 00:28:53,989

might be able to use fold up into a

670

00:28:58,479 --> 00:28:56,450

small package and put it on board and

671

00:29:01,089 --> 00:28:58,489

have them deploy it on the moon and

672

00:29:04,539 --> 00:29:01,099

drive for us Here I am and on the j2

673

00:29:07,810 --> 00:29:04,549

program I'm wrapping that up when the

674

00:29:10,899 --> 00:29:07,820

thoughts about coming up with a car for

675

00:29:13,839 --> 00:29:10,909

the astronauts was coming along here we

676
00:29:16,479 --> 00:29:13,849
had a car now that we had to somehow or

677
00:29:19,089 --> 00:29:16,489
other go out and get some bids on hadn't

678
00:29:23,409 --> 00:29:19,099
been to the moon yet all right so the

679
00:29:26,409 --> 00:29:23,419
specifications were quite if he would at

680
00:29:28,659 --> 00:29:26,419
best we didn't know exactly what what

681
00:29:30,029 --> 00:29:28,669
that car had to do so we gave the

682
00:29:32,409 --> 00:29:30,039
contract there's some very broad

683
00:29:35,969 --> 00:29:32,419
guidelines for specifications like it

684
00:29:38,469 --> 00:29:35,979
had to be stable on a 45-degree slope

685
00:29:41,979 --> 00:29:38,479
not only going up but but as well as

686
00:29:44,349 --> 00:29:41,989
downhill in sideways okay so that drove

687
00:29:46,619 --> 00:29:44,359
them into a big a big car design not a

688
00:29:49,659 --> 00:29:46,629

little one because they needed the wide

689

00:29:52,919 --> 00:29:49,669

expanse of the car to keep from hitting

690

00:29:55,450 --> 00:29:52,929

a rock or a crater and tipping over

691

00:29:57,209 --> 00:29:55,460

that's what we were faced with and we

692

00:30:00,700 --> 00:29:57,219

went out for bids with the contractors

693

00:30:03,129 --> 00:30:00,710

we had not yet landed on the moon and we

694

00:30:06,430 --> 00:30:03,139

selected a contractor we landed on the

695

00:30:09,940 --> 00:30:06,440

moon in July as I remember xx we were

696

00:30:13,239 --> 00:30:09,950

given the go-ahead before that time we

697

00:30:16,629 --> 00:30:13,249

finally picked the contractor decide the

698

00:30:19,629 --> 00:30:16,639

contract on the 1st of November and we

699

00:30:22,749 --> 00:30:19,639

had only 17 and a half months to design

700

00:30:25,149 --> 00:30:22,759

it test it build it and deliver flight

701
00:30:28,599 --> 00:30:25,159
hardware to the Cape so we went out for

702
00:30:30,029 --> 00:30:28,609
bid and lo and behold the Boeing teamed

703
00:30:33,459 --> 00:30:30,039
up with General Motors and General

704
00:30:37,269 --> 00:30:33,469
Motors was a subcontractor to Boeing on

705
00:30:39,909 --> 00:30:37,279
it and they got the bid they wanted they

706
00:30:43,060 --> 00:30:39,919
had the lowest cost the problem was

707
00:30:44,919 --> 00:30:43,070
there that the designs that our people

708
00:30:47,229 --> 00:30:44,929
in the lab were running and they were

709
00:30:49,779 --> 00:30:47,239
running cost estimates on it and they

710
00:30:52,239 --> 00:30:49,789
they looked like to them that it was

711
00:30:54,500 --> 00:30:52,249
gonna cost about 40 million dollars to

712
00:30:57,530 --> 00:30:54,510
develop and build that hardware

713
00:31:01,240 --> 00:30:57,540

we were getting bids in from the guy who

714

00:31:03,650 --> 00:31:01,250

knew the most on it over 26 million and

715

00:31:08,240 --> 00:31:03,660

the guy who knew the least which was the

716

00:31:10,430 --> 00:31:08,250

Boeing General Motors combination they

717

00:31:12,830 --> 00:31:10,440

bid the thing the lowest of all at

718

00:31:15,560 --> 00:31:12,840

nineteen point six million I think it

719

00:31:18,740 --> 00:31:15,570

was so we were concerned about the fact

720

00:31:20,390 --> 00:31:18,750

that we had a low bid in there well I

721

00:31:22,669 --> 00:31:20,400

took that up to NASA headquarters when

722

