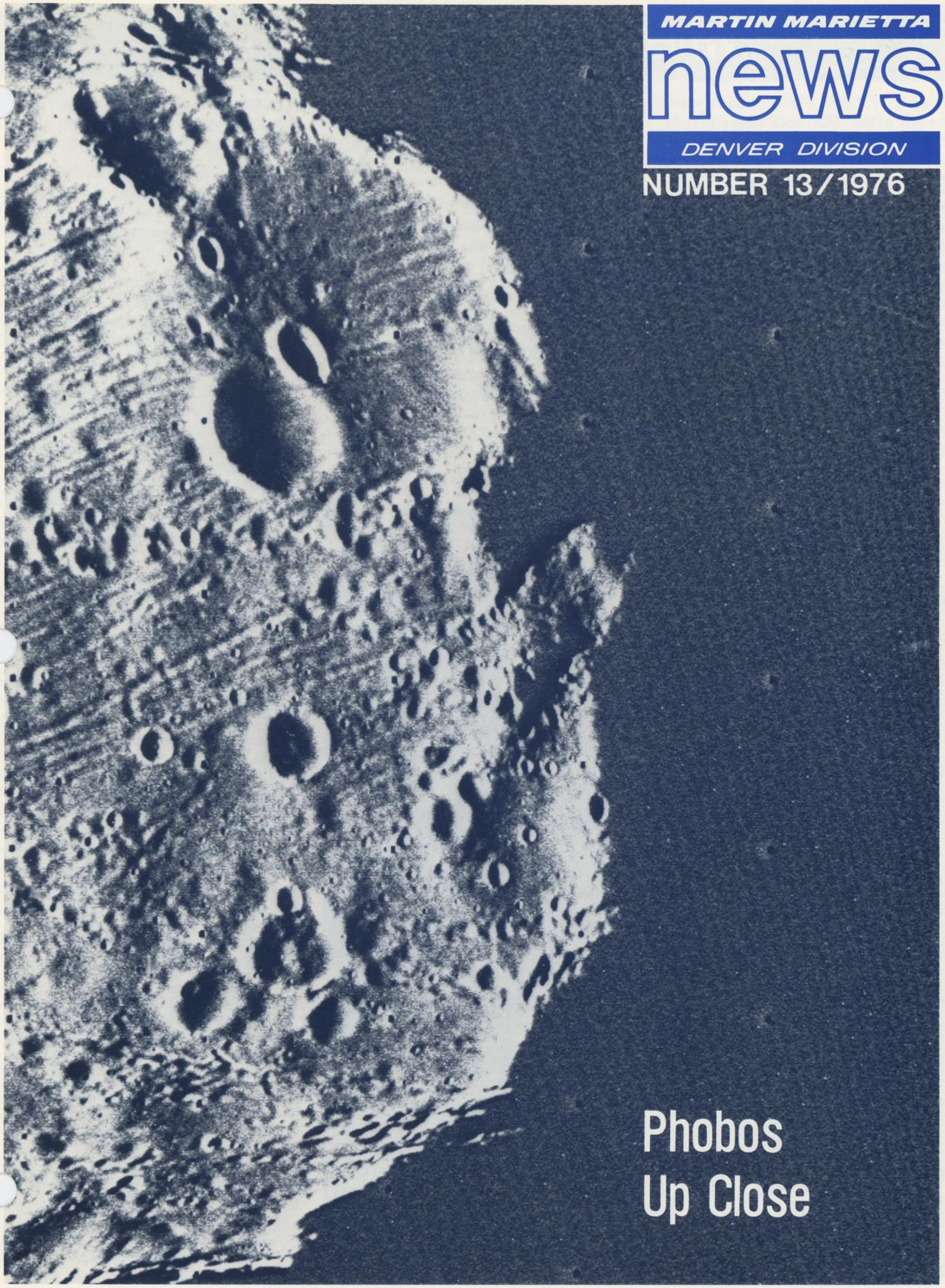
MARTIN MARIETTA
news
DENVER DIVISION
NUMBER 13/1976



Phobos Up Close

Where did all the water go?

