
WATCH THIS
SPACE
with Jim Bridenstine
NASA Administrator

1
00:00:07,674 --> 00:00:10,643
Hello and welcome to
"Watch This Space".

2
00:00:10,710 --> 00:00:12,812
I am Jim Bridenstine, the
NASA Administrator and

3
00:00:12,879 --> 00:00:14,914
today we we're going to
talk about the James Webb

4
00:00:14,981 --> 00:00:18,885
Space Telescope which is
going to change the way we

5
00:00:18,952 --> 00:00:22,922
see not only our galaxy
but other galaxies and the

6
00:00:22,989 --> 00:00:25,558
entire universe, in fact,
we are going to look back

7
00:00:25,625 --> 00:00:28,728
to the very dawn of time
with the James Webb Space

8
00:00:28,795 --> 00:00:29,396
Telescope.

9
00:00:29,462 --> 00:00:32,065
Today I have two
amazing guests.

10
00:00:32,132 --> 00:00:36,503
Dr. John Mather is NASA's
Nobel prize winning

11

00:00:36,569 --> 00:00:39,406
scientist, and he is
also the senior project

12
00:00:39,472 --> 00:00:43,143
scientist on the James
Webb Space Telescope and

13
00:00:43,209 --> 00:00:46,346
Dr. Thomas Zurbuchen,
Associate Administrator of

14
00:00:46,413 --> 00:00:48,982
the Science Mission
Directorate here at NASA.

15
00:00:49,048 --> 00:00:51,384
Gentlemen, thank you so
much for joining me here

16
00:00:51,451 --> 00:00:52,051
today.

17
00:00:52,118 --> 00:00:52,719
>> Glad to be here.

18
00:00:52,786 --> 00:00:53,386
>>Good to be here.

19
00:00:53,453 --> 00:00:54,053
>> Awesome.

20
00:00:54,120 --> 00:00:57,757
So, Dr. Mather tell me
from your perspective, you

21
00:00:57,824 --> 00:01:00,427
are going to be the senior
project scientist on the

22
00:01:00,493 --> 00:01:02,395
James Webb Space
Telescope.

23
00:01:02,462 --> 00:01:05,665
How excite ready you about
this mission and why?

24
00:01:05,732 --> 00:01:07,567
>> It is the most exciting
thing I could possibly

25
00:01:07,634 --> 00:01:09,169
imagine to be working on.

26
00:01:09,235 --> 00:01:11,471
It is the successor for
the Hubble Space Telescope

27
00:01:11,538 --> 00:01:13,873
and it will be far more
powerful and much larger

28
00:01:13,940 --> 00:01:15,809
and be able to see things
the Hubble could never

29
00:01:15,875 --> 00:01:16,476
see.

30
00:01:16,543 --> 00:01:17,143
>> Is that right?

31
00:01:17,210 --> 00:01:18,945
>> So, it can see the
thing the Hubble can't see

32
00:01:19,012 --> 00:01:22,182
because it is larger and

picks up infrared light

33
00:01:22,248 --> 00:01:25,251
which the Hubble cannot do
so infrared light comes

34
00:01:25,318 --> 00:01:27,754
from things that are too
cool to emit visible

35
00:01:27,821 --> 00:01:31,724
light, you are emitting
infrared light so we are

36
00:01:31,791 --> 00:01:34,494
building a telescope that
could see a bumble bee at

37
00:01:34,561 --> 00:01:36,863
the distance of a moon
just from the heat that

38
00:01:36,930 --> 00:01:38,465
the bumble bee gives off.

39
00:01:38,531 --> 00:01:40,767
>> So, this enables
us in the infrared

40
00:01:40,834 --> 00:01:44,337
electromagnetic spectrum
this enables us to see

41
00:01:44,404 --> 00:01:48,374
potentially stars from a
very, very long time ago,

42
00:01:48,441 --> 00:01:51,511
obviously, stars that
wouldn't even exist today.