00:31:24,560 --> 00:31:22,679

we decided who ought to possibly get

723

00:31:27,730 --> 00:31:24,570

this thing with our recommendations and

724

00:31:31,039 --> 00:31:27,740

the question came up because of the cost

725

00:31:34,610 --> 00:31:31,049

you think that Boeing would not be able

726
00:31:35,690 --> 00:31:34,620
to do the job and my comment was sure

727
00:31:38,060 --> 00:31:35,700
they'll be able to do it

728
00:31:41,270 --> 00:31:38,070
I just don't have as much confidence in

729
00:31:44,570 --> 00:31:41,280
their price as I do with some of the

730
00:31:45,830 --> 00:31:44,580
others and I said well if they can do

731
00:31:47,930 --> 00:31:45,840
the job let's give it to him

732
00:31:49,940 --> 00:31:47,940
well in the meantime sunny mariah has

733
00:31:52,280 --> 00:31:49,950
stuck with the job of negotiating a

734
00:31:55,120 --> 00:31:52,290
contract with a contractor that I was

735
00:31:58,940 --> 00:31:55,130
concerned was gonna overrun severely and

736
00:32:01,610 --> 00:31:58,950
and with a specification that we didn't

737
00:32:03,740 --> 00:32:01,620
know and he very much about we couldn't

738
00:32:05,659 --> 00:32:03,750

give him the details that we wanted to

739

00:32:08,600 --> 00:32:05,669

give him so we gave him very general

740

00:32:11,299 --> 00:32:08,610

details so now that question is you know

741

00:32:13,700 --> 00:32:11,309

if he begins to overrun well we're gonna

742

00:32:15,590 --> 00:32:13,710

get ourselves out of this mess we still

743

00:32:18,650 --> 00:32:15,600

didn't know the conditions on the

744

00:32:21,260 --> 00:32:18,660

surface we were just getting the first

745

00:32:23,480 --> 00:32:21,270

results back from Apollo 11 so NASA

746

00:32:25,610 --> 00:32:23,490

decided they were going to incentivize

747

00:32:27,980 --> 00:32:25,620

all of our contracts that was the big

748

00:32:30,830 --> 00:32:27,990

push incentivize all the big contracts

749

00:32:33,820 --> 00:32:30,840

so we were locked into going in with an

750

00:32:36,560 --> 00:32:33,830

incentive contract we finally picked

751
00:32:39,680 --> 00:32:36,570
telling them okay look if this program

752
00:32:43,419 --> 00:32:39,690
overruns 100 percent from what you you

753
00:32:48,220 --> 00:32:43,429
know you proposed you get zero fee okay

754
00:32:51,590 --> 00:32:48,230
and if you don't do deliver on time and

755
00:32:53,090 --> 00:32:51,600
the program gets cancelled because we

756
00:32:55,700 --> 00:32:53,100
were already told by the NASA

757
00:32:57,590 --> 00:32:55,710
Administrator that if we're not ready

758
00:32:59,810 --> 00:32:57,600
with that in flight hardware at the Cape

759
00:33:03,780 --> 00:32:59,820
seventeen and a half months from go

760
00:33:06,580 --> 00:33:03,790
ahead that they go without us without a

761
00:33:09,760 --> 00:33:06,590
so we said okay if you missed that

762
00:33:11,950 --> 00:33:09,770
delivery the first one I forget whether

763
00:33:14,350 --> 00:33:11,960

we told him they'd get a third off or

764

00:33:16,540 --> 00:33:14,360

what it was but we would penalize him a

765

00:33:18,040 --> 00:33:16,550

significant amount type of thing but it

766

00:33:20,770 --> 00:33:18,050

was another way for them to earn little

767

00:33:22,870 --> 00:33:20,780

of No Fee and then the third area was

768

00:33:25,240 --> 00:33:22,880

what happens if it technically doesn't

769

00:33:26,980 --> 00:33:25,250

do the job you know you can't climb the

770

00:33:29,170 --> 00:33:26,990

slope you can't get over there because

771

00:33:31,360 --> 00:33:29,180

the temperatures are wrong it hits a

772

00:33:34,570 --> 00:33:31,370

pothole or rock it had to go over Rock

773

00:33:36,400 --> 00:33:34,580

one foot high at high set top speed of a

774

00:33:40,540 --> 00:33:36,410

vehicle which was not very fast by the

