1
00:00:00,110 --> 00:00:04,600
BOLDEN: It means that we now understand much
more about our universe than we ever would

2
00:00:04,600 --> 00:00:06,490
have known had it not been for Hubble.

3
00:00:06,490 --> 00:00:10,940
GRUNSFELD: It just gives me that sense that
we live in this vast and remarkable universe.

4
00:00:10,940 --> 00:00:15,570
WEILER: Hubble today would be a piece of floating
space debris if it weren't for the human

5
00:00:15,570 --> 00:00:19,110
space flight program
NARRATOR: To build a telescope, in many ways

6
00:00:19,110 --> 00:00:21,460
is a decision to build a time machine.

7
00:00:21,460 --> 00:00:28,570
The United States Congress approved a large
space telescope in 1977, sparking work to

8
00:00:28,570 --> 00:00:34,250
begin on creating this large, complex, and
capable orbiting telescope.

9
00:00:34,250 --> 00:00:36,900
LECKRONE: Well, it wasn't easy.

10
00:00:36,900 --> 00:00:44,620
It was a long slog, difficult politically
at first to have it accepted and funded in

11
00:00:44,620 --> 00:00:45,620
the US Congress.

12
00:00:45,620 --> 00:00:46,620
And then, technically it was difficult.

13
00:00:46,620 --> 00:00:47,940
MASSIMINO: It's an amazing machine.

14
00:00:47,940 --> 00:00:53,470
It can orbit around the Earth at 17,500 miles
an hour.

15
00:00:53,470 --> 00:00:57,899
And the reason it can take all these great
images is not only because it's above the

16
00:00:57,899 --> 00:01:05,420
atmosphere, but because it can very steadily
hold its gaze on an object in space.

17
00:01:05,420 --> 00:01:09,690
NARRATOR: A globally connected telescope,
built through a partnership with the European

18
00:01:09,690 --> 00:01:14,080
Space Agency, which would look into the stars
well beyond international borders.

19
00:01:14,080 --> 00:01:15,630
SCOLESE: It takes a lot of people.

20
00:01:15,630 --> 00:01:20,550
You know, it takes people that--obviously
the scientists to conceive of it.

21
00:01:20,550 --> 00:01:25,229
It takes engineers to design it and build
it and test it.

22
00:01:25,229 --> 00:01:27,021

It takes technicians to actually build it.

23
00:01:27,021 --> 00:01:31,830
It takes the people to keep the rooms clean,
the facilities up and operating.

24
00:01:31,830 --> 00:01:38,240
So, it takes people from every walk of life
in order to do it, every skill set that you

25
00:01:38,240 --> 00:01:39,240
can think of.

26
00:01:39,240 --> 00:01:44,530
NARRATOR: To then place this telescope into
orbit to send back to us the data that scientists

27
00:01:44,530 --> 00:01:48,190
needed, unobstructed and unencumbered.

28
00:01:48,190 --> 00:01:52,090
WISEMAN: And when it was launched in 1990,
it really opened a new vista on the whole

29
00:01:52,090 --> 00:01:56,430
universe simply by enabling us to get sharper
images above the atmosphere.

30
00:01:56,430 --> 00:02:01,260
BOLDEN: And at the time, I was the--what we
called the PLT, or the pilot for the Hubble

31
00:02:01,260 --> 00:02:05,619
deploy mission, which was STS-31 aboard the
Shuttle Discovery.

32
00:02:05,619 --> 00:02:09,920
All of us in the crew had a certain feeling
of exhilaration and excitement.

33
00:02:09,920 --> 00:02:13,340
We knew that this was going to be an important mission.

34
00:02:13,340 --> 00:02:17,700
UNIDENTIFIED: Two, one, and liftoff of the Space Shuttle Discovery with the Hubble Space

35
00:02:17,700 --> 00:02:21,480
Telescope, our window on the universe.

36
00:02:21,480 --> 00:02:26,260
NARRATOR: On the 25th of April in 1990, the Space Shuttle Discovery, piloted by a future

37
00:02:26,260 --> 00:02:29,599
administrator of NASA, deployed the Hubble Space Telescope into an orbit around Earth.

38
00:02:29,599 --> 00:02:30,599
UNIDENTIFIED: Discovery, Houston.

39
00:02:30,599 --> 00:02:33,450
You have a go to open the doors.

40
00:02:33,450 --> 00:02:35,790
UNIDENTIFIED: Roger, Houston.