43
00:01:51,578 --> 00:01:55,048
>> But their wave length
as it traveled toward the

44
00:01:55,114 --> 00:01:57,717
Earth, the wavelength has
expanded and so it is in a

45
00:01:57,784 --> 00:02:00,086
different part of the
electromagnetic spectrum

46
00:02:00,153 --> 00:02:01,454
and that's what we
will be able to see?

47
00:02:01,521 --> 00:02:03,723
>> That's a big part of
it that we see the most

48
00:02:03,790 --> 00:02:06,059
distant Galaxy we can
possibly imagine finding,

49
00:02:06,125 --> 00:02:08,361
we are looking for the
first ones that formed

50
00:02:08,428 --> 00:02:11,564
after the expansion of the
universe began, we call it

51
00:02:11,631 --> 00:02:13,967
the "Big Bang" and what
what happened after that?

52
00:02:14,033 --> 00:02:16,536
The galaxies were formed
but we don't know how.

53
00:02:16,603 --> 00:02:19,506
>> Dr. Thomas Zurbuchen,
you are Associate

54
00:02:19,572 --> 00:02:21,074
Administrator of the
The Science Mission

55
00:02:21,140 --> 00:02:23,710
Directorate so, you have
responsibility over this

56
00:02:23,776 --> 00:02:25,712
program as well
as so many others.

57
00:02:25,778 --> 00:02:30,917
Share with us, going back
in time, how James Webb

58
00:02:30,984 --> 00:02:34,420
came into being ultimately
as a program, and where

59
00:02:34,487 --> 00:02:37,524
you see it going
in the future.

60
00:02:37,590 --> 00:02:40,226
>> The questions that
John just address ready

61
00:02:40,293 --> 00:02:43,730
questions that have been
with us for many, many

62
00:02:43,796 --> 00:02:46,399
decades, and the
telescope, of course, came

63
00:02:46,466 --> 00:02:48,968
into being after I would
say the success of Hubble

64
00:02:49,035 --> 00:02:51,704
which really, I would say
without Hubble there is no

65
00:02:51,771 --> 00:02:52,372
Webb, right?

66
00:02:52,438 --> 00:02:55,041
It is a magnificent
telescope which is still

67
00:02:55,108 --> 00:02:57,744
the most productive
science machine we have up

68
00:02:57,810 --> 00:03:01,214
there, close to 1,000
publication a year come

69
00:03:01,281 --> 00:03:05,385
from that one telescope,
it is just out of any

70
00:03:05,451 --> 00:03:07,620
other realm, I mean it
is just so amazing, so

71
00:03:07,687 --> 00:03:10,156
basically, what happened,
something like two decades

72
00:03:10,223 --> 00:03:12,325
ago, scientists came
together as part of the

73
00:03:12,392 --> 00:03:14,694
National Academies and
basically, said like what

74
00:03:14,761 --> 00:03:18,698
would be the next
big telescope?

75
00:03:18,765 --> 00:03:23,136
And they imagined Webb,
which as John said is

76
00:03:23,202 --> 00:03:25,338
important for two reasons,
the first one is, it is

77
00:03:25,405 --> 00:03:26,506
cold.

78
00:03:26,573 --> 00:03:28,775
The second one,
is it is big.

79
00:03:28,841 --> 00:03:31,244
And those two
characteristics really

80
00:03:31,311 --> 00:03:34,280
grow the Webb and of
course started the process

81
00:03:34,347 --> 00:03:37,750
that let it evolve to
where we are today with

82
00:03:37,817 --> 00:03:40,687
telescope in which
basically all parts are

83

00:03:40,753 --> 00:03:43,389
built, and we're in
integration and test.

84
00:03:43,456 --> 00:03:46,492
>> Tell me, how complex
of a spacecraft is this?

