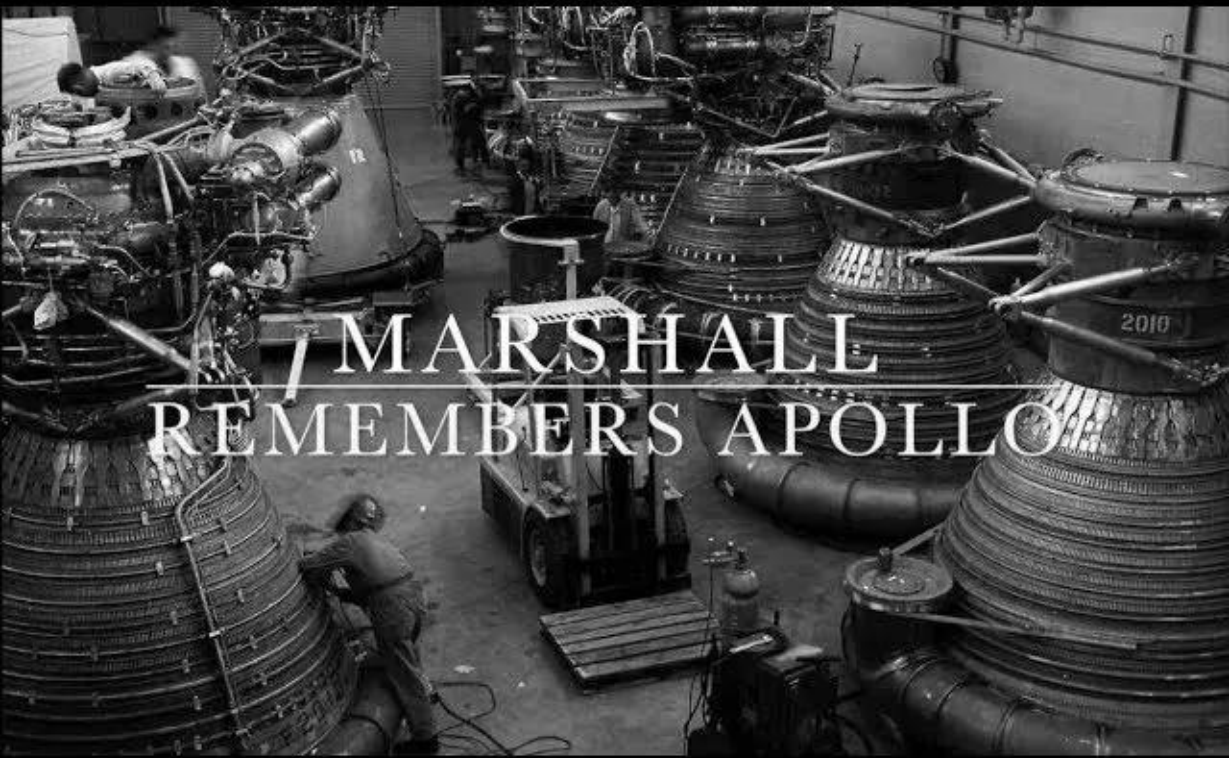
MARSHALL
REMEMBERS APOLLO

1
00:00:21,170 --> 00:00:16,300
[Music]