As early as 1863, Giovanni Schiaparelli, director of the Milan observatory in Italy, confounded the scientific world and fired the imagination of the public with the "discovery" of canals on Mars.

Until 1886, he was alone in his description of Martian canals and his discovery was suspect, because no telescope but his seemed to show them. But in 1866, astronomers at Nice—using a larger, 30-inch telescope—saw the canals and their intertwined network. Not long after, observers in England, Belgium, and other countries began recording canals on maps.

His eyesight failing, Schiaparelli retired from observing in 1890, but the cause and origin of the canals was taken up by Percival Lowell.

Lowell founded his own observatory in Flagstaff, Arizona where his observations of Mars convinced him that what Schiaparelli had observed and he himself had confirmed and expanded on, was a gigantic irrigation system Martian engineers had designed to keep their dying planet fertile.

The canal theory has been discounted, but photographs taken by Mariner missions showed what appeared to be dry river beds—much like the tributary systems on Earth.

But where had all the water gone, if indeed the channels were dry river beds?

In a recent briefing for the division's management staff B. Gentry Lee, director of the Viking flight team's science analysis and planning, proposed an answer to the question.

There is water on Mars, Lee reported. It exists in the planet's polar cap. The ca[illegible] not carbon dioxide (dry ice) as some suggest. It is water ice.

How do Viking scientists know? The frost temperature of carbon dioxide and the frost temperature of water are drastically different. The temperature of the polar cap clearly shows it is water ice.

The water that once flowed on the surface of Mars, leaving the channels that are now dry, is concentrated in the polar caps. That's the answer to where the water went.

With this further confirmation of the presence of water and earlier findings of nitrogen and carbon dioxide, it is again shown that elements necessary for life all exist on Mars.

"Yet, there is no clear evidence that life does exist on Mars," Lee commented and then added, "But neither is there clear evidence it does not exist.

"Perhaps," he suggested, "the question, 'Is there life on Mars?', is no longer as important because the conditions for life do exist."

But the search goes on with scientists divided on what the results from the biology experiments and the organic chemical analyses mean.

The biology instrument has conducted three experiments searching Martian soil samples for living micro-organisms. The labeled release experiment looked for signs of metabolism; the pyrolitic release experiment looked for micro-organisms functioning by photosynthesis or chemo-