85
00:03:46,559 --> 00:03:50,930
And how complex of a
scientist instrument is on

86
00:03:50,997 --> 00:03:51,598
board?

87
00:03:51,664 --> 00:03:52,932
>> I can talk about
the spacecraft.

88
00:03:52,999 --> 00:03:54,500
I will let you talk
about the instrument.

89
00:03:54,567 --> 00:03:57,236
Spacecraft is complex
for two reasons.

90
00:03:57,303 --> 00:04:00,807
The first one is that it
is a deployed mirror,

91
00:04:00,873 --> 00:04:01,474
right?

92
00:04:01,541 --> 00:04:03,543
Because the whole thing
unfurls -- like some

93
00:04:03,610 --> 00:04:07,246
origami type structure and

then it is put in place

94
00:04:07,313 --> 00:04:09,115
very, very accurately.

95
00:04:09,182 --> 00:04:11,250
>> Tell me this origami
type structure you are

96
00:04:11,317 --> 00:04:13,987
talking about the
spacecraft itself, what is

97
00:04:14,053 --> 00:04:16,589
the origami type
structure for?

98
00:04:16,656 --> 00:04:19,959
>> Imagine the mirror
itself is six and a half

99
00:04:20,026 --> 00:04:22,228
meters, that the
protection shield which

100
00:04:22,295 --> 00:04:25,298
again, is there to cool
everything down, is the

101
00:04:25,365 --> 00:04:28,501
area of a tennis court, so
there is no rocket that

102
00:04:28,568 --> 00:04:29,168
fits in.

103
00:04:29,235 --> 00:04:30,770
>> So, the thermal
protection shield, just

104
00:04:30,837 --> 00:04:34,007
for audience, we are
talking about something

105
00:04:34,073 --> 00:04:37,377
that blocks the sun so
that ultimately, we can

106
00:04:37,443 --> 00:04:41,180
have the absolute coldest
mirror possible to detect

107
00:04:41,247 --> 00:04:43,249
the heat signature
from infrared?

108
00:04:43,316 --> 00:04:43,916
>> Absolutely.

109
00:04:43,983 --> 00:04:47,186
It blocks some five times
over, that's how many such

110
00:04:47,253 --> 00:04:48,721
tennis courts
we are deployed.

111
00:04:48,788 --> 00:04:49,389
>> Okay.

112
00:04:49,455 --> 00:04:51,224
>> A small aluminum
foils that are out there

113
00:04:51,290 --> 00:04:54,427
deployed, and you know out
in space doing exactly

114
00:04:54,494 --> 00:04:55,128

what you said.

115
00:04:55,194 --> 00:04:55,795
>> Okay.

116
00:04:55,862 --> 00:04:56,462
>> Awesome.

117
00:04:56,529 --> 00:04:57,597
So that is
complex in itself.

118
00:04:57,664 --> 00:04:58,364
>> Oh, god it is.

119
00:04:58,431 --> 00:05:01,567
>> How many moving parts
in order to deploy that?

120
00:05:01,634 --> 00:05:07,140
>> Well, I mean, there is
between 300 and 350 single

121
00:05:07,206 --> 00:05:11,277
points that move or kind
of deploy in one fashion

122
00:05:11,344 --> 00:05:13,079
or another for
this to occur.

123
00:05:13,146 --> 00:05:13,746
>> Okay.

124
00:05:13,813 --> 00:05:15,081
And every single one
of them have to work

125
00:05:15,148 --> 00:05:17,550

perfectly for this
to deploy perfectly?

126
00:05:17,617 --> 00:05:18,685
>> The vast
majority of them.

127
00:05:18,751 --> 00:05:21,754
Some of these, something
like 50 or so, if they

128
00:05:21,821 --> 00:05:24,323
don't work, you know, we
can work around it, the

129
00:05:24,390 --> 00:05:25,491
others, yes, this
have to work.