2
00:00:23,420 --> 00:00:21,180
well in 1960 my we returned from Okinawa

3
00:00:24,970 --> 00:00:23,430
my dad was Air Force and he was

4
00:00:27,290 --> 00:00:24,980
stationed at Patrick Air Force Base

5
00:00:30,499 --> 00:00:27,300
which as you know was just down the road

6
00:00:32,930 --> 00:00:30,509
from Cape Canaveral so I went to high

7
00:00:37,930 --> 00:00:32,940
school there I was a freshman there and

8
00:00:43,250 --> 00:00:37,940
saw the launch of Sheppard and Glen and

9
00:00:45,170 --> 00:00:43,260
I loved math and science ah that's what

10
00:00:47,030 --> 00:00:45,180
I want to do and since dad was Air Force

11
00:00:48,979 --> 00:00:47,040
need been an Air Force pilot I always

12
00:00:49,939 --> 00:00:48,989
loved airplanes and one said I said okay

13
00:00:52,729 --> 00:00:49,949

this sounds great

14
00:00:54,979 --> 00:00:52,739
so going into high school and then I got

15
00:00:56,600 --> 00:00:54,989
interviewed by the Dean of engineering

16
00:00:58,240 --> 00:00:56,610
at Florida State University and they

17
00:01:03,710 --> 00:00:58,250
were looking for co-op students

18
00:01:05,750 --> 00:01:03,720
specifically for NASA so I said okay I

19
00:01:08,539 --> 00:01:05,760
went to Florida State in the engineering

20
00:01:12,050 --> 00:01:08,549
school and astronautical engineering

21
00:01:17,240 --> 00:01:12,060
wound up coming to Marshall to as a

22
00:01:19,160 --> 00:01:17,250
co-op student in 65 and it was amazing I

23
00:01:22,220 --> 00:01:19,170
mean to come here and so much was going

24
00:01:25,190 --> 00:01:22,230
on and everybody was so busy and we were

25
00:01:27,110 --> 00:01:25,200
just all heads down trying to get ready

26
00:01:29,720 --> 00:01:27,120
and you know it didn't matter that I was

27
00:01:30,440 --> 00:01:29,730
a co-op it didn't matter that I was 19

28
00:01:33,230 --> 00:01:30,450
years old

29
00:01:35,149 --> 00:01:33,240
so got into a lot of good work really

30
00:01:37,220 --> 00:01:35,159
quickly and got to do some things that

31
00:01:39,860 --> 00:01:37,230
really kind of showed me what

32
00:01:41,240 --> 00:01:39,870
engineering was I'm not sure people that

33
00:01:43,280 --> 00:01:41,250
go into engineering school really know

34
00:01:45,440 --> 00:01:43,290
what it is and I think here it's special

35
00:01:47,750 --> 00:01:45,450
anyway but that really hands-on

36
00:01:49,520 --> 00:01:47,760
experience was wonderful and going back

37
00:01:51,560 --> 00:01:49,530
to school it was kind of multi

38
00:01:56,230 --> 00:01:51,570

motivational both directions really

39
00:02:02,620 --> 00:01:59,380
I reported to Marshall signed in the

40
00:02:05,500 --> 00:02:02,630
next day they sent me out to school I

41
00:02:08,050 --> 00:02:05,510
just come back from school but they sent

42
00:02:09,910 --> 00:02:08,060
me out to IBM and I had to learn to

43
00:02:12,180 --> 00:02:09,920
program a computer because as you know

44
00:02:15,610 --> 00:02:12,190
we are it was early in the computer age

45
00:02:19,480 --> 00:02:15,620
so they sent me off off post to IBM and

46
00:02:22,510 --> 00:02:19,490
what I had to learn was machine language

47
00:02:24,910 --> 00:02:22,520
because that's what we coded in so

48
00:02:27,130 --> 00:02:24,920
everything was machine language commands

49
00:02:28,960 --> 00:02:27,140
there was none of this basic and Fortran

50
00:02:32,050 --> 00:02:28,970
and all that stuff didn't even exist and

51
00:02:34,750 --> 00:02:32,060
we only had I think somebody's told me

52
00:02:37,840 --> 00:02:34,760
one time about 275 K of memory on the

53
00:02:41,830 --> 00:02:37,850
whole bird so the whole trick was to be

54
00:02:44,050 --> 00:02:41,840
able to put as much process into as few

55
00:02:46,030 --> 00:02:44,060
steps as you can get because you really

56
00:02:47,140 --> 00:02:46,040
had to compress the memory so that was

57
00:02:49,930 --> 00:02:47,150
the challenge for programmers

58
00:02:51,610 --> 00:02:49,940
fortunately I wasn't a programmer but I

59
00:02:56,040 --> 00:02:51,620
could understand it well enough to do my

60
00:03:02,140 --> 00:02:56,050
real job which was punching data into

61
00:03:04,390 --> 00:03:02,150
data cards physical paper cards that we

62
00:03:07,330 --> 00:03:04,400
generated a stack about this long and

63
00:03:09,699 --> 00:03:07,340

fed them manually through a printer what

64
00:03:11,740 --> 00:03:09,709
all those cards were were data from the

65
00:03:14,080 --> 00:03:11,750
flight tests of the Saturn and the

66
00:03:16,509 --> 00:03:14,090
engines because what we were trying to

67
00:03:19,330 --> 00:03:16,519
do was make sure the trajectory was

68
00:03:20,620 --> 00:03:19,340
refined you had to know the weight and

69
00:03:22,570 --> 00:03:20,630
where the center of gravity was

70
00:03:25,150 --> 00:03:22,580
constantly to know how much fuel you

71
00:03:27,009 --> 00:03:25,160
were burning what the burn rate was at a

72
00:03:29,590 --> 00:03:27,019
particular time the angle the

73
00:03:32,140 --> 00:03:29,600
acceleration everything had to be

74
00:03:34,750 --> 00:03:32,150
understood so I did that for an entire

75
00:03:37,660 --> 00:03:34,760
co-op term was work and it was called

76
00:03:40,390 --> 00:03:37,670
weight weight and mass control and for

77
00:03:42,640 --> 00:03:40,400
the Saturn the next term I co-opted I

78
00:03:45,190 --> 00:03:42,650
was very fortunate and being sent to the

79
00:03:46,780 --> 00:03:45,200
materials division which was part of

80
00:03:49,780 --> 00:03:46,790
propulsion vehicle engineering

81
00:03:52,990 --> 00:03:49,790
laboratory at the time and there I got

82
00:03:55,300 --> 00:03:53,000
into some really great stuff one of the

83
00:03:58,840 --> 00:03:55,310
things they were doing when I got there

84
00:04:00,610 --> 00:03:58,850
was trying to figure out I don't know if

85
00:04:03,280 --> 00:04:00,620
you know what tribology means but it's

86
00:04:04,840 --> 00:04:03,290
kind of lubrication surface physics so I

87
00:04:06,610 --> 00:04:04,850
was in this group and what they were

88
00:04:08,560 --> 00:04:06,620

trying to figure out was how do they

89
00:04:09,330 --> 00:04:08,570
lubricate the clamps that were holding

90
00:04:12,270 --> 00:04:09,340
down

91
00:04:15,170 --> 00:04:12,280