775

00:33:43,090 --> 00:33:40,550

way like at 7 miles an hour all right

776

00:33:45,340 --> 00:33:43,100

but nevertheless you try going over a

777

00:33:48,460 --> 00:33:45,350

one foot obstacle with your car it's at

778

00:33:49,600 --> 00:33:48,470

7 miles an hour it's not an easy feat we

779

00:33:50,050 --> 00:33:49,610

have to be able to do that in this

780

00:33:53,260 --> 00:33:50,060

vehicle

781

00:33:56,050 --> 00:33:53,270

and it had had to be able to go into a

782

00:33:59,500 --> 00:33:56,060

crater that was 2 feet in diameter one

783

00:34:01,750 --> 00:33:59,510

foot deep and not tip over at the top

784

00:34:03,670 --> 00:34:01,760

speed had to be able to be at that top

785

00:34:05,800 --> 00:34:03,680

speed on the side of the mountain we

786

00:34:07,810 --> 00:34:05,810

negotiated that contract and we were all

787

00:34:10,360 --> 00:34:07,820

pretty proud there well we protected the

788

00:34:11,860 --> 00:34:10,370

government's interest somehow well

789

00:34:14,440 --> 00:34:11,870

everything was going fine except about

790

00:34:17,110 --> 00:34:14,450

three months into the program my team of

791

00:34:19,149 --> 00:34:17,120

guys who are watching the costs said you

792

00:34:21,340 --> 00:34:19,159

know they're not getting the the

793

00:34:23,200 --> 00:34:21,350

milestones accomplished that they said

794

00:34:24,850 --> 00:34:23,210

they would have done by now but they've

795

00:34:29,020 --> 00:34:24,860

spent the money that would have been

796

00:34:32,740 --> 00:34:29,030

spent so they began raising the red flag

797

00:34:35,649 --> 00:34:32,750

to me and I immediately raised it to my

798

00:34:37,740 --> 00:34:35,659

management well the guy up at

799

00:34:42,700 --> 00:34:37,750

headquarters his name was Rocco patron

800

00:34:44,409 --> 00:34:42,710

hurried about possible overrun and there

801
00:34:46,389 --> 00:34:44,419
was a congressional investigation that

802
00:34:50,560 --> 00:34:46,399
was kicked off to find out why this

803
00:34:52,300 --> 00:34:50,570
program might be in a 100% overrun all

804
00:34:54,669 --> 00:34:52,310
right and Rocco patron got in the middle

805
00:34:57,040 --> 00:34:54,679
of that and he squealed on the telephone

806
00:35:01,000 --> 00:34:57,050
to me what was going on and I figure my

807
00:35:03,070 --> 00:35:01,010
job was over you know well he went to

808
00:35:06,240 --> 00:35:03,080
Congress apparently and reported to the

809
00:35:08,470 --> 00:35:06,250
committee's I heard nothing from nothing

810
00:35:11,200 --> 00:35:08,480
and I know what was going on because

811
00:35:13,810 --> 00:35:11,210
well I expected the GAO team to be down

812
00:35:14,530 --> 00:35:13,820
in my office by the month of September

813
00:35:15,610 --> 00:35:14,540

and

814

00:35:18,070 --> 00:35:15,620

weren't there they didn't communicate

815

00:35:18,690 --> 00:35:18,080

with me or anything and I was still on

816

00:35:22,240 --> 00:35:18,700

the job

817

00:35:24,640 --> 00:35:22,250

so I finally called his Bracco's chief

818

00:35:27,160 --> 00:35:24,650

engineer fella by the name of Ben mill

819

00:35:29,500 --> 00:35:27,170

Witzke wonderful technically oriented

820

00:35:32,080 --> 00:35:29,510

guy who stayed in the program from day

821

00:35:35,940 --> 00:35:32,090

one he went to all my meetings came to

822

00:35:38,380 --> 00:35:35,950

all of my reviews so he was very well

823

00:35:40,720 --> 00:35:38,390

into the program integrated into it he

824

00:35:43,120 --> 00:35:40,730

knew what was going on and I said Ben I

825

00:35:46,150 --> 00:35:43,130

haven't heard from Rocko what's happened

826

00:35:48,850 --> 00:35:46,160

the GAO coming a win he says oh didn't

827

00:35:50,890 --> 00:35:48,860

he call you and I said no yeah I said

828

00:35:53,530 --> 00:35:50,900