130
00:05:25,558 --> 00:05:27,260
So, in other words
you can't just have a

131
00:05:27,326 --> 00:05:29,495
half-deployed tennis court
out there, it would be

132
00:05:29,562 --> 00:05:32,165
really hard, it is really
hard to actually fly the

133
00:05:32,231 --> 00:05:34,567
spacecraft and it would
not be as cold as it needs

134
00:05:34,634 --> 00:05:35,234
to be.

135
00:05:35,301 --> 00:05:35,902
>> Okay.

136
00:05:35,968 --> 00:05:38,371
As far as the scientific
instruments on board, how

137
00:05:38,438 --> 00:05:41,307
complex are those and the
challenges that we have?

138
00:05:41,374 --> 00:05:44,811
>> Well, they are very
complex, what makes them

139
00:05:44,877 --> 00:05:47,280
especially difficult is
they have to be cold also,

140
00:05:47,346 --> 00:05:49,649
some of them run at seven
degrees Kelvin, very close

141
00:05:49,716 --> 00:05:53,186
to absolute zero, and some
at 40 degrees Kelvin, also

142
00:05:53,252 --> 00:05:54,854
very cold.

143
00:05:54,921 --> 00:05:56,556
So, this is something that
we can do, but it is not

144
00:05:56,622 --> 00:05:57,223
familiar.

145
00:05:57,290 --> 00:05:59,926
>> So, Dr. Zurbuchen, tell
us where are we right now

146

00:05:59,992 --> 00:06:03,930
with James Webb and what
can we expect as far as

147
00:06:03,996 --> 00:06:06,666
when are we going to see
the first science from it

148
00:06:06,733 --> 00:06:10,436
and ultimately when can
the public be inspired by

149
00:06:10,503 --> 00:06:11,337
it?

150
00:06:11,404 --> 00:06:14,040
>> So, the good news is,
all of the parts of the

151
00:06:14,107 --> 00:06:17,210
telescope are basically
built, they are standing

152
00:06:17,276 --> 00:06:20,947
in California in one
company, altogether.

153
00:06:21,013 --> 00:06:21,614
>> Good.

154
00:06:21,681 --> 00:06:23,382
>> And are being
integrated and tested and

155
00:06:23,449 --> 00:06:26,552
we are right now in the
test program of the

156
00:06:26,619 --> 00:06:29,188
spacecraft, you know that

tennis court, in all of

157
00:06:29,255 --> 00:06:31,624
the sun shield, all of
these things, we are

158
00:06:31,691 --> 00:06:35,695
testing right now, and
are basically, doing

159
00:06:35,762 --> 00:06:37,997
everything we need to do,
cooling, we are shaking

160
00:06:38,064 --> 00:06:40,166
it, we are blasting sound
at it to make sure it can

161
00:06:40,233 --> 00:06:42,101
survive launch
and so forth.

162
00:06:42,168 --> 00:06:45,638
Right afterwards, the
telescope Otis, the

163
00:06:45,705 --> 00:06:47,774
instruments in the
telescope are being

164
00:06:47,840 --> 00:06:50,610
integrated with the
spacecraft and then the

165
00:06:50,676 --> 00:06:54,080
whole test program or a
.. subset thereof starts

166
00:06:54,147 --> 00:06:57,583
again and we make

sure that this entire

167
00:06:57,650 --> 00:07:00,086
spacecraft with its
instrument cab actually

168
00:07:00,153 --> 00:07:01,087
survive launch.

169
00:07:01,154 --> 00:07:01,788
>> Okay.

170
00:07:01,854 --> 00:07:05,224
>> And can be deployed and
then we ship it and get it

171
00:07:05,291 --> 00:07:10,163
to space and if everything
goes well, goes up in '21,

172
00:07:10,229 --> 00:07:12,932
it is out there and starts
deploying over a time

173
00:07:12,999 --> 00:07:15,268
period of about
John >> two weeks.

174
00:07:15,334 --> 00:07:15,935
>> yes.