Saturn five on the launch pad to make

92
00:04:19,560 --> 00:04:15,180
sure they all released in the same

93
00:04:21,599 --> 00:04:19,570
microsecond so it's not goose grease it

94
00:04:23,370 --> 00:04:21,609
wasn't bacon grease it wasn't anything

95
00:04:24,930 --> 00:04:23,380
that was currently available they were

96
00:04:27,689 --> 00:04:24,940
developing things that were called

97
00:04:30,900 --> 00:04:27,699
molybdenum disulphide lubricants and

98
00:04:33,270 --> 00:04:30,910
graphite mixed with that so I was the

99
00:04:35,460 --> 00:04:33,280
coop so I get to do a lot of the testing

100
00:04:37,469 --> 00:04:35,470
and it was a lot of long nights and a

101
00:04:40,409 --> 00:04:37,479
lot of long days but I loved it I'm

102
00:04:43,170 --> 00:04:40,419
working a real problem contributing

103
00:04:45,840 --> 00:04:43,180
directly to this vehicle that everybody

104
00:04:49,170 --> 00:04:45,850
was so excited about and I think it was

105
00:04:51,270 --> 00:04:49,180
just thinking about that as i sat there

106
00:04:52,740 --> 00:04:51,280
those long hours and one of the things I

107
00:04:57,719 --> 00:04:52,750
would think about was who would have

108
00:05:01,320 --> 00:04:57,729
thought to worry about that I was so

109
00:05:05,120 --> 00:05:01,330
impressed as a as a young person with

110
00:05:08,520 --> 00:05:05,130
the detail and the questioning and the

111
00:05:10,980 --> 00:05:08,530
curiosity and the the delving to know

112
00:05:13,260 --> 00:05:10,990
all the answers about everything no

113
00:05:15,270 --> 00:05:13,270

matter how small and this being such a

114
00:05:16,890 --> 00:05:15,280
small thing but you had a really bad day

115
00:05:19,529 --> 00:05:16,900
if they didn't all release at the same

116
00:05:21,629 --> 00:05:19,539
time and of course it all worked so what

117
00:05:24,060 --> 00:05:21,639
I found was if you ask questions people

118
00:05:25,560 --> 00:05:24,070
were so happy to help you and when I

119
00:05:27,870 --> 00:05:25,570
went to materials lab it was the

120
00:05:29,730 --> 00:05:27,880
technicians I wanted to learn how to

121
00:05:32,129 --> 00:05:29,740
operate the equipment in the laboratory

122
00:05:34,500 --> 00:05:32,139
I wanted to learn why they did what they

123
00:05:36,330 --> 00:05:34,510
did I wanted to learn what the data

124
00:05:38,820 --> 00:05:36,340
meant and how you accumulated the data

125
00:05:41,370 --> 00:05:38,830
and how you analyze the data all those

126
00:05:42,060 --> 00:05:41,380
things - part of finding answering a big

127
00:05:44,040 --> 00:05:42,070
question

128
00:05:46,920 --> 00:05:44,050
took that delving down into that

129
00:05:49,830 --> 00:05:46,930
solution level but everybody wanted to

130
00:05:52,620 --> 00:05:49,840
help they wanted to help you learn they

131
00:05:54,719 --> 00:05:52,630
wanted to help you do well in this very

132
00:05:58,050 --> 00:05:54,729
strange environment of working it was

133
00:06:00,300 --> 00:05:58,060
not school so it was there was never any

134
00:06:02,100 --> 00:06:00,310
question about finding help and that was

135
00:06:04,140 --> 00:06:02,110
that way throughout my entire career a

136
00:06:06,570 --> 00:06:04,150
member when I became a chief engineer

137
00:06:10,820 --> 00:06:06,580
and the first problem I got handed was a

138
00:06:14,810 --> 00:06:10,830

big discussion between dynamic sand and

139
00:06:18,779 --> 00:06:14,820
stress in a structure I called Bob Ryan

140
00:06:20,850 --> 00:06:18,789
Bob helped me I don't understand enough

141
00:06:21,610 --> 00:06:20,860
about this I'm not a mechanical engineer

142
00:06:24,070 --> 00:06:21,620
I'm not a done

143
00:06:27,219 --> 00:06:24,080
Amyx specialist so he gave me his

144
00:06:29,140 --> 00:06:27,229
version Jim Blair gave me the the the

145
00:06:31,390 --> 00:06:29,150
lecture on dynamics I said okay we're

146
00:06:33,700 --> 00:06:31,400
all going to get in a room and I had

147
00:06:36,129 --> 00:06:33,710
them explain the problem to me by which

148
00:06:37,780 --> 00:06:36,139
they came up with their own solution so

149
00:06:39,610 --> 00:06:37,790
it was all about their getting people

150
00:06:41,230 --> 00:06:39,620
talking but it was never a question of

151
00:06:43,060 --> 00:06:41,240
people being willing to teach you

152
00:06:49,109 --> 00:06:43,070
because they all loved what they did

153
00:06:53,369 --> 00:06:51,449
they were the ones also that started a

154
00:06:55,919 --> 00:06:53,379
little program here at Marshalls very

155
00:06:59,999 --> 00:06:55,929
low key called concept verification

156
00:07:02,369 --> 00:07:00,009
testing and I was fortunate enough to be

157
00:07:04,919 --> 00:07:02,379
engaged with that and dr. Mary Holland

158
00:07:07,199 --> 00:07:04,929
Johnson endorsed Chandler and Whitaker

159
00:07:10,739 --> 00:07:07,209
was involved with us and we became a

160
00:07:12,959 --> 00:07:10,749
female crew to CVT and the idea there

161
00:07:14,789 --> 00:07:12,969
was being able to be a scientist being

162
00:07:17,609 --> 00:07:14,799
able to interact in this modular

163
00:07:20,459 --> 00:07:17,619

environment on the ground but to help us

164
00:07:22,799 --> 00:07:20,469
understand how do you integrate how do

165
00:07:25,919 --> 00:07:22,809
you make the science operate how do you

166
00:07:29,669 --> 00:07:25,929
schedule crew how do you train them how

167
00:07:32,009 --> 00:07:29,679
do you communicate when their process of

168
00:07:33,749 --> 00:07:32,019
doing experiments is that they're alone

169
00:07:36,329 --> 00:07:33,759
doing their thing are you connected to

170
00:07:38,759 --> 00:07:36,339
the ground it was harder than I thought

171
00:07:41,759 --> 00:07:38,769
it would be because I thought it would

172
00:07:44,249 --> 00:07:41,769
be like walking into my lab and doing my

173
00:07:46,589 --> 00:07:44,259
thing with my hardware well no my

174
00:07:50,459 --> 00:07:46,599
hardware was up there it was not there

175
00:07:52,979 --> 00:07:50,469
and you couldn't just run to the toolbox

176
00:07:53,999 --> 00:07:52,989
if it wasn't on board that was part of

177
00:07:55,919 --> 00:07:54,009
the problems figuring out what do you

178
00:07:59,879 --> 00:07:55,929
take with you if it wasn't there you

179
00:08:01,049 --> 00:07:59,889