what happened is he went to Congress and

829

00:35:56,020 --> 00:35:53,540

the congressional staffers said they

830

00:35:58,030 --> 00:35:56,030

were amazed at how well that thing was

831

00:36:00,490 --> 00:35:58,040

organized in terms of protecting the

832

00:36:03,880 --> 00:36:00,500

government's interests they turned the

833

00:36:06,820 --> 00:36:03,890

GAO off off the GAO was turned off by

834

00:36:13,310 --> 00:36:06,830

the congressional staffers okay never

835

00:36:19,790 --> 00:36:16,600

he was probably the most incredible

836

00:36:21,940 --> 00:36:19,800

positive manager that I have ever seen

837

00:36:25,220 --> 00:36:21,950

in my life I worked for in my life

838

00:36:27,860 --> 00:36:25,230

people were his product not the hardware

839

00:36:29,030 --> 00:36:27,870

as much as the people I went on a tour

840

00:36:30,950 --> 00:36:29,040

with one Brown of one of the

841

00:36:33,920 --> 00:36:30,960

laboratories structures and propulsion

842

00:36:37,130 --> 00:36:33,930

and I think a lab director was with us

843

00:36:39,260 --> 00:36:37,140

myself and my immediate boss and he

844

00:36:41,600 --> 00:36:39,270

would just drop in on his laboratories

845

00:36:45,020 --> 00:36:41,610

he had nine labs he just dropped in and

846

00:36:46,670 --> 00:36:45,030

asked the manager the lab director how

847

00:36:47,780 --> 00:36:46,680

about taking me around so let's see what

848

00:36:49,820 --> 00:36:47,790

you all doing here

849

00:36:52,160 --> 00:36:49,830

so he was walking down the hall and he

850

00:36:54,470 --> 00:36:52,170

peered into one of the rooms and he saw

851
00:36:56,720 --> 00:36:54,480
this single the young guy on a drafting

852
00:36:58,790 --> 00:36:56,730
board drawing on something he just

853
00:37:01,670 --> 00:36:58,800
walked in and he said hi I'm Reina von

854
00:37:03,500 --> 00:37:01,680
Braun and he says who are you and kid

855
00:37:06,080 --> 00:37:03,510
introduced himself he was an intern you

856
00:37:08,060 --> 00:37:06,090
know he wasn't even an employee and he

857
00:37:09,950 --> 00:37:08,070
was working on he was drafting something

858
00:37:14,210 --> 00:37:09,960
so what he doing he says well I'm

859
00:37:16,400 --> 00:37:14,220
drafting a a fairing to put on a a line

860
00:37:20,450 --> 00:37:16,410
that comes out of the Redstone event

861
00:37:22,100 --> 00:37:20,460
line of some type and and I got this eye

862
00:37:24,140 --> 00:37:22,110
arrow dynamic fairing that I'm trying to

863
00:37:26,150 --> 00:37:24,150

design on it and von Braun looked at it

864

00:37:28,880 --> 00:37:26,160

and says oh he says you know what that

865

00:37:30,590 --> 00:37:28,890

line is and the kids said no and he said

866

00:37:31,910 --> 00:37:30,600

and explained to him he knew the

867

00:37:34,070 --> 00:37:31,920

hardware well enough that he knew what

868

00:37:36,440 --> 00:37:34,080

that vent line was and how important it

869

00:37:40,220 --> 00:37:36,450

was and he explained this to this young

870

00:37:41,930 --> 00:37:40,230

engineer to be and then when he was

871

00:37:44,390 --> 00:37:41,940

through explaining it he says you know

872

00:37:45,860 --> 00:37:44,400

let me see if I can improve a little bit

873

00:37:47,750 --> 00:37:45,870

on the curves that you got in this thing

874

00:37:49,820 --> 00:37:47,760

from the little knowledge I have of

875

00:37:51,290 --> 00:37:49,830

aerodynamics he says I think if you

876

00:37:53,810 --> 00:37:51,300

change the design a little bit in this

877

00:37:55,400 --> 00:37:53,820

area and he sat down on the kid bench

878

00:37:57,050 --> 00:37:55,410

right next to him and he started

879

00:37:58,880 --> 00:37:57,060

redesigning it for him a little bit to

880

00:38:00,020 --> 00:37:58,890

improve it and he says I think that

881

00:38:03,320 --> 00:38:00,030