175
00:07:16,002 --> 00:07:17,937
John and I will be very
nervous in that time

176
00:07:18,004 --> 00:07:20,540
period because we are
going to get data back on

177

00:07:20,606 --> 00:07:23,910
the ground about all of
these single points, all

178
00:07:23,976 --> 00:07:26,712
of these little things
puffs that make sure that,

179
00:07:26,779 --> 00:07:30,149
you know, this sun shield
deploys, that everything

180
00:07:30,216 --> 00:07:32,285
goes just like planned.

181
00:07:32,351 --> 00:07:35,755
>> As much as we have
invested into this

182
00:07:35,822 --> 00:07:37,890
critically important
scientific instrument, we

183
00:07:37,957 --> 00:07:40,993
have to get it complete,
and, you know, my

184
00:07:41,060 --> 00:07:43,429
understanding is we are on
the five-yard line and as

185
00:07:43,496 --> 00:07:45,865
you mentioned all of the
components are built.

186
00:07:45,932 --> 00:07:48,334
All we have to do now is
punch it into the end

187
00:07:48,401 --> 00:07:49,068

zone.

188
00:07:49,135 --> 00:07:50,469
We are all very
excited about that.

189
00:07:50,536 --> 00:07:53,873
How confident are you that
the new schedule that we

190
00:07:53,940 --> 00:07:55,208
are going to lay out,
which says we are going to

191
00:07:55,274 --> 00:07:58,544
launch in March of 2021,
how confident are you we

192
00:07:58,611 --> 00:08:01,848
will be able to
accomplish that?

193
00:08:01,914 --> 00:08:05,184
>> I am confident that
the schedule is precisely

194
00:08:05,251 --> 00:08:08,020
sufficient and also, the
funding that we have

195
00:08:08,087 --> 00:08:10,990
allocated is sufficient
to get us over the finish

196
00:08:11,057 --> 00:08:12,859
line, like you said.

197
00:08:12,925 --> 00:08:13,559
>> Okay.

198
00:08:13,626 --> 00:08:14,660
>> We have to execute.

199
00:08:14,727 --> 00:08:15,661
We have the team.

200
00:08:15,728 --> 00:08:19,498
We have independent voices
that have told us this is

201
00:08:19,565 --> 00:08:22,134
what it takes, this is
sufficient, we have done

202
00:08:22,201 --> 00:08:25,171
exactly that and now it
is a matter of, you know,

203
00:08:25,238 --> 00:08:26,772
lining up the team,
like you said.

204
00:08:26,839 --> 00:08:29,175
>> Yes, and
carrying that ball.

205
00:08:29,242 --> 00:08:33,746
>> We probably were
excessively optimistic on

206
00:08:33,813 --> 00:08:36,916
how -- on how the
integration and testing

207
00:08:36,983 --> 00:08:37,917
was going to go.

208
00:08:37,984 --> 00:08:42,955
The sun shield proved

to be very complex and

209
00:08:43,022 --> 00:08:45,558
deploying it and then
refolding it, of course,

210
00:08:45,625 --> 00:08:47,226
has proven to be a
challenge and all of this

211
00:08:47,293 --> 00:08:48,594
has to be tested.

212
00:08:48,661 --> 00:08:51,998
We want to discover any
challenges on Earth rather

213
00:08:52,064 --> 00:08:54,567
than after it is a million
miles away from Earth,

214
00:08:54,634 --> 00:08:57,136
where it can no longer be
serviced, so this is all

215
00:08:57,203 --> 00:08:58,571
part of the
normal process.

216
00:08:58,638 --> 00:09:00,706
We discovered that sun
shield is going to be more

217
00:09:00,773 --> 00:09:02,141
complex than usual.

218
00:09:02,208 --> 00:09:04,477
And that it was going
to require more time.

219
00:09:04,543 --> 00:09:06,646
We called for an
independent review board.