didn't have it so it was I think when

180
00:08:01,529 --> 00:08:01,059
they were learning to integrate the

181
00:08:03,419 --> 00:08:01,539
racks

182
00:08:05,519 --> 00:08:03,429
it was interesting a little thing they

183
00:08:08,040 --> 00:08:05,529
were they were trying a track approach

184
00:08:10,799 --> 00:08:08,050
where we'd roll the experiment racks in

185
00:08:12,269 --> 00:08:10,809
on the tracks well I went in there one

186
00:08:14,159 --> 00:08:12,279
day we were doing the checkout and

187
00:08:16,589 --> 00:08:14,169
testing getting ready to run our mission

188
00:08:19,409 --> 00:08:16,599

and I reached up and touched a rack and

189
00:08:23,489 --> 00:08:19,419
a spark about this long fluke the

190
00:08:25,769 --> 00:08:23,499
electrical had been fired from so we

191
00:08:28,259 --> 00:08:25,779
found out very quickly okay test and

192
00:08:31,109 --> 00:08:28,269
check out we need to do more tests and

193
00:08:33,029 --> 00:08:31,119
check out so that became a real effort

194
00:08:34,709 --> 00:08:33,039
especially for Space Lab and everything

195
00:08:36,779 --> 00:08:34,719
and a lot of that workhorse was done at

196
00:08:39,119 --> 00:08:36,789
KSC and teams from Marshall would go

197
00:08:41,459 --> 00:08:39,129
down there because you began to

198
00:08:43,170 --> 00:08:41,469
understand that if you're not as careful

199
00:08:45,420 --> 00:08:43,180
with this as you were with the launch

200
00:08:47,280 --> 00:08:45,430
vehicle then there's gonna be an issue

201
00:08:50,460 --> 00:08:47,290
they're gonna be things that don't work

202
00:08:52,860 --> 00:08:50,470
and and it all needs to work it's a big

203
00:08:54,929 --> 00:08:52,870
effort to put these things together but

204
00:08:57,030 --> 00:08:54,939
I think that was a quite an eye-opener

205
00:08:58,860 --> 00:08:57,040
for me I said wait a minute it doesn't

206
00:09:02,040 --> 00:08:58,870
mean just because somebody built it it

207
00:09:05,189 --> 00:09:02,050
was built right so it was a

208
00:09:07,799 --> 00:09:05,199
learning point to say okay ask again it

209
00:09:10,410 --> 00:09:07,809
was a lot of learning in not just

210
00:09:12,509 --> 00:09:10,420
operating in space Johnson Space Center

211
00:09:14,509 --> 00:09:12,519
is very good at that with their

212
00:09:18,210 --> 00:09:14,519
astronaut corps they do a fantastic job

213
00:09:20,429 --> 00:09:18,220

but then being able to take this science

214
00:09:22,470 --> 00:09:20,439
and observations of science and the data

215
00:09:25,439 --> 00:09:22,480
of science and how do you make that work

216
00:09:28,769 --> 00:09:25,449
how do you get the most out of it so we

217
00:09:30,900 --> 00:09:28,779
got out of CVT how do you configure Iraq

218
00:09:34,379 --> 00:09:30,910
how do you load an experiment how should

219
00:09:36,329 --> 00:09:34,389
you build them and it was it was quite a

220
00:09:37,999 --> 00:09:36,339
learning experience and then Marshall

221
00:09:41,400 --> 00:09:38,009
got the assignment to actually develop

222
00:09:43,679 --> 00:09:41,410
Space Lab and Jackley was a big project

223
00:09:45,929 --> 00:09:43,689
manager of that and that turned out of

224
00:09:48,900 --> 00:09:45,939
course to be just a wonderful program

225
00:09:51,179 --> 00:09:48,910
that that led directly to accomplishing

226
00:09:54,389 --> 00:09:51,189
the science on Space Station I mean we

227
00:09:56,789 --> 00:09:54,399
knew that we were kind of a thing I mean

228
00:09:58,499 --> 00:09:56,799
an all-female crew and I guess everybody

229
00:10:02,449 --> 00:09:58,509
thought we'd get in fights but of course

230
00:10:07,199 --> 00:10:02,459
we never did but you know it's when two

231
00:10:10,139 --> 00:10:07,209
needs merge and I think there was a need

232
00:10:12,629 --> 00:10:10,149
at the time for for something that

233
00:10:15,480 --> 00:10:12,639
reinforced the job that Marshall and

234
00:10:18,660 --> 00:10:15,490
NASA was doing and that that looked more

235
00:10:20,009 --> 00:10:18,670
to the future and and I think with

236
00:10:22,530 --> 00:10:20,019
everything that was going on the country

237
00:10:24,960 --> 00:10:22,540
was probably a good thing - I may be one

238
00:10:27,600 --> 00:10:24,970

until 1975 they opened up the astronaut

239
00:10:33,600 --> 00:10:27,610
selection to women and Marielle and I

240
00:10:35,669 --> 00:10:33,610
both applied to that in 75 so it was it

241
00:10:38,600 --> 00:10:35,679
met our needs I think it was a learning

242
00:10:41,519 --> 00:10:38,610
experience for all of us and it was

243
00:10:45,359 --> 00:10:41,529
intellectually mechanically stimulating

244
00:10:48,239 --> 00:10:45,369
to do it so I didn't I know we never

245
00:10:50,789 --> 00:10:48,249
felt badly about it I mean it was all

246
00:10:52,109 --> 00:10:50,799
goodness if it served them great and we

247
00:10:54,299 --> 00:10:52,119
were here working for the team at

248
00:10:56,789 --> 00:10:54,309
Marshall and we got a lot of learning

249
00:11:04,180 --> 00:10:56,799
out of it too that helped us much more

250
00:11:09,340 --> 00:11:06,790
that was a shock I mean I love we were

251
00:11:11,650 --> 00:11:09,350
invited to to go over and use the

252
00:11:13,889 --> 00:11:11,660
neutral buoyancy simulator but at the

253
00:11:16,810 --> 00:11:13,899
time we were also starting to really

254
00:11:19,030 --> 00:11:16,820
design and develop experiments for space

255
00:11:21,999 --> 00:11:19,040
but we didn't understand zero-gravity

256
00:11:24,910 --> 00:11:22,009
how it felt how it affected the design

257
00:11:26,800 --> 00:11:24,920
of your machinery Marshall was already

258
00:11:29,319 --> 00:11:26,810
training astronauts certainly in the

259
00:11:31,720 --> 00:11:29,329
neutral buoyancy simulator and the

260
00:11:35,170 --> 00:11:31,730
opportunity to go over there and learn

261
00:11:37,809 --> 00:11:35,180
and work with hardware changed how we

262
00:11:40,800 --> 00:11:37,819
thought about our hardware it wasn't

263
00:11:44,710 --> 00:11:40,810

like our lab and we needed that

264
00:11:46,689 --> 00:11:44,720
understanding very early on to be able

265
00:11:48,550 --> 00:11:46,699
to not only do things for ourselves but

266
00:11:50,680 --> 00:11:48,560
advised those scientists that we from