41
00:02:35,790 --> 00:02:41,450
BOLDEN: The mission itself was pretty intense in training, because we had to train for any

42
00:02:41,450 --> 00:02:44,879
number of contingencies that we all prayed would not happen.

43
00:02:44,879 --> 00:02:49,190
Ironically, one of those contingencies was failure of the solar array to deploy.

44
00:02:49,190 --> 00:02:53,590
It took us much of the day for the flight
control team to say, "Look, we--this is not

45
00:02:53,590 --> 00:02:54,590
working out.

46
00:02:54,590 --> 00:02:57,520
We don't think we're going to get the solar
arrays deployed."

47
00:02:57,520 --> 00:03:00,830
UNIDENTIFIED CHATTER
Bolden: All of a sudden this great experience

48
00:03:00,830 --> 00:03:03,750
turned out to just go, "This is not good."

49
00:03:03,750 --> 00:03:06,690
UNIDENTIFIED CHATTER
Bolden: When the ground control team called

50
00:03:06,690 --> 00:03:08,070
and said, "Stop, stop.

51
00:03:08,070 --> 00:03:10,360
We think we found a solution.

52
00:03:10,360 --> 00:03:12,220
You know, just stop where you are.

53
00:03:12,220 --> 00:03:14,080
We're going to try this."

54
00:03:14,080 --> 00:03:16,600
And they did and it worked, and so we went
ahead and deployed.

55
00:03:16,600 --> 00:03:19,450
UNIDENTIFIED: The deploy activity so far is going very smoothly.

56
00:03:19,450 --> 00:03:21,430
BOLDEN: Okay, they copy you, Story.

57
00:03:21,430 --> 00:03:22,430
And we're at--.

58
00:03:22,430 --> 00:03:27,520
BOLDEN: --It all worked out because of the incredible work of the combination of the

59
00:03:27,520 --> 00:03:34,670
crew onboard, the flight control team in Houston, but most especially very smart people at the

60
00:03:34,670 --> 00:03:40,620
Goddard Space Flight Center who actually knew the Hubble Space Telescope about as well as

61
00:03:40,620 --> 00:03:42,360
any people around.

62
00:03:42,360 --> 00:03:45,060
MUSGRAVE: Discovery, go for Hubble release.

63
00:03:45,060 --> 00:03:46,319
BOLDEN: Houston, Discovery.

64
00:03:46,319 --> 00:03:47,989
MUSGRAVE: Go ahead, Charlie.

65
00:03:47,989 --> 00:03:49,250
BOLDEN: Okay, Story.

66
00:03:49,250 --> 00:03:50,920

We've been taking marks.

67
00:03:50,920 --> 00:03:56,570
Residuals and ratios look good, and we'd like
to go ahead and go to the filter state.

68
00:03:56,570 --> 00:03:57,830
MUSGRAVE: We concur, Charlie.

69
00:03:57,830 --> 00:04:01,510
BRAD BIRD: The science that is astronomy would
never be the same.

70
00:04:01,510 --> 00:04:05,269
STRAUGHN: When people think about a telescope
here on Earth, they think about a mirror with

71
00:04:05,269 --> 00:04:06,519
a tube around it.

72
00:04:06,519 --> 00:04:08,690
And that's exactly what Hubble is.

73
00:04:08,690 --> 00:04:12,280
It's a huge mirror with a huge tube around
it in space.

74
00:04:12,280 --> 00:04:16,320
--of course, the purpose of Hubble is to take
these beautiful images that we learn about,

75
00:04:16,320 --> 00:04:18,349
and then the data is sent back to Earth for
us to study.

76
00:04:18,349 --> 00:04:22,999
NARRATOR: The Hubble Space Telescope powered
up, all systems nominal, and the data began

77

00:04:22,999 --> 00:04:28,409
to stream in; images of far off distances,
galaxies, and stars, but there was something

78
00:04:28,409 --> 00:04:29,409
wrong.

79
00:04:29,409 --> 00:04:34,059
The magnificent space observatory's imagery
was not clear, not crisp.

80
00:04:34,059 --> 00:04:39,360
BOLDEN: We saw the first light images, and
to the amateur like me, it looked great because

81
00:04:39,360 --> 00:04:42,830
we had made this great discovery right off
the bat; what we thought was a single star

82
00:04:42,830 --> 00:04:44,949
turned out to be a binary star.

83
00:04:44,949 --> 00:04:48,300
When we learned that no, it's not really that
good an image.

84
00:04:48,300 --> 00:04:50,259
It's kind of blurred because we have this
thing.

