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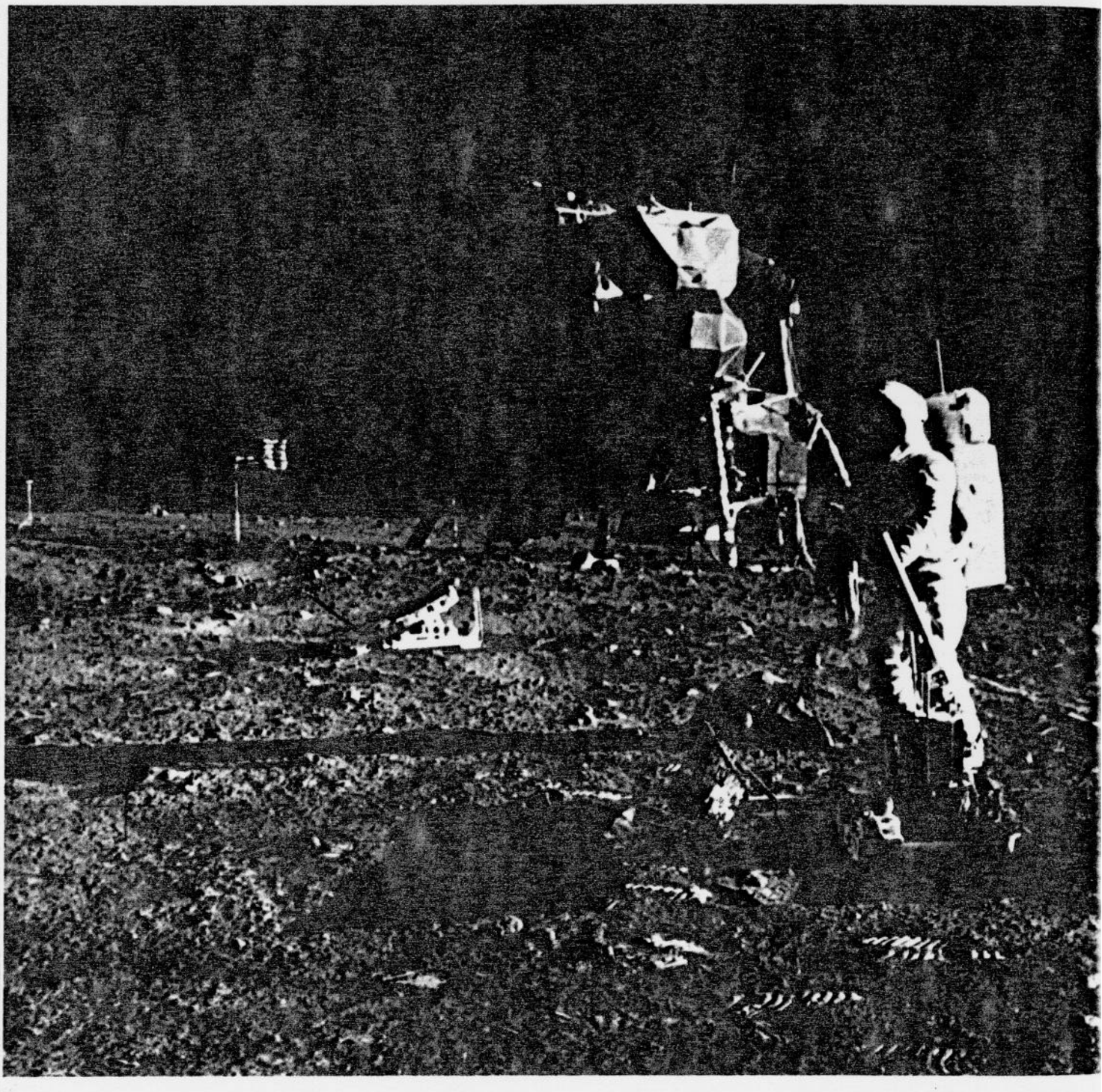