267
00:11:53,980 --> 00:11:50,690
the outside that we were working with as

268
00:11:55,900 --> 00:11:53,990
to how to do those things seeing myself

269
00:11:59,199 --> 00:11:55,910
in the scuba suit was nothing I ever

270
00:12:01,090 --> 00:11:59,209
really enjoyed but it it was I think it

271
00:12:05,139 --> 00:12:01,100
really contributed to the job it

272
00:12:07,240 --> 00:12:05,149
contributed to our understanding of what

273
00:12:09,639 --> 00:12:07,250
the people doing this stuff in space

274
00:12:11,740 --> 00:12:09,649
really had to work with and and it's

275
00:12:14,470 --> 00:12:11,750
hard it's really hard and we didn't

276
00:12:16,870 --> 00:12:14,480
appreciate that so much of it was about

277
00:12:19,780 --> 00:12:16,880
just a human factors aspect of operating

278
00:12:21,850 --> 00:12:19,790
in space and I mean an astronaut knows

279
00:12:24,220 --> 00:12:21,860
that once they've been into space they

280
00:12:25,840 --> 00:12:24,230
know it when they've been through the

281
00:12:27,840 --> 00:12:25,850
neutral buoyancy training and zero

282
00:12:29,949 --> 00:12:27,850
gravity flight and stuff like that but

283
00:12:32,379 --> 00:12:29,959
we didn't have anything like that here

284
00:12:35,019 --> 00:12:32,389
but using the neutral buoyancy simulator

285
00:12:36,670 --> 00:12:35,029
that made human factors real it wasn't

286
00:12:42,869 --> 00:12:36,680
reading a textbook it was actually

287
00:12:47,609 --> 00:12:45,059
doors worked in the systems laboratory

288
00:12:50,689 --> 00:12:47,619

which I had hardly heard of at the time

289
00:12:53,489 --> 00:12:50,699
because I was still in materials lab and

290
00:12:56,669 --> 00:12:53,499
she was probably the best systems

291
00:13:00,749 --> 00:12:56,679
engineer I run into at that point in my

292
00:13:04,859 --> 00:13:00,759
career so she helped all of us as the

293
00:13:07,529 --> 00:13:04,869
rest of the crew understand how to get

294
00:13:10,139 --> 00:13:07,539
things together and what we observed and

295
00:13:12,029 --> 00:13:10,149
what needed to be communicated I think

296
00:13:14,879 --> 00:13:12,039
that was a big thing to when we would

297
00:13:17,129 --> 00:13:14,889
try to do something on board and and we

298
00:13:18,269 --> 00:13:17,139
would well it was a struggle or we were

299
00:13:21,239 --> 00:13:18,279
trying to do something different she

300
00:13:24,090 --> 00:13:21,249
said you need to tell them because it's

301
00:13:26,759 --> 00:13:24,100
the engineers who are learning how we're

302
00:13:29,219 --> 00:13:26,769
going to go about doing this job and it

303
00:13:31,949 --> 00:13:29,229
was all about communicating that not

304
00:13:34,139 --> 00:13:31,959
just doing our thing but just as we were

305
00:13:36,769 --> 00:13:34,149
a team and other things how do you

306
00:13:40,169 --> 00:13:36,779
become that team between science

307
00:13:41,849 --> 00:13:40,179
operators and engineers to really learn

308
00:13:44,099 --> 00:13:41,859
those lessons and get that data out

309
00:13:46,710 --> 00:13:44,109
there and I'd say Doris was really

310
00:13:51,740 --> 00:13:46,720
instrumental in that she was a leader of

311
00:13:58,010 --> 00:13:55,210
I didn't feel like it was ever an issue

312
00:14:00,110 --> 00:13:58,020
I was the only woman in the engineering

313
00:14:03,890 --> 00:14:00,120

school so maybe that helped I was

314
00:14:05,420 --> 00:14:03,900
acclimated but coming here actually in

315
00:14:07,070 --> 00:14:05,430
the materials division I wound up

316
00:14:10,220 --> 00:14:07,080
working with Anne Whitaker who was

317
00:14:13,310 --> 00:14:10,230
already here and Anne was tremendous as

318
00:14:15,050 --> 00:14:13,320
a mentor and and all that but it was

319
00:14:16,940 --> 00:14:15,060
never really an issue I think it was

320
00:14:21,950 --> 00:14:16,950
again it was the time and we were all

321
00:14:24,290 --> 00:14:21,960
pressing 469 so we really had to get all

322
00:14:26,320 --> 00:14:24,300
of us doing the job pulling the wagon in

323
00:14:32,830 --> 00:14:26,330
the same direction at the same time and

324
00:14:38,260 --> 00:14:35,890
I had so many mentors I had mentors I

325
00:14:40,510 --> 00:14:38,270
didn't even know I had I mean when

326
00:14:42,490 --> 00:14:40,520
you're 17 and 18 years old you don't

327
00:14:43,900 --> 00:14:42,500
know what that means and and you're

328
00:14:45,580 --> 00:14:43,910
taking book learn and you know and

329
00:14:47,950 --> 00:14:45,590
trying to translate it into this work

330
00:14:50,020 --> 00:14:47,960
environment but I think back on all the

331
00:14:53,260 --> 00:14:50,030
people that helped me people like and

332
00:14:56,320 --> 00:14:53,270
people like Bob swing hammer Bob Ryan

333
00:14:58,210 --> 00:14:56,330
there were so many that contributed so

334
00:14:59,680 --> 00:14:58,220
much again the early it was the

335
00:15:01,420 --> 00:14:59,690
technicians that taught me really

336
00:15:02,680 --> 00:15:01,430
hands-on stuff they said if you didn't

337
00:15:04,330 --> 00:15:02,690
get your hands dirty you weren't doing

338
00:15:10,390 --> 00:15:04,340

the job and I agree with that

339
00:15:13,030 --> 00:15:10,400
it's there was there was mentorship that

340
00:15:14,770 --> 00:15:13,040
was not formal I don't think we had a

341
00:15:17,170 --> 00:15:14,780
mentorship program here for many many

342
00:15:19,540 --> 00:15:17,180
years after that but somehow the

343
00:15:22,300 --> 00:15:19,550
informal worked and I think it was part

344
00:15:24,070 --> 00:15:22,310
of the team structure the team attitude

345
00:15:26,680 --> 00:15:24,080
when you're working with other people

346
00:15:30,160 --> 00:15:26,690
and you can see they need help you help

347
00:15:32,110 --> 00:15:30,170
them and that was mentoring at the best

348
00:15:34,000 --> 00:15:32,120
level I think very one-on-one very

349
00:15:35,740 --> 00:15:34,010
personal they could be technical it

350
00:15:42,500 --> 00:15:35,750
could be personal it could be anything

351
00:15:48,460 --> 00:15:44,840
I think it was very much a team culture

352
00:15:50,800 --> 00:15:48,470
and I think that's what made it work

353
00:15:51,879 --> 00:15:50,810
Marshall was a very strong team

354
00:15:55,069 --> 00:15:51,889
[Music]