85
00:04:50,259 --> 00:04:56,419
FRANK CEPOLLINA: From an agency perspective
and from a public perspective and a Congressional

86
00:04:56,419 --> 00:04:57,860
perspective, it was doom and gloom.

87
00:04:57,860 --> 00:05:04,430
MIKULSKI: Working on a bipartisan basis, we
used the best tools to identify, was this

88
00:05:04,430 --> 00:05:11,719
a techno turkey that we would just bag as
a terrible mistake and say bye-bye boondoggle,

89
00:05:11,719 --> 00:05:14,479
or were we really going to try to fix it?

90
00:05:14,479 --> 00:05:16,319
WEILER: What we had was a spherical aberration.

91
00:05:16,319 --> 00:05:18,909
CEPOLLINA: The mirror was polished incorrectly.

92
00:05:18,909 --> 00:05:24,270
We were off by half the thickness of a human
hair from center to edge.

93
00:05:24,270 --> 00:05:30,199
And that's pretty astounding, that, you know,
we could come so close and yet not make it.

94
00:05:30,199 --> 00:05:35,080
GRUNSFELD: The truly remarkable feature of
the Hubble Space Telescope is that it was

95
00:05:35,080 --> 00:05:37,749
designed to be upgraded and fixed.

96
00:05:37,749 --> 00:05:41,599
MUSGRAVE: And NASA is absolutely expertise
on this.

97
00:05:41,599 --> 00:05:47,020
When you got to get the job done, the team
comes from many different places.

98
00:05:47,020 --> 00:05:48,849
UNIDENTIFIED: Two, one.

99
00:05:48,849 --> 00:05:53,229
And we have liftoff, liftoff of the Space
Shuttle Endeavor on an ambitious mission to

100
00:05:53,229 --> 00:05:54,919
service the Hubble Space Telescope.

101
00:05:54,919 --> 00:05:59,599
MUSGRAVE: The real magic on the Hubble mission
is almost 40 hours of spacewalking, and we

102
00:05:59,599 --> 00:06:01,029
had almost no surprises.

103
00:06:01,029 --> 00:06:05,979
MOUNTAIN: Because astronauts from NASA have
been able to go back and refurbish it, put

104
00:06:05,979 --> 00:06:10,159
in new instruments, repair it, and so that
25 years has made it an increasingly more

105
00:06:10,159 --> 00:06:11,349
powerful telescope.

106
00:06:11,349 --> 00:06:15,039
And it's the fact the Hubble is so powerful
today which is so remarkable.

107
00:06:15,039 --> 00:06:19,830
After 25 years, it's basically 10 to 100 times
more powerful than when it was first launched.

108
00:06:19,830 --> 00:06:25,500
FOALE: I did a mission to the Hubble Space
Telescope, and it was a--it wasn't really

109
00:06:25,500 --> 00:06:26,500

a refurbishment.

110
00:06:26,500 --> 00:06:32,999
It was a rescue mission, because the Hubble
Telescope uses gyroscopes to determine how

111
00:06:32,999 --> 00:06:37,219
it's moving and how to point, with absolutely
no motion, at a star.

112
00:06:37,219 --> 00:06:39,089
And those gyroscopes were failing.

113
00:06:39,089 --> 00:06:42,809
And then, by the time we got there, only one,
I think, was working.

114
00:06:42,809 --> 00:06:47,539
And so, it was a dead telescope at that point,
and our role on that mission was to basically

115
00:06:47,539 --> 00:06:49,270
repair the Hubble Telescope.

116
00:06:49,270 --> 00:06:53,919
It was a real repair mission, just like the
first repair mission to change the optics.

117
00:06:53,919 --> 00:06:57,349
If I had messed that up, I would be the one
that had broken the telescope forever.

118
00:06:57,349 --> 00:07:01,220
REZAC: I guess that's part of the excitement
of having worked a Hubble mission, because

119
00:07:01,220 --> 00:07:05,689
you know you've got the best team on the ground,
the best crew upstairs.

120
00:07:05,689 --> 00:07:08,969
It's exciting, but there is a level of confidence
you're going to pull through this.

121
00:07:08,969 --> 00:07:12,699
GRUNSFELD: We were able to leave the Hubble
in even better shape, such that now we're

122
00:07:12,699 --> 00:07:14,870
able to celebrate the 25th anniversary.

