
EPISODE FOUR
MOON DETECTIVE

1
00:00:01,600 --> 00:00:05,970
DAVE: This is the only long-term information that we have from the surface of the Moon.

2
00:00:05,970 --> 00:00:08,820
PAT: I don't think the search for data is over with.

3
00:00:08,820 --> 00:00:13,440
ERNIE: Where did all of this stuff come from? How did it form? What was the process?

4
00:00:13,440 --> 00:00:20,900
Does it happen all the time across the universe? Or are we somehow unique or at least unusual? What does it

5
00:00:20,900 --> 00:00:28,400
NARRATOR: I'm Katie Atkinson, and this is NASA Explorers: Apollo, where we tell stories about our Moon and

6
00:00:28,400 --> 00:00:34,900
ARCHIVAL AUDIO FOOTAGE: Tape recorder's running.

7
00:00:34,900 --> 00:00:36,900
[MUSIC]

8
00:00:36,900 --> 00:00:46,000
NARRATOR: 50 years ago, NASA's Apollo program brought humans further into space than we'd ever gone b

9
00:00:46,000 --> 00:00:53,980
On July 20th 1969, astronauts Neil Armstrong and Buzz Aldrin trekked the surface of the Moon for two and a h

10
00:00:53,980 --> 00:00:58,340
The Apollo 11 crew would spend about a week in space.

11
00:00:58,340 --> 00:01:09,358
But us? We're still learning. By all appearances scientific discoveries seem to happen in an instant.

12
00:01:09,358 --> 00:01:18,000
We often forget that science progresses slowly, quietly inching us towards something meaningful.

13
00:01:18,000 --> 00:01:27,150

We pick up pieces of information over decades, try to make sense of them and then venture into a new set of n

14
00:01:27,150 --> 00:01:29,400
[MUSIC]

15
00:01:29,400 --> 00:01:38,050
It takes time. For the Apollo program, at least half a century... and we're not done yet.

16
00:01:38,050 --> 00:01:44,059
The Moon still has plenty of unanswered questions for us.

17
00:01:44,059 --> 00:01:52,623
ARCHIVAL AUDIO FOOTAGE: (APOLLO 11 LIFT-OFF NARRATION) T-Minus one minute, 35 seconds on the

18
00:01:52,623 --> 00:02:00,333
the flight to land the first men on the Moon … all indications coming into the control center at this time indicate

19
00:02:00,333 --> 00:02:04,140
… one minute, 25 seconds and counting.

20
00:02:04,140 --> 00:02:08,660
NARRATOR: During NASA's Apollo program, six crews of astronauts landed on the Moon.

21
00:02:08,660 --> 00:02:14,960
During those visits, the astronauts set up what were called Lunar Surface Experiment Packages.

22
00:02:14,960 --> 00:02:20,900
They were heat flow experiments, solar wind spectrometers, ion detectors...

23
00:02:20,900 --> 00:02:24,740
instruments that studied the Moon inside and out.

24
00:02:24,740 --> 00:02:30,300
These scientific experiments gathered massive amounts of information and sent it back to Earth.

25
00:02:30,300 --> 00:02:33,900
But the thing about that data? A lot of it... was misplaced.

26
00:02:33,900 --> 00:02:37,880
[MUSIC]

27
00:02:37,880 --> 00:02:40,780
NARRATOR: Dave Williams is on a mission to track it down.

28
00:02:40,780 --> 00:02:46,620
DAVE: I work on a lot of the older Apollo data, which is really sort of incomplete.

29
00:02:46,620 --> 00:02:52,707
Unfortunately towards the end of the Apollo program, a lot of the data were just archived away and weren't rea

30
00:02:52,707 --> 00:02:56,820
And, the other problem is that back in the 70s the data were archived

31
00:02:56,820 --> 00:03:01,420
on things like microfilm, microfiche, that were really almost inaccessible.