355
00:15:58,850 --> 00:15:55,079
everybody shared their knowledge as

356
00:16:01,460 --> 00:15:58,860
already talked about I remembered a

357
00:16:03,889 --> 00:16:01,470
little further down then obviously the

358
00:16:07,610 --> 00:16:03,899
landing on the moon but when we launched

359
00:16:09,889 --> 00:16:07,620
Skylab and the shield came off I was in

360
00:16:12,199 --> 00:16:09,899
materials laboratory then as an engineer

361
00:16:14,540 --> 00:16:12,209
talk about problem solving

362
00:16:17,780 --> 00:16:14,550
Bob swing hammer was the head of the lab

363
00:16:21,860 --> 00:16:17,790

and I have never met anybody that had

364
00:16:24,170 --> 00:16:21,870
more problem-solving capabilities arms

365
00:16:27,259 --> 00:16:24,180
around any problem and give you an

366
00:16:29,269 --> 00:16:27,269
excellent and practical solution so the

367
00:16:31,670 --> 00:16:29,279
laboratory immediately everybody

368
00:16:33,980 --> 00:16:31,680
coalesced Bob gave the marching orders

369
00:16:36,110 --> 00:16:33,990
we all went off to develop a solar

370
00:16:38,569 --> 00:16:36,120
shield to save Skylab we had worked on

371
00:16:43,220 --> 00:16:38,579
Skylab so long funny thing about that

372
00:16:45,560 --> 00:16:43,230
was before it was launched someone

373
00:16:48,220 --> 00:16:45,570
realized there was no American flag

374
00:16:51,769 --> 00:16:48,230
painted on the side of the vehicle

375
00:16:56,210 --> 00:16:51,779
so our job then in the lab was to come

376
00:16:57,920 --> 00:16:56,220
up with a flag that could be painted

377
00:17:01,309 --> 00:16:57,930
which means you had to have paint that

378
00:17:04,069 --> 00:17:01,319
would survive that environment the real

379
00:17:06,470 --> 00:17:04,079
problem with the paint was we had spent

380
00:17:08,990 --> 00:17:06,480
years testing materials to make sure

381
00:17:10,850 --> 00:17:09,000
they didn't Crudup the optics because we

382
00:17:14,090 --> 00:17:10,860
were flying the Apollo telescope mount

383
00:17:15,710 --> 00:17:14,100
on Skylab so we had kept those optics

384
00:17:17,360 --> 00:17:15,720
clean for so long and then we had to

385
00:17:19,640 --> 00:17:17,370
paint a red white and blue flag on the

386
00:17:23,150 --> 00:17:19,650
outside that was gonna be exposed to all

387
00:17:26,120 --> 00:17:23,160
these optics oh my goodness well it was

388
00:17:29,000 --> 00:17:26,130

typical Bob's wing hammer he came in one

389
00:17:32,539 --> 00:17:29,010
day with cans of paint set him down

390
00:17:35,480 --> 00:17:32,549
these work on my boat and it's resistant

391
00:17:39,020 --> 00:17:35,490
to UV we're gonna see if it'll work on a

392
00:17:42,080 --> 00:17:39,030
Skylab flag and by god it did the patent

393
00:17:44,480 --> 00:17:42,090
the flag got painted on on plates we put

394
00:17:45,530 --> 00:17:44,490
it in we baked it we out gassed it long

395
00:17:47,299 --> 00:17:45,540
enough that it wasn't going to

396
00:17:49,730 --> 00:17:47,309
contaminate the optics and there we go

397
00:17:51,380 --> 00:17:49,740
problem solved but it was just amazing

398
00:17:53,919 --> 00:17:51,390
how that man could think I mean who

399
00:17:56,470 --> 00:17:53,929
would think about paint come on

400
00:17:58,810 --> 00:17:56,480
hoodude I think one of the it's one of

401
00:18:00,279 --> 00:17:58,820
the things that developed in people at

402
00:18:02,529 --> 00:18:00,289
Marshall I know it developed me as a

403
00:18:04,509 --> 00:18:02,539
systems engineer because when you face a

404
00:18:07,509 --> 00:18:04,519
problem there is a core to the problem

405
00:18:10,149 --> 00:18:07,519
but then beyond that all the disciplines

406
00:18:13,149 --> 00:18:10,159
wind up getting involved in finding the

407
00:18:15,249 --> 00:18:13,159
solution and implementing it so you had

408
00:18:16,960 --> 00:18:15,259
people in manufacturing you had people

409
00:18:19,720 --> 00:18:16,970
in development you had people in

410
00:18:21,789 --> 00:18:19,730
research you had had people in the

411
00:18:24,430 --> 00:18:21,799
process to get this thing approved for

412
00:18:27,489 --> 00:18:24,440
flight so it took all of that together

413
00:18:30,879 --> 00:18:27,499

in a very integrated system approach to

414
00:18:32,739 --> 00:18:30,889
make it all work well you were you were

415
00:18:34,989 --> 00:18:32,749
immersed in it you were part of the

416
00:18:38,230 --> 00:18:34,999
system automatically when you came in

417
00:18:40,149 --> 00:18:38,240
and everyone had value everyone was

418
00:18:43,090 --> 00:18:40,159
contributing everybody had something

419
00:18:45,430 --> 00:18:43,100
they were good at or knew more about

420
00:18:47,549 --> 00:18:45,440
than somebody else so it all got thrown

421
00:18:49,570 --> 00:18:47,559
in the pot when the stew was amazing

422
00:18:52,989 --> 00:18:49,580
well there weren't a lot of boundaries

423
00:18:55,810 --> 00:18:52,999
between organizations you went did your

424
00:18:58,389 --> 00:18:55,820
job now I'm sure at upper levels maybe

425
00:18:59,769 --> 00:18:58,399
the all that was going on but boy if we

426
00:19:02,889 --> 00:18:59,779
needed to go work with somebody from

427
00:19:05,529 --> 00:19:02,899
systems or thermal or structures it was

428
00:19:08,200 --> 00:19:05,539
all all for one and one for all it just

429
00:19:15,470 --> 00:19:08,210
didn't matter to us it was who could

430
00:19:23,120 --> 00:19:20,060
I think the one that was really caused a

431
00:19:25,190 --> 00:19:23,130
real click in my head was I was able to