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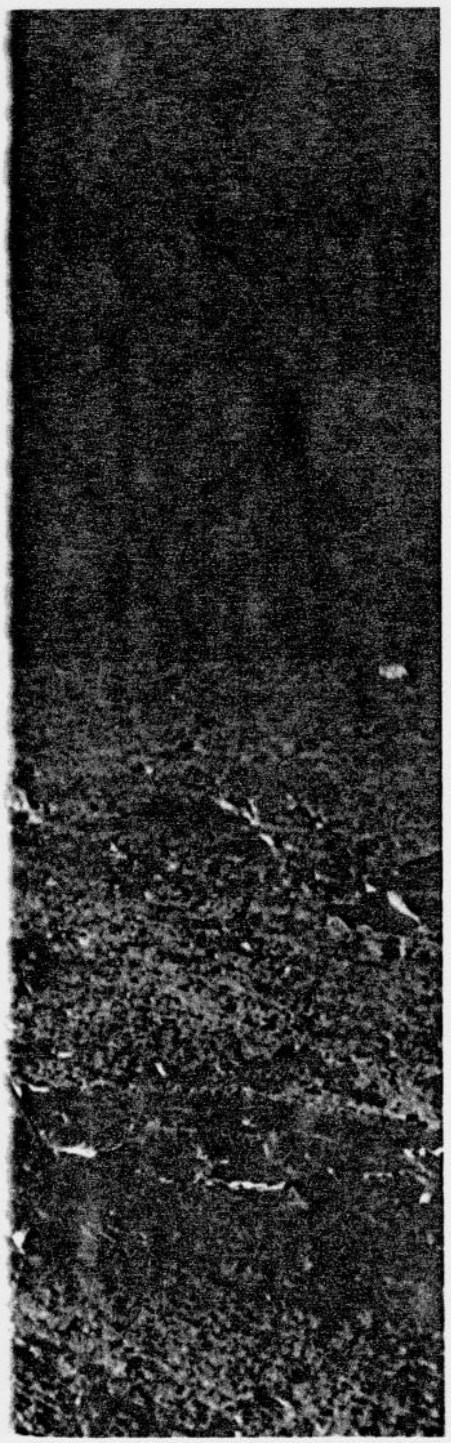

David N. Kaye
West Coast Editor

Isn't it preferable to send instruments instead of men into space to gather data and samples and to transmit them to earth?

Dr. Wernher von Braun, director of the Marshall Space Flight Center in Huntsville, Ala., answers the question this way: "Well, back in the 15th century Columbus and his men could have stayed at home, waiting until European science and technology could build unmanned ships to cross the Atlantic. These robots could then have scooped up a handful of sand and transmitted photographs of the Americas. But history would have been different."

When asked the same question, Lt. Col. Michael Collins, pilot of the Apollo 11 spacecraft, also referred to Columbus, a hero to most of the astronauts. "Scrap the manned exploration mission in favor of placing instrument packages on the moon?" he repeated. "That would be the same as Columbus sailing to within 60 miles of the Florida coast and deciding to turn around and go home."

Man's role in the loop

With few exceptions, the concensus of scientists interviewed by ELECTRONIC DESIGN was that man must always be in the loop in space, in one capacity or another.

The most important contribution that man can make to space travel today is his judgment. That was the opinion of Dr. William Pickering, director of the Jet Propulsion Laboratory in Pasadena, Calif. A dramatic example of this came on the Apollo 11 flight when Neil Armstrong seized the manual controls of the lunar module to avoid a boulder-strewn crater and bring the spacecraft to a safe landing on a smooth plain of the moon.

Another contribution is man's ability to evaluate data at the source, said an Air Force officer high in the manned space flight program. In the case of an unmanned system, "bringing it all down" for examination would pose quite a transmission problem.

Still another contribution is man's ability to increase the reliability of a space system by performing maintenance, the Air Force officer pointed out. "We wouldn't have put a LEM on the moon if man hadn't been able to override that gyration Apollo 9 went through," he noted.

And all of these advantages of man in space pertain to the present. In the future, space stations, colonies, travel to the outer planets and military command posts have all been suggested.

"Whether the vehicle is manned or unmanned, man fits into the loop," said Dr. Pickering. "If the vehicle is unmanned, man is on the ground directing it or has the capacity to give it a certain number of commands."

Manned-unmanned mix

As to proportion of control: "I believe that the optimum is a manned-unmanned mix," said Dr.

Seismic experiment package is deployed by Edwin Aldrin Jr. Already in place at left center is the laser reflector. To the left of it is the American flag and, far left, the lunar surface TV camera.

Krafft A. Ehricke, chief scientist for advanced programs, North American Rockwell Corp. Space Div. in Downey, Calif.

Dr. Ehricke went on to say that although the proportions of the mix will vary as the technology progresses, man will always have a place in it.