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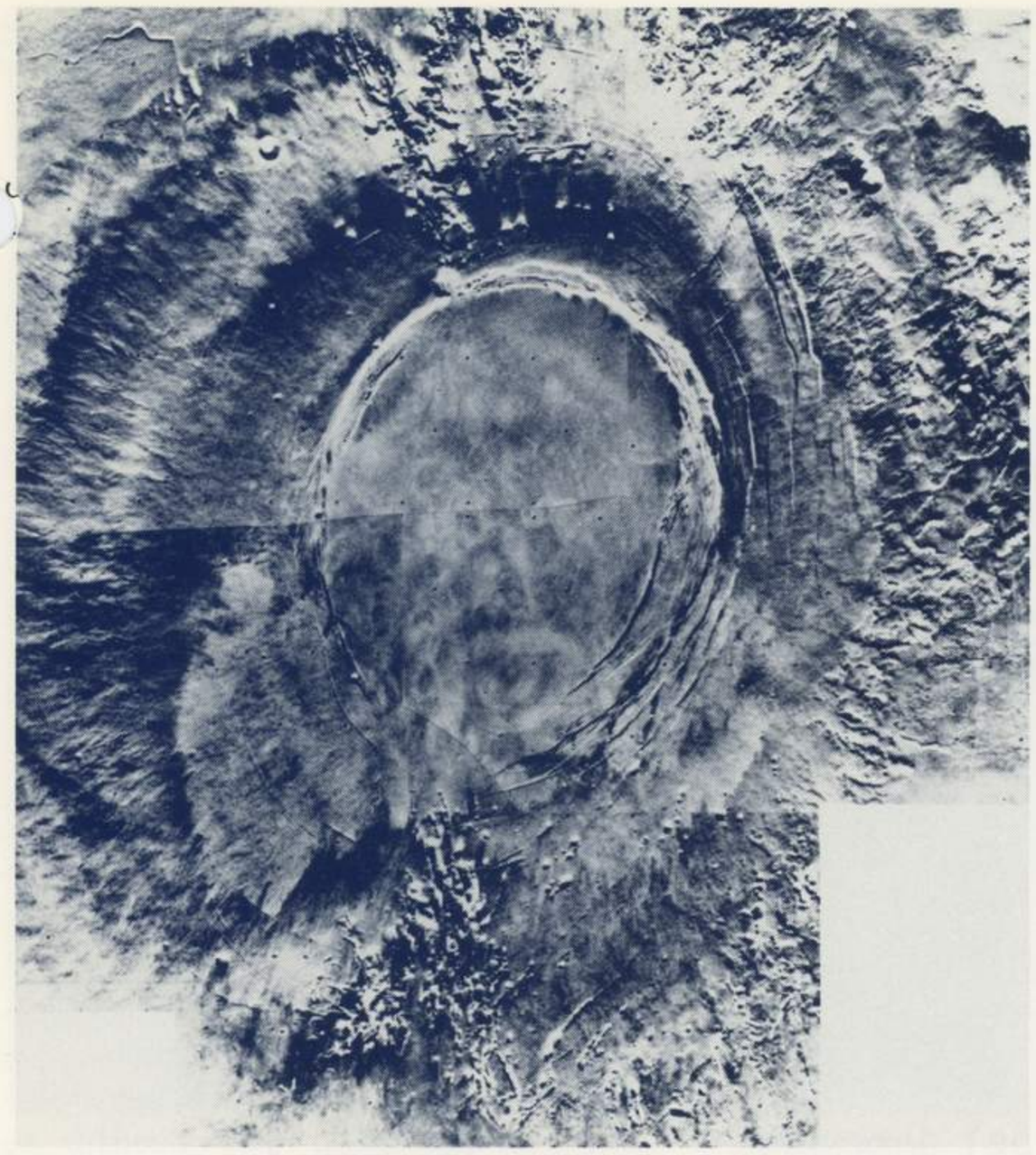
Probably the most photogenic feature on Mars is the enormous canyon—Valles Marineris—which cuts deeply into the surface and stretches nearly a third of the way around the planet. This photomosaic was made from pictures taken Aug. 23 by Viking Orbiter 1 from an average range of 4200 kilometers (2600 miles). The principal canyon crosses the bottom half of the picture. North is to the top. The far wall of the main canyon shows several large landslides which probably formed in episodes and perhaps were triggered by Mars quakes. Along the near wall, another widening process appears to have occurred; a series of branch channels cuts into the plateau at the bottom. Th[illegible] may have formed either by slow erosion [illegible] result of the release of ground water or by mass wasting processes in which rock debris moves slowly downhill as ground ice freezes and thaws. Other branches of the canyon are visible at the top.



This is a mosaic of five pictures of Arsia Mons, or the Mariner 9 "South Spot" on Mars, taken from Viking Orbiter 1 on Aug. 22 from a distance of 6000 kilometers (3700 miles). Arsia Mons, which is located at 9° S. Lat., 120° W. Long., is one of the three large Tharsis volcanoes. It stands about 19 kilometers (12 miles) above the surrounding terrain. The central caldera, or circular collapse despression, is about 120 kilometers (75 miles) across. Outside the caldera, particularly at the right side of the picture, numerous lava flows are visible as fine linear features. The irregular re-entrants into the main part of the volcano to the north (top) and south are sources of vast amounts of lava which appear to have flooded the surrounding plains. The Tharsis volcanoes are among the youngest of the surface features on the planet.