432
00:19:28,940 --> 00:19:25,200
go down to the Cape and watch Apollo 8

433
00:19:32,930 --> 00:19:28,950
launch and that was such an experience

434
00:19:34,700 --> 00:19:32,940
and such a it was emotional and it was

435
00:19:38,300 --> 00:19:34,710
moving and it was the nation and

436
00:19:40,370 --> 00:19:38,310
leadership and it was just so much of oh

437
00:19:42,050 --> 00:19:40,380
this is what I've been doing for these

438
00:19:45,620 --> 00:19:42,060

years and this is what I want to do

439
00:19:47,420 --> 00:19:45,630
forever so it was just being able to be

440
00:19:50,210 --> 00:19:47,430
there see that happen

441
00:19:52,700 --> 00:19:50,220
hearing everything that went on when

442
00:19:55,790 --> 00:19:52,710
those guys orbited the moon was just

443
00:19:59,510 --> 00:19:55,800
amazing I mean our planet was no longer

444
00:20:02,030 --> 00:19:59,520
alone the moon was connected to us and

445
00:20:04,340 --> 00:20:02,040
we were connected to it and then I was

446
00:20:07,970 --> 00:20:04,350
also able to go down and see Apollo 11

447
00:20:11,720 --> 00:20:07,980
but I think Apollo 8 was the really the

448
00:20:13,250 --> 00:20:11,730
one that grabbed me the most I said I'm

449
00:20:17,830 --> 00:20:13,260
a NASA engineer this is what I'm going

450
00:20:27,520 --> 00:20:23,530
I think it was it was dynamic but it was

451
00:20:31,260 --> 00:20:27,530
also frustrating because we we get

452
00:20:36,130 --> 00:20:31,270
engaged in a program and then it would

453
00:20:39,340 --> 00:20:36,140
dissipate and while the formulation and

454
00:20:41,770 --> 00:20:39,350
the the job to work with Congress and

455
00:20:43,840 --> 00:20:41,780
work with headquarters to really develop

456
00:20:47,500 --> 00:20:43,850
the shuttle which course had been on von

457
00:20:50,080 --> 00:20:47,510
Braun's plate from day one was was a

458
00:20:53,050 --> 00:20:50,090
time of real uncertainty there were

459
00:20:55,750 --> 00:20:53,060
rifts and layoffs here at the center I

460
00:20:57,430 --> 00:20:55,760
was fortunate enough to be sponsored by

461
00:20:59,920 --> 00:20:57,440
NASA to go to graduate school in that

462
00:21:02,230 --> 00:20:59,930
same period of time so that kind of kept

463
00:21:03,700 --> 00:21:02,240

me on a little better keel but we were

464
00:21:05,620 --> 00:21:03,710
also at the same time doing some really

465
00:21:08,980 --> 00:21:05,630
great stuff the Apollo application

466
00:21:11,050 --> 00:21:08,990
program started it was and then it was

467
00:21:14,100 --> 00:21:11,060
not about Apollo just going to the moon

468
00:21:17,010 --> 00:21:14,110
it was about science in space and

469
00:21:19,270 --> 00:21:17,020
putting men into space is one thing

470
00:21:23,140 --> 00:21:19,280
expanding the realm of science and

471
00:21:26,590 --> 00:21:23,150
exploration with people is something

472
00:21:28,450 --> 00:21:26,600
that really hadn't been done in space so

473
00:21:30,310 --> 00:21:28,460
it was an opportunity I started working

474
00:21:32,680 --> 00:21:30,320
on some material science experiments

475
00:21:35,530 --> 00:21:32,690
trying to understand how zero-gravity

476
00:21:38,470 --> 00:21:35,540
affected the way material solidified are

477
00:21:41,440 --> 00:21:38,480
there better materials out there started

478
00:21:45,910 --> 00:21:41,450
looking at the behavior of fluids the

479
00:21:48,280 --> 00:21:45,920
behavior of animals plants all these

480
00:21:50,730 --> 00:21:48,290
things that we did not know and of

481
00:21:55,380 --> 00:21:50,740
course that all culminated really in

482
00:21:58,390 --> 00:21:55,390
Skylab which was a great scientific

483
00:22:01,030 --> 00:21:58,400
laboratory we did astronomy we did

484
00:22:03,670 --> 00:22:01,040
material science we did bioscience it

485
00:22:07,090 --> 00:22:03,680
was just amazing and being able to be

486
00:22:08,980 --> 00:22:07,100
engaged in that at the at the scientist

487
00:22:10,780 --> 00:22:08,990
level though I wasn't a scientist I

488
00:22:12,730 --> 00:22:10,790

loved it and so it was a matter of

489
00:22:15,250 --> 00:22:12,740
taking that and the engineering and

490
00:22:17,950 --> 00:22:15,260
putting those together and then working

491
00:22:21,190 --> 00:22:17,960
with scientists who had proposed to fly

492
00:22:25,150 --> 00:22:21,200
to help them understand what it took to

493
00:22:28,210 --> 00:22:25,160
get an experiment from an idea to the

494
00:22:30,490 --> 00:22:28,220
hardware to approval for flight through

495
00:22:31,330 --> 00:22:30,500
the flight operations and then being

496
00:22:33,310 --> 00:22:31,340
able to bring

497
00:22:35,680 --> 00:22:33,320
them back the data they needed to test

498
00:22:38,590 --> 00:22:35,690
their theories so I think it was really

499
00:22:40,750 --> 00:22:38,600
the beginning of a larger science

500
00:22:43,210 --> 00:22:40,760
program so some things were winding down

501
00:22:46,780 --> 00:22:43,220
but other things were increasing so by

502
00:22:49,600 --> 00:22:46,790
the time we were ready to do shuttle we

503
00:22:51,940 --> 00:22:49,610
were thinking about Space Lab we were

504
00:22:53,980 --> 00:22:51,950
thinking about how do you make the

505
00:22:55,800 --> 00:22:53,990
shuttle a vehicle that's really going to

506
00:22:58,360 --> 00:22:55,810
be able to accomplish science in space

507
00:23:00,940 --> 00:22:58,370
because you can do automated science a

508
00:23:03,340 --> 00:23:00,950
lot of observatories do that but having

509