32
00:03:01,420 --> 00:03:06,120
This is the only long-term information that we have from the surface of the Moon.

33
00:03:06,120 --> 00:03:08,600
There's just nothing else.

34
00:03:08,600 --> 00:03:16,160
And so we decided if we really wanted to know about the Moon, we were going to have to restore these data.

35
00:03:16,160 --> 00:03:21,320
NARRATOR: Dave is a scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

36
00:03:21,320 --> 00:03:23,660
He's also a data detective.

37
00:03:23,660 --> 00:03:29,040
Dave's job is to find, digitize and archive lost data from the Apollo era

38
00:03:29,040 --> 00:03:32,600

so they can be used by researchers for generations to come.

39
00:03:32,600 --> 00:03:39,920
Uncovering these data could help scientists make new discoveries about our Moon, as we plan to send human

40
00:03:39,920 --> 00:03:43,580
But tracking down the information is an incredible challenge.

41
00:03:43,580 --> 00:03:50,380
DAVE: There wasn't a lot done with these data. So when we went back to them, we had to dust these things of

42
00:03:50,380 --> 00:03:56,312
You know, a lot of things you just can't figure out by looking at them... and so we had to go find old documentat

43
00:03:56,312 --> 00:04:00,460
we had to try to find the principal investigators or the other scientists who worked on the experiments,

44
00:04:00,460 --> 00:04:08,118
or the technicians who built the experiments and find out from them how the things worked, and how the data w

45
00:04:08,118 --> 00:04:15,720
NARRATOR: When he began his search for data, Dave approached scientist Patrick Taylor to ask him and his

46
00:04:15,720 --> 00:04:20,800
PAT: Well we looked at each other and we said...

47
00:04:20,800 --> 00:04:27,755
each instrument, each program was very highly reviewed and vetted. They're all good. They're all important. Yo

48
00:04:27,755 --> 00:04:33,880
NARRATOR: That's Pat. He's a NASA scientist who thinks that every bit of data is an important piece of the pu

49
00:04:33,880 --> 00:04:37,580
Dave's restoration of old heat flow data, for example,

50
00:04:37,580 --> 00:04:40,320
helped Pat make a new discovery about our Moon.

51
00:04:40,320 --> 00:04:54,000
PAT: So while we didn't have a lot of data, we found enough to confirm that the lunar surface underneath the s

52
00:04:54,000 --> 00:04:57,560
instead of reaching equilibrium temperature.

53
00:04:57,560 --> 00:05:04,580
NARRATOR: The restored data allowed Pat and his team to study the transfer of heat through the Moon's surf

54
00:05:04,580 --> 00:05:09,400
They learned that the Moon is a little bit more active than previously thought.

55
00:05:09,400 --> 00:05:12,200
When the Apollo astronauts trekked across the Moon,

56
00:05:12,200 --> 00:05:15,500
their footprints disturbed the Moon's surface,

57
00:05:15,500 --> 00:05:19,180
changing the way it absorbs and reflects light and heat.

58
00:05:19,180 --> 00:05:26,900
Knowing how heat moves through the Moon helps us figure out how it formed, how it evolved and what it's mad

59
00:05:26,900 --> 00:05:33,771
PAT: So the heat flow tells us, is the Moon dead? Is it alive? How much is it alive? What's the distribution

60
00:05:33,771 --> 00:05:36,820
of radioactive elements in the near surface?

61
00:05:36,820 --> 00:05:48,620
And our data showed that if you disturb the structure on the lunar regolith, you'll change its thermal history.

62
00:05:48,620 --> 00:05:55,120
When we go back to the Moon with robotic missions, the heat flow instrument has to be designed

63
00:05:55,120 --> 00:06:00,910

so as not to overly disturb the surrounding area where it's going into the hole.

64
00:06:00,910 --> 00:06:05,920
So in that regard, our work is important for future missions.