This mosaic of the Mars surface is made of pictures taken from Viking Orbiter 1 on revolutions 44 through 47, Aug. 4 through 9. The area is centered at 17° N., 55° W., to the west of the A1 landing site in Chryse Planitia. Just to the west of the area are the plains of Lunae Planum. The terrain shown in the picture slopes from west to east with a drop of about 3 kilometers. The channels are a continuation of those to the west of the A1 landing site and are suggestive of a massive flood of waters from Lunae Planum, across this intervening cratered terrain, and into the general region of the A1 landing site. In several cases the channels cut through craters; in others, the craters are clearly later than the flood and superimposed in the channels. The source region for the flood is not known, but some areas of chaotic terrain at the south end of Lunae Planum are suspected. Orbiter 1 is continuing to photograph these features upstream in an effort to isolate the source.

Water

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trophy, or response to chemicals; and the gas exchange experiment sought living organisms by measuring changes in gases in a closed environment.

The gas chromatograph mass spectrometer performs organic chemical analyses of the Martian soil and analyzes the components of the Martian atmosphere at the surface. The investigation can reveal any existence of past life on the planet.

There is apparent biological activity on the planet, but no organic molecules have been found. Can biological life exist without organic matter? Is the apparent biological activity really biology or is it some very interesting chemistry?

Three theories have been suggested to explain how there can be biological activity without confirmation that organic matter exists.

The theories are the oasis theory, the ecological system theory, and a theory that Mars organic matter contains only three or four carbon atoms which cannot be seen when blended with carbon dioxide in the gas chromatograph mass spectrometer.

The oasis theory in the words of Lee:

"If you were a bug on Mars, you'd be very careful where you picked to live. You'd look for an oasis. . .a shady spot, maybe under a rock, where you don't get pelted by ultraviolet radiation that can wipe you out or, alternatively, you pick a nice spot under the surface where, during some parts of the year, you can find a little bit of liquid water.

"But you don't live any place very long. Mars is not a very hospitable place.

"In the summer you might go to a place like Chryse where there is very nice Martian weather with the high daytime temperature at minus 25 degrees and the low at night minus 110 degrees. It's really not a very comfortable place to live if you are a bug.

"The theory is that these bugs live in very small pockets around the planet and that they are picked up with the dust and blown around the planet. They live only a short time in the new place before they die."

What may be being picked up in soil samples for Viking are a few stragglers, who metabolize a little bit in the experiments and then disappear.

"I don't care much for this theory," Lee

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Water

from preceding page

said. "There are too many things that can fall apart. We don't have a nice set of criteria to define these microhabitats. Besides that I'm an Earth chauvinist. I haven't seen any of these microhabitats. We have bugs everywhere on Earth."

The prime theory, in Lee's view, is the ecological system theory.

There is not a lot of carbon on Mars nor is there a lot of nitrogen. These are the two principal chemical elements for building anything that looks like life.

On Earth, these elements are abundant. Biological systems do not use all that is available.

However, on Mars, because of the scarcity of these elements, not an atom is wasted.

The ecological system, if it could talk to itself, would say, according to Lee, "I'm not going to let that sort of gunk fly around like that. As soon as I find a nitrogen or carbon atom not being used in a biological system, I'm going to glom on to it (cannabalism, if you will) and use it."

The theory is consistent with the results achieved so far in the pyrolitic release experiment and the organic analysis. The organic response in the pyrolitic release experiment was not great enough that the same response could be detected in the gas chromatograph mass spectrometer organic analysis. The response would have to be one thousand times greater before it would show up.

It is possible organic compounds on the surface of Mars are being destroyed by the Sun's ultraviolet radiation.

"It's obvious what we want to do," Lee said. "We want to dig a soil sample that has been protected. We want to dig under a rock.

"We've formed a rock rollers working group to study all the techniques for moving a 60-pound rock so we can get beneath it and get a sample.

"If we can find one molecule of organic matter, the whole issue of Martian life may be settled."

Not all elements of the exploration of Mars are as complex as the question of biological life.