123
00:07:14,870 --> 00:07:18,749
NARRATOR: With the repairs completed, Hubble
blew the world away with what it saw and what

124
00:07:18,749 --> 00:07:19,749
we now could behold: sharp, clean, and crisp
data, images of stars forming, and Ultra Deep

125
00:07:19,749 --> 00:07:20,749
Field images of thousands of galaxies showing
just a glimpse at how big this universe is.

126
00:07:20,749 --> 00:07:24,809
Circling the globe at five miles per second,
this school bus sized observatory was the

127
00:07:24,809 --> 00:07:30,149
most technologically advanced device ever
launched, and has stayed amazingly advanced

128
00:07:30,149 --> 00:07:35,259
through five repair and upgrade missions,
from the first mission critical optics repair

129
00:07:35,259 --> 00:07:42,679
on Space Shuttle mission STS-61 to the last
servicing mission, STS-125, which added the

130

00:07:42,679 --> 00:07:48,429
wide field camera three and replaced or improved
sensors, batteries, and numerous other components.

131
00:07:48,429 --> 00:07:53,559
BOLDEN: The magnitude of the things that they
wanted to accomplish almost meant certain

132
00:07:53,559 --> 00:07:54,710
failure somewhere.

133
00:07:54,710 --> 00:07:58,270
But, the crew said "Look, we can do this.

134
00:07:58,270 --> 00:08:02,569
You know, we will have accomplished so much
more in making Hubble better than it is ever

135
00:08:02,569 --> 00:08:03,610
believed to be."

136
00:08:03,610 --> 00:08:05,709
GARCIA: Everybody knows Hubble.

137
00:08:05,709 --> 00:08:07,300
It's really true.

138
00:08:07,300 --> 00:08:12,729
Worldwide, all throughout the US, everybody,
all ages, all walks of life, you say Hubble

139
00:08:12,729 --> 00:08:15,029
Space Telescope, people know what you're talking
about.

140
00:08:15,029 --> 00:08:20,159
NARRATOR: More than a simple telescope, Hubble
is humanity's grand observatory of the vastness

141

00:08:20,159 --> 00:08:21,229
of space.

142
00:08:21,229 --> 00:08:25,259
And we've kept exploring by staring into the
universe and moving forward.

143
00:08:25,259 --> 00:08:29,479
STRAUGHN: The great thing about Hubble now,
this year, is that it's still going strong.

144
00:08:29,479 --> 00:08:32,889
And we expect it to last out 'til 2020, maybe
even longer.

145
00:08:32,889 --> 00:08:41,219
TYSON: Hubble has consistently taken us to
places we've never been visually, of course,

146
00:08:41,219 --> 00:08:49,339
and given--and empowered us to answer questions
that, in a previous generation of telescopes,

147
00:08:49,339 --> 00:08:50,620
we couldn't even pose.

148
00:08:50,620 --> 00:08:55,260
GRUNSFELD: And that allowed us to probe much
deeper in the universe and see phenomena that

149
00:08:55,260 --> 00:08:57,600
were otherwise hidden from us.

150
00:08:57,600 --> 00:09:03,740
And it revealed a scientific wonderland of
discoveries, but even more so, it showed us

151
00:09:03,740 --> 00:09:06,839
for the first time how beautiful the universe
is.

152
00:09:06,839 --> 00:09:12,509
Because the Hubble Space Telescope was able
to observe the cosmos with the kind of intricate

153
00:09:12,509 --> 00:09:15,300
detail that we observe with our human eyeballs.

154
00:09:15,300 --> 00:09:20,110
Bolden: It means that we now understand much
more about our universe than we ever would

155
00:09:20,110 --> 00:09:23,000
have known had it not been for hubble.

156
00:09:23,000 --> 00:09:30,350
That we have not only young people, students,
but now professionals who have grown up with

157
00:09:30,350 --> 00:09:36,110
Hubble and who have had Hubble change their
lives and change their minds about careers

158
00:09:36,110 --> 00:09:40,149
because they saw a hubble image and decided
that you know “I don’t really think I

159
00:09:40,149 --> 00:09:43,050
like science, but I think I want to try it.

160
00:09:43,050 --> 00:09:48,020
Because I want to go take part in doing something
with this particular instrument that makes

161
00:09:48,020 --> 00:09:50,740
these incredible visual images for people.

162
00:09:50,740 --> 00:09:54,250
So I think it has changed not just text books,

but people’s lives.

163
00:09:54,250 --> 00:09:58,440
NARRATOR: We’re on a never ending journey
and the hubble space telescope celebrates