There are those, on the other hand, who argue that exploration can be better accomplished unmanned. Dr. Bruce C. Murray of the California Institute of Technology in Pasadena, Calif., strongly supports this view. He said:

"If one takes any particular function and sets out to do it, he can pretty well arrive at the fact that it's cheaper to do it unmanned than manned. Often you can do it better. For example, in making astronomical measurements from orbit, man interferes. He interferes with the stabilization system. If you want to get a second of arc accuracy in pointing, having a man aboard is a very serious problem. He moves around, and his heartbeat causes problems."

Man's judgment useful

Dr. Pickering countered: "Man's judgment in making observations allows him to take advantage of targets of opportunity which would be missed if he weren't there on the spot. Take the example of an unmanned Surveyor sitting on the moon. The television camera can report to earth that there is a rock that looks interesting. But a man accompanying the same Surveyor could say: 'That rock isn't very interesting, but there is one over here, just out of sight, which looks very interesting. Let's go over and get that one.' Man adds the dimension of performing functions which were unanticipated."

Steps in outer space

What of the future, now that the U.S. has opted for putting astronauts in the loop?

"Whenever you go into a new environment, there are three basic steps," Dr. Ehricke said. "They are *exploration*, *occupation* and *utilization*.

"The exploration is the investment. In other words, you find out what is there and what are the conditions of the environment. After you have found out what it is all about, you have to go into the occupation phase.

"That means you have to assure yourself of a good foothold; that you can exist there, work there and you can get there and back. Access and residence are the two major objectives of the occupation phase.

"The final phase is when you finally start to utilize the new environment on a practical basis."

The next step in this nation's moon program is the occupation phase. NASA plans to establish space stations and to develop residence and good access capabilities.

To advance into the utilization phase, Dr. Ehricke said, we must answer two questions: Are there useful resources in space? If the answer is yes, then is man needed to tap them?

"The answer to question one is definitely yes," Dr. Ehricke said, "Space is useful in three respects primarily:

"1. *Information transmission.* We are using this already with communication satellites. We will expand this into education from orbit. For example, I can see a portion of our foreign aid being instructions to farmers in lesser developed countries on how to improve their crops.

"2. *Information acquisition.* This refers to observing and taking inventory of our planet. Earth can be thought of as a spaceship. In order to operate our ship properly, we must have proper status reports. There must be a global inventory of our resources.

"3. *Value generation.* Processing the environment of space, for example, could include focusing light and beaming it down at certain territories. Rescue operations could go on around the the clock. Certain areas of cities could be illuminated to fight crime at night. That would be processing a natural environment, like sunlight, from space. And that gets us into processing other materials utilizing the environment.

"Weightlessness and vacuum are two very important factors that can be used. I would like to expand on this by saying that space offers the ability to choose your own g level. Weightlessness is just one extreme. Space offers the possibility of extreme weights that can't be produced on the earth. This is due to the fact that centrifuges in space don't have to deal with air drag. Certain alloys can be formed at 10,000 g's. The technique on the earth is called explosive forming, since these g levels can only be provided momentarily rather than for long periods of time as in space."

Yes, Dr. Ehricke affirmed, wherever judgment, intelligence and rapid responsiveness to unforseen situations are necessary, man must be in the loop. He fits into all three steps in the space program: exploration, occupation and utilization.

"His place in exploration is with reconnaissance flights," Dr. Ehricke summed up, "but only after unmanned probes. Man really comes into his own in the occupational phase."

Support for this position is widespread, even outside the scientific community.

Col. John H. Glenn, the first American astronaut to circle the globe and now the president of Royal Crown Cola International in New York City, told ELECTRONIC DESIGN in an interview:

"Up to now, most of the effort in the space program has been concerned with trying to define man's role—what he can do best and what he can't do—and developing the transportation system for him to use.

"I think that the next major thrust in space will be utilizing this transportation system, which we have spent over $20-billion to develop, to get a maximum scientific return from it. We should get as much information as we can: earth resources, and earth orbiting laboratory and new techniques to utilize the weightlessness in space in manufacturing."

Dr. Issac Asimov, professor at Boston University and a writer of science fiction, said: "Men are curious. Men want to go. To not go would ruin the whole thing psychologically.

"A self-supporting colony on the moon is the most important possibility of all. It will establish a psychological frontier once again. The earth has largely vanished as a frontier." ■■