The weather is an example.

"Tell me what the weather was yesterday and I'll tell you what it will be today—within one percent," Lee said.

And the wind:

"Tell me the time of day and I'll tell you which way the wind is blowing and how fast—within five percent."

Some things are simple—and will stay that way.

The search for life is not simple—and there is little indication it will become any easier.

On the cover

Most detailed photograph ever obtained of Mars' inner satellite, Phobos, was taken Sept. 18, by Viking Orbiter 2. The asteroid-size moon has been photographed bundreds of times by Mars-orbiting spacecraft—Mariner 9, Viking 1 and Viking 2—but never before at this range (880 kilometers or 545 miles) or with this resolution (smallest object visible is 40 meters, or 130 feet, across). At this close distance, where the direction to Phobos is changing rapidly, Viking's TV camera was slewed during the exposure so that the picture would not be smeared. The camera-slewing experiment was a remarkable success, producing a very sharp image of about half of the craggy oval which, here, measures about 18 kilometers (11 miles) top to bottom and 9 kilometers (5.6 miles) left to right. Phobos' north pole is near upper left. The tiny moon is seen to be heavily cratered as was expected but, surprisingly, shows striations and chains of small craters. Similar chains of small craters on Earth's moon, Mars, and Mercury were formed by secondary cratering from a larger impact. The origin of the striations is a puzzle which may be solved with additional high-resolution coverage later in the mission. Striations may possibly be formed by: a) ejecta from a larger crater not visible in this picture; b) a collision with a cloud of debris or a large body; or c) we may be viewing the results of an event when Phobos was part of a larger body. Another interesting feature is what appears to be a central peak in a large crater near the bottom of the picture. The camera-slewing technique used here will allow taking even more remarkable high-resolution pictures of Phobos, Deimos and Mars in the Viking extended mission where flybys of a few hundred kilometers will be possible.

MARTIN MARIETTA NEWS
Published by Public Relations
MARTIN MARIETTA AEROSPACE
Call Ext. 5364 with suggestions or information for articles.
Denver Division
P.O. Box 179
Denver, Colorado 80201
October 1976

Martin Marietta cited for Viking mission role

Martin Marietta has been awarded th Theodore von Karman Award for Science and Engineering for its role in the Viking mission to Mars.

The award, which Martin Marietta shared with the National Aeronautics and Space Administration, was presented by the Air Force Association at its annual convention in Washington, D. C. Sept. 22.

Accepting the joint award were Thomas G. Pownall, executive vice president of Martin Marietta, and James S. Martin Jr., Viking project manager for NASA.

Announcing the award, AFA president George M. Douglas called the Mars mission "one of the most striking technological achievements in the history of science—the design of the Viking celestial laboratory, its soft landing on Mars eleven months after launch, and subsequent scientific tests of the planet's chemical content and geological history—is indeed worthy of recognition."

U. S. Senator Frank E. Moss of Utah, chairman of the Senate committee o Aeronautical and Space Sciences, whe he learned of the award wrote to Mr. Pownall, "...I want to congratulate you, the employees of Martin Marietta, and your subcontractors who have worked so long and hard on Viking. The success of Viking has excited the nation and generated new interest in and support for the entire space program. The von Karman award is a symbol of the pride I and all Americans have in Viking. Please convey my congratulations and best wishes and those of the Committee to all members of the Viking industry team. We appreciate your efforts and applaud your engineering and manufacturing prowess."

Martin Marietta, principal contractor for the Vikings, their scientific experiments and the mission integration, headquartered the direction, design, building, and test of the spacecraft at the Denver division.

Viking 1 landed on the Plain of Chryse July 20, followed by Viking 2 which settled on the surface of Mars at the Utopia Plain Sept. 3.

The AFA award is named for the jet propulsion pioneer, physicist, and internationally recognized aviation expert Dr. Theodore von Karman.

SCATHA fabrication to begin

The detailed definition phase of the division's first satellite and first military space vehicle program has been completed. Next step is the preliminary design with fabrication to begin late this year or early in 1977.