would work a little better what do you

882

00:38:05,720 --> 00:38:03,330

think kids yeah that looks good and he

883

00:38:08,360 --> 00:38:05,730

left now what do you think is in the

884

00:38:12,110 --> 00:38:08,370

mind of that young man having met the

885

00:38:14,330 --> 00:38:12,120

giant of all engineers and in the space

886

00:38:16,370 --> 00:38:14,340

program to have sat down with him and

887

00:38:20,670 --> 00:38:16,380

personally given him a little bit of a

888

00:38:23,950 --> 00:38:20,680

of an insight just great

889

00:38:28,269 --> 00:38:23,960

yes great the first man I went to work

890

00:38:31,120 --> 00:38:28,279

for I got involved in the in the

891

00:38:33,490 --> 00:38:31,130

actuator on the redstone and it was in

892

00:38:36,900 --> 00:38:33,500

an office that was headed by a fella by

893

00:38:38,650 --> 00:38:36,910

the name of Curt Linda

894

00:38:41,829 --> 00:38:38,660

apparently he was a doggone good

895

00:38:44,170 --> 00:38:41,839

engineer and when Hitler when von Braun

896

00:38:47,079 --> 00:38:44,180

decided who he was gonna take out with

897

00:38:49,750 --> 00:38:47,089

him he picked Kurt to go with him so he

898

00:38:52,720 --> 00:38:49,760

basically saved Kurt's life because the

899

00:38:54,940 --> 00:38:52,730

Russians over ran Peenemunde a but Kirk

900

00:38:58,029 --> 00:38:54,950

got into this country so he was a very

901
00:39:00,880 --> 00:38:58,039
devoted individual to von Braun well

902
00:39:02,829 --> 00:39:00,890
Kirk gets to have a heart attack that

903
00:39:06,190 --> 00:39:02,839
almost took him out and I was in the

904
00:39:08,529 --> 00:39:06,200
office when Kurt came back after his

905
00:39:09,130 --> 00:39:08,539
heart attack and he's getting ready to

906
00:39:11,880 --> 00:39:09,140
work again

907
00:39:14,349 --> 00:39:11,890
because we had this problem with this

908
00:39:18,039 --> 00:39:14,359
operation up in New York that I was

909
00:39:20,259 --> 00:39:18,049
doing liaison work with and von Braun

910
00:39:22,529 --> 00:39:20,269
sat down with Kurt and he said Kurt I've

911
00:39:26,710 --> 00:39:22,539
made arrangements to get you a full

912
00:39:28,960 --> 00:39:26,720
medical retirement okay and I want you

913
00:39:32,529 --> 00:39:28,970

to go ahead and take it we don't need

914

00:39:35,470 --> 00:39:32,539

you dropping dead on the job and Kurt

915

00:39:40,240 --> 00:39:35,480

listened and he said Verna he says no I

916

00:39:43,599 --> 00:39:40,250

will not leave you his you've saved my

917

00:39:45,549 --> 00:39:43,609

life once before he says I want to die

918

00:39:49,029 --> 00:39:45,559

on the job if I have to working for you

919

00:39:52,420 --> 00:39:49,039

and if you I'm Brown was arguing with

920

00:39:54,870 --> 00:39:52,430

him no I want to stay I want to help the

921

00:39:57,329 --> 00:39:54,880

best I can

922

00:40:01,059 --> 00:39:57,339

well Kurt died two or three years later

923

00:40:03,069 --> 00:40:01,069

but he died at home but he didn't retire

924

00:40:05,859 --> 00:40:03,079

he worked von Braun tore up the

925

00:40:08,799 --> 00:40:05,869

paperwork and let him stay on Dida growl

926

00:40:10,839 --> 00:40:08,809

was head of our control quality control

927

00:40:13,210 --> 00:40:10,849

laboratory okay he was one of the

928

00:40:18,999 --> 00:40:13,220

Germans that came over with von Braun

929

00:40:21,370 --> 00:40:19,009

and the army was doing hydrogen bomb

930

00:40:24,160 --> 00:40:21,380

testing at Kwajalein and out in the

931

00:40:26,980 --> 00:40:24,170

Pacific there and they came to NASA if

932

00:40:29,670 --> 00:40:26,990

we had anyone who had a good experience

933

00:40:32,849 --> 00:40:29,680

in quality control okay

934

00:40:35,819 --> 00:40:32,859

so von braun offered up dieter ground to

935