00:23:05,500 --> 00:23:03,350
the people interaction with the

510
00:23:08,020 --> 00:23:05,510
experiment is something that if that's

511
00:23:10,960 --> 00:23:08,030
missed their observation and their

512
00:23:13,060 --> 00:23:10,970
knowledge and what you are gleaning out

513
00:23:15,580 --> 00:23:13,070

of it is so helpful to the scientist who

514
00:23:18,100 --> 00:23:15,590
is still on the ground to understand

515
00:23:21,250 --> 00:23:18,110
what happens so I was involved in Sky's

516
00:23:24,130 --> 00:23:21,260
sky lab and then Space Lab so and then

517
00:23:27,460 --> 00:23:24,140
Space Station so that that thread of

518
00:23:33,990 --> 00:23:27,470
science and exploration just carried

519
00:23:42,600 --> 00:23:38,279
I think the legacy of Apollo is at many

520
00:23:45,180 --> 00:23:42,610
different levels I think one the legacy

521
00:23:47,639 --> 00:23:45,190
of that that leadership and that shining

522
00:23:50,460 --> 00:23:47,649
star that the United States put out

523
00:23:51,869 --> 00:23:50,470
there that leadership was maintained

524
00:23:53,789 --> 00:23:51,879
through these other programs we have an

525
00:23:58,529 --> 00:23:53,799
International Space Station which the

526
00:24:01,980 --> 00:23:58,539
u.s. primarily leads I think it's it's

527
00:24:05,759 --> 00:24:01,990
been at the human level it's connected

528
00:24:10,610 --> 00:24:05,769
people to space like they never had been

529
00:24:12,960 --> 00:24:10,620
connected before and it a micro-level my

530
00:24:15,389 --> 00:24:12,970
seven-year-old granddaughter came up to

531
00:24:19,009 --> 00:24:15,399
me the other day and she is grandma did

532
00:24:23,879 --> 00:24:19,019
you know the universe is expanding

533
00:24:25,740 --> 00:24:23,889
really to me I was so amazed that a

534
00:24:28,019 --> 00:24:25,750
seven-year-old would know that when I

535
00:24:31,049 --> 00:24:28,029
was a seven-year-old you didn't know

536
00:24:32,519 --> 00:24:31,059
space existed didn't understand what it

537
00:24:35,789 --> 00:24:32,529
was or what it could be

538
00:24:38,129 --> 00:24:35,799

so the the generation of today not my

539
00:24:38,909 --> 00:24:38,139
children but my grandchildren take that

540
00:24:42,029 --> 00:24:38,919
for granted

541
00:24:44,879 --> 00:24:42,039
they understand space is an expansion of

542
00:24:47,369 --> 00:24:44,889
Earth they understand there's a big

543
00:24:49,409 --> 00:24:47,379
universe out there they understand there

544
00:24:51,840 --> 00:24:49,419
are big dreams and big things that can

545
00:24:55,590 --> 00:24:51,850
be done which I wouldn't trade anything

546
00:24:57,899 --> 00:24:55,600
for to be to have been able to be

547
00:24:59,249 --> 00:24:57,909
involved in that and engaged in that

548
00:25:02,119 --> 00:24:59,259
that put that thought in my

549
00:25:03,840 --> 00:25:02,129
granddaughter's mind was priceless

550
00:25:06,389 --> 00:25:03,850
wouldn't do without it

551
00:25:08,580 --> 00:25:06,399
I think the stem programs that are going

552
00:25:10,769 --> 00:25:08,590
on in the schools now are a great step

553
00:25:13,039 --> 00:25:10,779
in the right direction because I think

554
00:25:15,960 --> 00:25:13,049
they feed a child's curiosity and

555
00:25:17,610 --> 00:25:15,970
whether that kid is a boy or a girl

556
00:25:20,369 --> 00:25:17,620
I don't know that it really matters we

557
00:25:22,619 --> 00:25:20,379
need people that can think we need

558
00:25:25,409 --> 00:25:22,629
people to be creative we need people to

559
00:25:27,389 --> 00:25:25,419
be able to expand their thoughts and be

560
00:25:29,279 --> 00:25:27,399
able to problem-solve understand how to

561
00:25:32,100 --> 00:25:29,289
do that my granddaughter's actually in a

562
00:25:35,100 --> 00:25:32,110
stem class so they come up with an idea

563
00:25:38,249 --> 00:25:35,110

and they build things they they actually

564
00:25:43,080 --> 00:25:38,259
build things so that's I think that

565
00:25:45,539 --> 00:25:43,090
helps it's it's not enough I think there

566
00:25:46,910 --> 00:25:45,549
are enough impediments out there still

567
00:25:50,420 --> 00:25:46,920
in society that

568
00:25:52,790 --> 00:25:50,430
that creates a problem just images of

569
00:25:54,170 --> 00:25:52,800
boys versus images of girls I don't know

570
00:25:55,550 --> 00:25:54,180
if that's ever gonna change

571
00:25:57,680 --> 00:25:55,560
but I know it's a lot better than it

572
00:26:00,080 --> 00:25:57,690
used to be several years ago there was

573
00:26:02,990 --> 00:26:00,090
like 30% of the engineering class some

574
00:26:07,130 --> 00:26:03,000
universities were female engineers and I

575
00:26:10,880 --> 00:26:07,140
think that's amazing but it still it

576
00:26:12,590 --> 00:26:10,890
needs work it needs work I've got one

577
00:26:14,330 --> 00:26:12,600
daughter who's an engineer I've got

578
00:26:16,550 --> 00:26:14,340
another one who's a financial person and

579
00:26:19,160 --> 00:26:16,560
I've got a son who's a journalist so you

580
00:26:23,900 --> 00:26:19,170
know me raising them didn't matter but

581
00:26:25,490 --> 00:26:23,910
it it's a it has to be what the kids are

582
00:26:27,950 --> 00:26:25,500
interested in and that interest has to

583
00:26:30,050 --> 00:26:27,960
be peaked early very early in their

584
00:26:32,570 --> 00:26:30,060
lives and if you catch them when they're

585
00:26:33,710 --> 00:26:32,580
five six and seven years old they're

586
00:26:35,960 --> 00:26:33,720
going to do something with it because