The satellite—known by the acronym SCATHA for Space Charging At High Altitude—will undergo systems tests in late 1977 and will be launched in July 1978 from the Eastern Test Range aboard a NASA Delta vehicle.

Robert B. Demoret, SCATHA program director for the division, calls the program "an exciting one from the technical and operational view and a challenging one from the engineering design standpoint."

"We have but a single opportunity for success, "Demoret said. "The satellite and its equipment must work the first time. This is also a low-cost program. That gives us difficult dual objectives: low cost, high success."

The SCATHA program was initiated to find a solution to a problem that plagues both commercial and military satellites, particularly those in synchronous orbit.

The problem is the electrical charge that builds on the surface of satellites, as high as 20,000 volts, and the arc discharges that result.

These discharges disrupt normal satellite operation and cause improper functioning of equipment electrical circuits.

"The job of SCATHA is to gather information on how and why different materials are effected by this space charging and what happens to them," Demoret says. "From this information, we can establish design criteria for future spacecraft that will eliminate or minimize the charging effect."

The SCATHA vehicle will be about five-and-a-half feet in diameter and just under six feet long. It will weigh 1400 pounds, including 650 pound solid rocket motor for final orbit insertion. It will carry experiments provided by various government agencies, including the Air Force, Navy, and NASA.

SCATHA's internal equipment must be immune to the effects of the charging while its surfaces and external collectors are fully exposed to the charging.

Demoret, who is leading the program, is a Denver native and has bachelor's and master's degrees in aeronautical engineering from the University of Colorado. He has been with the division since 1956, starting on the Titan program where he held a variety of assignments, many in advance design.

From 1967 to 1972, he was on the Skylab program, again with a variety of key assignments.

Working with Demoret on the SCATHA program in major roles are Harrison C. Wroton, deputy program director and total system integration; Clair F. Grubb, contract administration; Leon J. Ginsberg, configuration and data management; Robert H. Snodgress, subcontract management; Paul L. Dalton, mission success; Walter F. Barker, space vehicle development; Dale Massey, assembly and test; and Donald W. Hodder, planning and cost management.

Economic facts

Taxes hit family budget

The Federal Government will cost the average family $5,328 in the next fiscal year, warns the Chamber of Commerce of the United States in its *Washington Report.*

"Ask anyone what the largest item in his family budget is and he might say food, housing, or an automobile," the Chamber says.

"Actually, the government costs the average family more than food, housing, and automobiles combined," according to the Chamber. "This year, as it has every year since 1965, the Federal budget will once again increase as the Federal Government chalks up record expenditures."

Federal expenditures during the past 10 years have increased 99 percent per household, from $2,672 in 1967 to a projected level of $5,328 in 1977.

Most significant increase is in income security which more than tripled and now costs the average household $1,853. This is because more persons have become eligible for Social Security and the new Supplemental Security Income and new programs in the public health area have resulted in those expenditures quadrupling on a per family basis.

Doubling of the national debt has resulted in a 163 percent increase in the cost per family of debt service charges to $558 per household.

Mobile blood unit here October 27

The Bonfils mobile blood unit will be at the division Wednesday, Oct. 27, to accept blood for the Belle Bonfils Memorial Blood Center.

Blood donated by employees is credited to the Martin Marietta account, permitting employees and their families to draw from the Bonfils blood reserves. Requests to draw from the reserves are processed by the division's medical department and only that department may authorize release of the blood.

Employees who have not participated in the blood donor program may volunteer by completing the form below.

Donors are contacted and scheduled individually. Approximately 150 are scheduled for each mobile blood unit visit.

Since the start of the program in 1973, more than 1200 units have been donated by Denver division, Denver Data Center, and Air Force personnel.

Employees and their families have used more than half the blood donated, ranging from one pint for emergency treatment and 12 pints for open heart surgery up to 50 pints for leukemia treatment.