00:40:38,640 --> 00:40:35,829

help so the girl had an assignment went

936

00:40:42,809 --> 00:40:38,650

to Quadra Lane and did his thing in in

937

00:40:46,589 --> 00:40:42,819

the quality control area on the bomb and

938

00:40:49,380 --> 00:40:46,599

when he came back he was asked to give

939

00:40:51,750 --> 00:40:49,390

us a rundown as to generally you know

940

00:40:53,460 --> 00:40:51,760

what his experiences were and what did

941

00:40:56,160 --> 00:40:53,470

he do and that sort of thing without

942

00:40:57,510 --> 00:40:56,170

getting into sensitive areas dieter got

943

00:40:58,950 --> 00:40:57,520

up then he was and I happened to be in

944

00:41:01,410 --> 00:40:58,960

the meeting for this and it really

945

00:41:03,120 --> 00:41:01,420

impressed me because he he had trouble

946

00:41:05,490 --> 00:41:03,130

with the English language which was

947

00:41:08,010 --> 00:41:05,500

another story too was von Braun insisted

948

00:41:10,140 --> 00:41:08,020

that they not speak German if there was

949

00:41:12,510 --> 00:41:10,150

an American in the room that they speak

950

00:41:15,359 --> 00:41:12,520

English so he forced him to speak

951
00:41:16,230 --> 00:41:15,369
English rather than have him communicate

952
00:41:18,870 --> 00:41:16,240
even though they could better

953
00:41:21,029 --> 00:41:18,880
communicate in German with fun Brown he

954
00:41:24,750 --> 00:41:21,039
wouldn't let him do that so he gets into

955
00:41:26,849 --> 00:41:24,760
this in this presentation now and you

956
00:41:28,289 --> 00:41:26,859
could see that he was stumbling a little

957
00:41:30,480 --> 00:41:28,299
bit because of the English language

958
00:41:32,819 --> 00:41:30,490
of trying to get his points across and

959
00:41:34,769 --> 00:41:32,829
von Braun instead of embarrassing him

960
00:41:37,289 --> 00:41:34,779
like a later director would have done

961
00:41:38,819 --> 00:41:37,299
okay he says neither wait a minute let

962
00:41:41,130 --> 00:41:38,829
me see if I understand what you're

963
00:41:42,720 --> 00:41:41,140

telling me are you telling me and he

964

00:41:45,450 --> 00:41:42,730

went ahead and gave a summary on this

965

00:41:48,000 --> 00:41:45,460

chart of what Dida was trying to say he

966

00:41:49,440 --> 00:41:48,010

and when he was done doing that do you

967

00:41:56,680 --> 00:41:49,450

say yeah that's what I meant

968

00:42:02,079 --> 00:41:59,800

vacation I was a private pilot and I had

969

00:42:04,990 --> 00:42:02,089

an illinois airplane and my kids hadn't

970

00:42:07,270 --> 00:42:05,000

been on a big vacation or my wife in ten

971

00:42:10,210 --> 00:42:07,280

years I spent seven and a half years

972

00:42:12,460 --> 00:42:10,220

developing the f1 as a manager another

973

00:42:14,109 --> 00:42:12,470

two and a half years on the j2 so I had

974

00:42:16,329 --> 00:42:14,119

ten years that we hadn't had any big

975

00:42:18,250 --> 00:42:16,339

vacation but because I had the use of

976

00:42:20,890 --> 00:42:18,260

the plane I could fly down to the Gulf

977

00:42:22,780 --> 00:42:20,900

on a weekend get a dip in the in the

978

00:42:23,740 --> 00:42:22,790

Gulf come back and be at work on Monday

979

00:42:25,960 --> 00:42:23,750

morning okay

980

00:42:27,760 --> 00:42:25,970

and we did that for a year or two you

981

00:42:30,359 --> 00:42:27,770

know just one after the others fortunate

982

00:42:33,280 --> 00:42:30,369

that I had an airplane I was a

983

00:42:36,160 --> 00:42:33,290

commercially rated pilot and I was a

984

00:42:38,170 --> 00:42:36,170

flight instructor and so I could fly my

985

00:42:40,770 --> 00:42:38,180

airplane just about any place I wanted

986

00:42:43,870 --> 00:42:40,780

to it had a thousand mile range and

987

00:42:46,030 --> 00:42:43,880

every Christmas we used to fly it to New

988