65
00:06:05,920 --> 00:06:10,180
NARRATOR: And according to Pat, the hunt for data is far from finished.

66
00:06:10,180 --> 00:06:15,010
PAT: I don't think the search for data is over with.There's got to be more data out there!

67
00:06:15,010 --> 00:06:18,180
The Moon has still got a lot of secrets it's keeping.

68
00:06:18,180 --> 00:06:23,100
NARRATOR: To find those secrets, Dave and his team look for first-hand sources,

69
00:06:23,100 --> 00:06:28,260
the people who were there during the Apollo era and can help shed some light on what was collected.

70
00:06:28,260 --> 00:06:34,077
DAVE: Luckily, there were still an awful lot of people around from the Apollo days who still remembered this stu

71
00:06:34,077 --> 00:06:38,600
which I find amazing. I mean, I try to figure out what I was doing 2 weeks ago,

72
00:06:38,600 --> 00:06:41,260
and these guys are remembering what they did 40 years ago.

73
00:06:41,260 --> 00:06:44,840
NARRATOR: Sometimes, Dave's research involves making house calls.

74
00:06:44,840 --> 00:06:50,280
In 2016, he and his team visited the man who worked at NASA during the Apollo era,

75
00:06:50,280 --> 00:06:52,220
a man named Otto Berg.

76
00:06:52,220 --> 00:06:54,920
DAVE: He was a principal investigator for one of the instruments.

77
00:06:54,920 --> 00:07:00,600
We did get hold of him, and we talked to him, and he said oh yeah, he had all these detailed notebooks

78
00:07:00,600 --> 00:07:06,460
and if we would like to look at them, we could come visit him and take a look at the notebooks.

79
00:07:06,460 --> 00:07:09,560
Now this is this fellow was 90-something years old

80
00:07:09,560 --> 00:07:12,620
and we called him the day before...

81
00:07:12,620 --> 00:07:17,180
he said 'well, I just got out of hospital, I've been really sick, I'm not feeling well,

82
00:07:17,180 --> 00:07:20,180
but you can still come up, but I may not be able to talk that long.'

83
00:07:20,180 --> 00:07:24,520
We went up and sure enough he did look a little sick, a little tired.

84
00:07:24,520 --> 00:07:27,520
He brought out his books and he started talking to us.

85
00:07:27,520 --> 00:07:33,140
NARRATOR: Otto worked on an experiment that analyzed cosmic dust from the Moon's surface.

86
00:07:33,140 --> 00:07:39,870
DAVE: While he was talking to us, you could see him, suddenly start to lighten up and then he just kept talking

87
00:07:39,870 --> 00:07:44,256
about his experiment and he just seemed like he was getting better and better while he was talking about it.

88
00:07:44,256 --> 00:07:47,880

We ended up being there for like two and a half hours talking to him about all this stuff

89
00:07:47,880 --> 00:07:53,764
and then he ended up lending us his notebooks, his personal notebooks, so that we could scan them.

90
00:07:53,764 --> 00:07:57,460
They were really beautiful notebooks, I mean, he had written down everything really carefully.

91
00:07:57,460 --> 00:08:03,450
He had made graphs, all different colored pens he had used to highlight different things.

92
00:08:03,450 --> 00:08:12,200
They were really quite something, and we scanned every one of them and now, I feel like all this stuff is is com

93
00:08:12,200 --> 00:08:14,780
[MUSIC]

94
00:08:14,780 --> 00:08:22,100
NARRATOR: Otto Berg passed away in January of 2017. He was 99 years old.

95
00:08:22,100 --> 00:08:28,740
The work that he dedicated his career to is now free and accessible through the National Space Science Data

96
00:08:28,740 --> 00:08:34,120
for anyone who wants to learn more about Earth's closest neighbor.