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Mail to: Trudy Dion, Mail No. 6310

Mrs. Ida Stallworth has received the first Spot Award presented by external tank operations at the Kennedy Space Center. She was awarded a pen and pencil set for her outstanding performance in single-handedly creating the documentation control center for the ET program at KSC. She completed the task in six weeks.

From Michoud

Space Shuttle orbiter shown to public

Theme music from the famous television program "Star Trek" echoed across the concrete hardstand. More than 2,000 persons waited with anticipation. Slowly, the nation's newest spacecraft rolled into the sunlight.

Enterprise, officially Space Shuttle Orbiter 101, made its first public appearance Sept. 17.

This was the first in a long series of events for Enterprise. Next January, it will be transported overland to NASA's Dryden Flight Research Center at Edwards Air Force Base to begin an extensive approach and landing test program.

Actual flight tests will begin in July 1977 when a modified Boeing 747 will carry Enterprise—minus its engines—to approximately 27,000 feet, descend to 23,000 feet where the two-man orbiter crew will separate the spacecraft from the 747. The astronauts will bring the orbiter down to a powerless landing on a dry-lake bed runway, assessing structural integrity, performance, handling, and sepatation.

Attending the rollout ceremonies at Rockwell International facilities in Palmdale, Calif., from Martin Marietta were Thomas G. Pownall, Martin Marietta executive vice president; L. J. Adams, Martin Marietta Aerospace president; C. B. Hurtt, vice president and general manager of the Denver division; George E. Smith, vice president and project director of Michoud operations; James McCowan, deputy director at Michoud; Lee Tarlton, director of materiel at Michoud; Howard F. Keyser, vice president for program development at the Denver division; John H. Boyd Jr., director of public relations for the division; Eugene C. Wood, program director for CCMS—checkout, control, and monitoring subsystem for Space Shuttle's launch processing system; and L. J. Lippy, director of program development in the division's technical operations.

Orbiter 101 was scheduled to be named Constitution, but a letter-writing campaign by fans of "Star Trek," the long-running science fiction television program, brought about a change. "Enterprise" is boldly displayed just aft of the crew compartment on the space craft.

Enterprise and its first crews are shown shortly after rollout of the nation's newest spacecraft. Set to begin testing of the Space Shuttle orbiter are, left to right, Charles Fullerton, pilot and Fred Haise, commander; and Joe Engle, commander, and Richard Truly, pilot.

Main propulsion test article moves toward delivery

Production has started on the first all-up external tank for Space Shuttle at Michoud, the culmination of several years of planning, designing, tool fabrication, and procurement activity.

The first tank will support shuttle's main engine testing at the National Space Technology Laboratory in Bay St. Louis, Miss. The tank, called the main propulsion test article, is scheduled for delivery in July 1977.

A special test team has been named by George E. Smith, vice president and project director at Michoud, to assure that the important test milestone in the Space Shuttle program is met.

The team, led by Tom Morris, production operations, is composed of Colin Harrison, engineering; Lee Tarlton, procurement; George Rodney, product assurance; and Bill Ewig, planning and business management.

The team is directing all project activities to support main propulsion test article production and will make immediate decisions to resolve problems and maintain proper documentation. Daily meetings are held to review detail activities and plan work actions to identify and preclude potential shortages and missed requirements before schedule delays are created.

Advances in schedules, processes, and procedures have been made and momentum is building. All major structural procurement requirements for the program are on hand and major structural components for the liquid hydrogen tank have been welded. Every major tool has been or will be in use in time to support tank delivery.

"The experience and learning gained as a result of task team pathfinding," team member Ewig said, "will contribute to our confidence that the on-time delivery of subsequent test articles can be supported."

Department picnics held

Two major picnics were held in the New Orleans area recently by Michoud Operations production operations (in City Park) and structures (in Bucaneer State Park). Food, drinks and games were the order of the day with the adults going home muscle sore and weary and the kids just weary.

In Michoud

Call C. H. Fleisher at 3710 with suggestions or information for articles for the Martin Marietta News.