220
00:09:06,712 --> 00:09:09,348
They have now finished
their assessment and they

221
00:09:09,415 --> 00:09:10,416
have given them to us.

222
00:09:10,483 --> 00:09:16,188
Tell me, Dr. Zurbuchen,
what are some of the

223
00:09:16,255 --> 00:09:18,491
biggest challenges and
what are we doing to

224
00:09:18,557 --> 00:09:20,293
address those challenges?

225
00:09:20,359 --> 00:09:23,829
>> The key recommendations
that came back to us, as

226
00:09:23,896 --> 00:09:26,365
you mentioned, we have
accepted all of them.

227
00:09:26,432 --> 00:09:27,767
But the key
recommendations that came

228
00:09:27,833 --> 00:09:31,604
back really focused on
mission success overall,

229
00:09:31,671 --> 00:09:37,710

and one of them, relates
to really looking at this

230
00:09:37,777 --> 00:09:42,481
deployment sequence, over
weeks and months as we

231
00:09:42,548 --> 00:09:45,551
cool down, but the two
weeks deployment sequence

232
00:09:45,618 --> 00:09:49,188
in the same way as we look
at a Mars landing, entry

233
00:09:49,255 --> 00:09:52,558
descent and landing, again
a very nerve wracking time

234
00:09:52,625 --> 00:09:55,094
in which you, it
just has to work.

235
00:09:55,161 --> 00:09:56,762
There is no go backs.

236
00:09:56,829 --> 00:09:57,663
It has to work.

237
00:09:57,730 --> 00:09:58,331
>> Right.

238
00:09:58,397 --> 00:09:59,665
>> And so basically we
have actually, we are

239
00:09:59,732 --> 00:10:01,767
putting in place a
manager, very senior

240
00:10:01,834 --> 00:10:06,572
management to just oversee
that in isolation of

241
00:10:06,639 --> 00:10:08,841
everything else, of course
together with everything

242
00:10:08,908 --> 00:10:10,176
else, but that is a focus.

243
00:10:10,242 --> 00:10:16,415
>> So a single world class
systems engineer that can

244
00:10:16,482 --> 00:10:20,386
oversee end to end the
deployment of the James

245
00:10:20,453 --> 00:10:23,456
Webb once it is in space?

246
00:10:23,522 --> 00:10:24,190
>> Exactly right.

247
00:10:24,256 --> 00:10:26,292
And so that was the
recommendation that we

248
00:10:26,359 --> 00:10:27,660
have put place.

249
00:10:27,727 --> 00:10:28,327
>> Okay.

250
00:10:28,394 --> 00:10:30,062
The second piece and I
would argue is probably

251
00:10:30,129 --> 00:10:34,233
the most important one,
is that we focus on human

252
00:10:34,300 --> 00:10:35,968
errors and
embedded problems.

253
00:10:36,035 --> 00:10:39,171
Embedded problems are
human errors we haven't

254
00:10:39,238 --> 00:10:42,174
found yet that if you
want, asleep in the system

255
00:10:42,241 --> 00:10:46,078
somewhere it will come up
in integration and test

256
00:10:46,145 --> 00:10:48,414
and if we are not careful
even worse in space.

257
00:10:48,481 --> 00:10:50,516
>> What NASA is doing is
something that has never

258
00:10:50,583 --> 00:10:51,317
been done before.

259
00:10:51,384 --> 00:10:55,154
This is a very complex
system so I want to

260
00:10:55,221 --> 00:10:57,590
reemphasize that's a great
point you just made.

261

00:10:57,656 --> 00:11:01,093
We want to find these
things out on Earth, not

262
00:11:01,160 --> 00:11:01,794
in space.

263
00:11:01,861 --> 00:11:02,628
>> Exactly right.