97
00:08:34,120 --> 00:08:39,240
Thanks to Dave's team, current and future scientists can use information like this

98
00:08:39,240 --> 00:08:45,430
to paint a more detailed picture of the Moon. Data from the Apollo era gives us a window to the past,

99
00:08:45,430 --> 00:08:51,380
as NASA plans to send astronauts back to the surface of the Moon in the near-future.

100
00:08:51,380 --> 00:08:57,200
Data collected with today's technology, combined with information preserved from the Apollo program,

101
00:08:57,200 --> 00:09:01,000
places us at the edge of new discoveries.

102
00:09:01,000 --> 00:09:08,034
DAVE: In so many ways, this really is the golden age of understanding our solar system. There's all sorts of am

103
00:09:08,034 --> 00:09:15,300
that are returning data at a rates and with instruments that we couldn't have even dreamed of 40 years ago.

104
00:09:15,300 --> 00:09:21,169
NASA is probably doing more science and for understanding of the solar system

105
00:09:21,169 --> 00:09:24,940
and the universe than, than ever.

106
00:09:24,940 --> 00:09:29,880
NARRATOR: Everything we collect, even the scribbles of a personal notebook,

107
00:09:29,880 --> 00:09:35,280
helps scientists learn more about our Moon, furthering our understanding of the universe.

108
00:09:35,280 --> 00:09:45,620
[MUSIC]

109
00:09:45,620 --> 00:09:49,460
NARRATOR: We asked you to help NASA tell the story of Apollo.

110
00:09:49,460 --> 00:09:52,960
Hundreds of people answered ... from all over the world.

111
00:09:52,960 --> 00:09:56,720
Here's what Ketan from Sugarland, Texas remembers:

112
00:09:56,720 --> 00:10:01,520
KETAN: My memory of the Apollo Moon landing is probably going to be very different

113
00:10:01,520 --> 00:10:10,664

because I was not in the US, I was a five-year-old child in Mumbai, India in 1969. We did not have a TV,

114
00:10:10,664 --> 00:10:13,460
so we did not see the event live.

115
00:10:13,460 --> 00:10:18,980
My family and some family friends -- we all saw the event a few months later,

116
00:10:18,980 --> 00:10:27,251
probably October or November 1969. My dad heard about the United States having sent a man to the Moon,

117
00:10:27,251 --> 00:10:35,100
and he wanted to give his children a first-hand look. He got the film on loan from the United States Information

118
00:10:35,100 --> 00:10:38,540
hired a technician, rented a projector,

119
00:10:38,540 --> 00:10:41,820
and invited his nieces and some friends.

120
00:10:41,820 --> 00:10:46,520
We all saw the film together, projected on a wall in the living room.

121
00:10:46,620 --> 00:10:54,258
The wall must have been about 10 feet wide and 12 feet tall. It was painted white, and all the picture frames an

122
00:10:54,258 --> 00:10:57,520
were taken off for the film projection.

123
00:10:57,520 --> 00:11:04,840
I clearly remember that that was the day when I fell in love with everything associated with America -- the coun

124
00:11:04,840 --> 00:11:13,200
the people, the inventions and NASA. My deep interest in science is partly because of that film.

125
00:11:13,200 --> 00:11:17,180
Thanks NASA, for everything!

126
00:11:17,180 --> 00:11:20,640
NARRATOR: Thanks, Ketan for sharing the story with us.

127
00:11:20,640 --> 00:11:23,460
What do you remember about Apollo?

128
00:11:23,460 --> 00:11:28,300
Or what space exploration, do you hope you get to see in your lifetime?

129
00:11:28,300 --> 00:11:37,916
NASA wants to hear your Apollo stories. Visit nasa.gov/apollostories to learn how to get involved.

130
00:11:37,916 --> 00:11:43,660
This audio series was produced at NASA's Goddard Space Flight Center in Greenbelt, Maryland.

131
00:11:43,660 --> 00:11:54,500
The NASA Explorers: Apollo team includes Micheala Sosby, Haley Reed, and Katie Atkinson, with original mus