00:42:48,069 --> 00:42:46,040

York for the holidays took the whole

989

00:42:50,380 --> 00:42:48,079

family with me and I could get to New

990

00:42:52,270 --> 00:42:50,390

York in five hours in ten minutes from

991

00:42:54,130 --> 00:42:52,280

the time I left the ground here in

992

00:42:55,690 --> 00:42:54,140

Huntsville and I couldn't beat that with

993

00:42:57,430 --> 00:42:55,700

a commercial airline in those days

994

00:42:59,200 --> 00:42:57,440

because I had to go to the land and

995

00:43:02,319 --> 00:42:59,210

change airplanes there was always a

996

00:43:03,940 --> 00:43:02,329

major delay between flights so I

997

00:43:06,160 --> 00:43:03,950

actually could get to New York faster in

998

00:43:07,599 --> 00:43:06,170

my own small airplane than if I went

999

00:43:10,240 --> 00:43:07,609

through the commercial airline routine

1000

00:43:13,599 --> 00:43:10,250

plus it was cheaper at least

1001

00:43:15,700 --> 00:43:13,609

incrementally so not for the price of

1002

00:43:17,770 --> 00:43:15,710

the airplane and so we used to go up

1003

00:43:19,720 --> 00:43:17,780

there for Christmas all the time I could

1004

00:43:23,079 --> 00:43:19,730

do that and we used to take those summer

1005

00:43:25,240 --> 00:43:23,089

vacations two days at a time one day at

1006

00:43:27,160 --> 00:43:25,250

a time because I had the plane I can be

1007

00:43:29,020 --> 00:43:27,170

down at the beach we take off at 8

1008

00:43:31,120 --> 00:43:29,030

o'clock on a Saturday morning I was in

1009

00:43:32,950 --> 00:43:31,130

the Gulf of Mexico swimming at 11

1010

00:43:37,820 --> 00:43:32,960

o'clock in the morning so it was that

1011

00:43:41,540 --> 00:43:39,770

well I think the legacy of the whole

1012

00:43:44,240 --> 00:43:41,550

space program is that it really has

1013

00:43:47,120 --> 00:43:44,250

opened up a whole new venue for mankind

1014

00:43:50,360 --> 00:43:47,130

now you know the astronaut said it right

1015

00:43:54,910 --> 00:43:50,370

this is one small step for man one major

1016

00:43:57,650 --> 00:43:54,920

step for mankind paraphrased I guess but

1017

00:43:59,990 --> 00:43:57,660

and I think that is the legacy of this

1018

00:44:03,110 --> 00:44:00,000

whole thing I've been a part of that

1019

00:44:06,530 --> 00:44:03,120

program that has opened up mankind's

1020

00:44:10,550 --> 00:44:06,540

view into the future and the exploration

1021

00:44:13,910 --> 00:44:10,560

for life elsewhere the exploration of

1022

00:44:17,180 --> 00:44:13,920

our whole universe you know the the

1023

00:44:19,700 --> 00:44:17,190

Egyptians I guess in my mind they the

1024

00:44:23,930 --> 00:44:19,710

ancient Egyptians kind of developed the

1025

00:44:25,640 --> 00:44:23,940

concept of an afterlife okay that's why

1026

00:44:29,380 --> 00:44:25,650

they built those huge pyramids for the

1027

00:44:33,710 --> 00:44:29,390

for the Pharaohs the Greeks gave us

1028

00:44:35,900 --> 00:44:33,720

philosophy and and the architecture that

1029

00:44:40,190 --> 00:44:35,910

they left with us which is incredible

1030

00:44:43,250 --> 00:44:40,200

and the Romans gave us some of the best

1031

00:44:45,410 --> 00:44:43,260

engineering activities in the world at

1032

00:44:47,840 --> 00:44:45,420

the time and so I think we're in the

1033

00:44:49,610 --> 00:44:47,850

next phase now you know the Wright

1034

00:44:51,860 --> 00:44:49,620

brothers and those who were in that

1035

00:44:54,380 --> 00:44:51,870

field at the time they gave us the world

1036

00:44:56,540 --> 00:44:54,390

of aviation which allowed man to fly off

1037

00:44:58,730 --> 00:44:56,550

the ground like the birds and I think

1038

00:45:01,430 --> 00:44:58,740

we've given man the capability in the

1039

00:45:02,750 --> 00:45:01,440

space program now to fly off to the