264
00:11:02,695 --> 00:11:05,231
And so it is really
unusual with James Webb,

265
00:11:05,297 --> 00:11:08,067
so we found integration we
have 107 science missions

266
00:11:08,134 --> 00:11:10,603
right now, some in flight
and some in the ground, in

267
00:11:10,669 --> 00:11:13,272
all of them we are doing
integration tests or have

268
00:11:13,339 --> 00:11:14,607
done it, right?

269
00:11:14,673 --> 00:11:18,177
What is unusual here is
the enormous complexity of

270
00:11:18,244 --> 00:11:20,613
the mission, so basically
what happens is you make a

271
00:11:20,679 --> 00:11:26,085
mistake, what happens, it
costs a lot of money and a

272
00:11:26,152 --> 00:11:29,889
lot of time, just because
this very complex

273
00:11:29,955 --> 00:11:32,324
machinery comes to a
grinding halt right there.

274
00:11:32,391 --> 00:11:34,994
>> So one small mistake
has massive impact?

275
00:11:35,061 --> 00:11:35,728
Exactly right.

276
00:11:35,795 --> 00:11:39,932
So what you have to do,
let's go back to your

277
00:11:39,999 --> 00:11:43,469
football analogy, you have
to build a dream team,

278
00:11:43,536 --> 00:11:47,606
nobody can lose their
role, and everybody has to

279
00:11:47,673 --> 00:11:50,910
communicate with each
other and so that actually

280
00:11:50,976 --> 00:11:54,280
-- so here at Headquarters
through NASA Goddard, you

281
00:11:54,346 --> 00:11:56,882
know, our managing
organization, Northrup

282
00:11:56,949 --> 00:11:59,452
Grumman where this is
done, all the way to the

283
00:11:59,518 --> 00:12:01,287
shop floor with the
technicians with the

284
00:12:01,353 --> 00:12:04,356
screwdriver in their hand,
and it turns out that

285
00:12:04,423 --> 00:12:06,559
technician is actually
more important than I am.

286
00:12:06,625 --> 00:12:07,226
>> Yes.

287
00:12:07,293 --> 00:12:09,595
>> At this moment in time,
probably in general, but

288
00:12:09,662 --> 00:12:15,167
in this moment in time,
what she does on the floor

289
00:12:15,234 --> 00:12:18,604
affects this telescope in
a direct fashion and she

290
00:12:18,671 --> 00:12:22,908
needs to tell us if there
is any worry and needs to,

291
00:12:22,975 --> 00:12:26,445
in fact, with her
colleagues fix those

292

00:12:26,512 --> 00:12:29,348
worries right away, and so
basically, it is really

293
00:12:29,415 --> 00:12:31,984
building that awareness,
that's how we cut down

294
00:12:32,051 --> 00:12:34,487
human errors, we all make
mistakes but the impact of

295
00:12:34,553 --> 00:12:38,424
mistakes can be eliminated
if we have checks and

296
00:12:38,491 --> 00:12:41,560
balances, we help each
other when I touch a

297
00:12:41,627 --> 00:12:43,863
screw, you check that
I do it the right way.

298
00:12:43,929 --> 00:12:44,530
>> Right.

299
00:12:44,597 --> 00:12:46,065
And say stop, that
does not make sense.

300
00:12:46,132 --> 00:12:48,701
So that is the type of
recommendations that were

301
00:12:48,767 --> 00:12:49,368
done.

302
00:12:49,435 --> 00:12:52,905
Build those systems

and make sure that the

303
00:12:52,972 --> 00:12:54,907
vigilance goes up, a lot.

304
00:12:54,974 --> 00:12:58,544
>> As the senior project
scientist, what are some

305
00:12:58,611 --> 00:13:01,180
of the things you are
thinking about as you go

306
00:13:01,247 --> 00:13:04,083
through -- they call it
the commissioning process,

307
00:13:04,150 --> 00:13:06,819
where we're deploying
the sun shield, we are

308
00:13:06,886 --> 00:13:09,255
deploying the antennas
that are going to

309
00:13:09,321 --> 00:13:14,493
communicate back to Earth,
there is a whole host of

310
00:13:14,560 --> 00:13:19,231
different booms and pulley
systems that ultimately

311
00:13:19,298 --> 00:13:22,501
are going to have to be
deployed on this vehicle.

312
00:13:22,568 --> 00:13:23,903
What are some of the
things you are thinking

313
00:13:23,969 --> 00:13:27,907
about and how do you
provide mission assurance

314
00:13:27,973 --> 00:13:31,477
once it is in orbit or
once it is in space?

315
00:13:31,544 --> 00:13:34,213
>> It is very tricky to
deploy this thing, but we

316
00:13:34,280 --> 00:13:36,048
rehearse everything
in advance.

317
00:13:36,115 --> 00:13:38,918
Many times here on the
ground, we deploy and

318
00:13:38,984 --> 00:13:42,321
fold, deploy and fold
again and then in space we

319
00:13:42,388 --> 00:13:45,291
know what we are going to
do, much of the detail has

320
00:13:45,357 --> 00:13:46,225
already been worked out.

321
00:13:46,292 --> 00:13:49,328
Day by day, hour by hour,
minute-by-minute, what we

322
00:13:49,395 --> 00:13:52,831
are going to do when we
get there, and we already

323
00:13:52,898 --> 00:13:54,166
have plans for what
happens just in case

324
00:13:54,233 --> 00:13:56,835
something isn't
quite right.

325
00:13:56,902 --> 00:13:58,170
We have TELEMETRY which is
instrumentation on board a

326
00:13:58,237 --> 00:14:00,472
to tell us whether things
have been done correctly.

327
00:14:00,539 --> 00:14:04,810
And we have a plan for
what happens just in case.

328
00:14:04,877 --> 00:14:07,146
So for instance, we have
on everything that is

329
00:14:07,213 --> 00:14:10,149
supposed to move we have
two ways to make it move,

330
00:14:10,216 --> 00:14:12,618
a motor has two sets of
windings and two sets of

331
00:14:12,685 --> 00:14:14,119
electronics to control it,
so if one doesn't work we

332
00:14:14,186 --> 00:14:15,921
try the other one.

333

00:14:15,988 --> 00:14:19,325
So that is one of the ways
that we know it should

334
00:14:19,391 --> 00:14:20,960
work, but we will
certainly be watching it

335
00:14:21,026 --> 00:14:23,929
very carefully and
thinking about it as it

336
00:14:23,996 --> 00:14:24,363
goes.

337
00:14:24,430 --> 00:14:28,801
>> So this makes it in a
way less hazardous than

338
00:14:28,867 --> 00:14:31,503
the Mars lander I which had
to do it all by itself.

339
00:14:31,570 --> 00:14:34,740
We get to watch the
step-by-step by step

340
00:14:34,807 --> 00:14:37,977
process and intervene if
something is not quite

341
00:14:38,043 --> 00:14:39,912
right and we have
our backup plan.

342
00:14:39,979 --> 00:14:42,481
>> There are concerns here
that are very real and

343
00:14:42,548 --> 00:14:44,550

need to be respected and
we are going to follow the

344
00:14:44,617 --> 00:14:46,752
guidance of the
independent review board,

345
00:14:46,819 --> 00:14:49,088
but at the same time
we are going to be

346
00:14:49,154 --> 00:14:51,257
successful, we are going
to get this spacecraft

347
00:14:51,323 --> 00:14:54,260
launched and we are going
to see back to the very

348
00:14:54,326 --> 00:14:56,962
beginning of time,
which is going to be

349
00:14:57,029 --> 00:14:59,531
revolutionary in the
history of science.

350
00:14:59,598 --> 00:15:01,367
So thank you, gentlemen
for joining me today.

351
00:15:01,433 --> 00:15:04,203
This is "Watch
This Space".