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SPECIAL SUPPLEMENT

APOLLO

SPACE ODYSSEY 1969

MAN ON THE MOON

Man has arrived on the Moon — the first step in his conquest of the Universe.

This is his stepping-stone to the planets, and then to the stars.

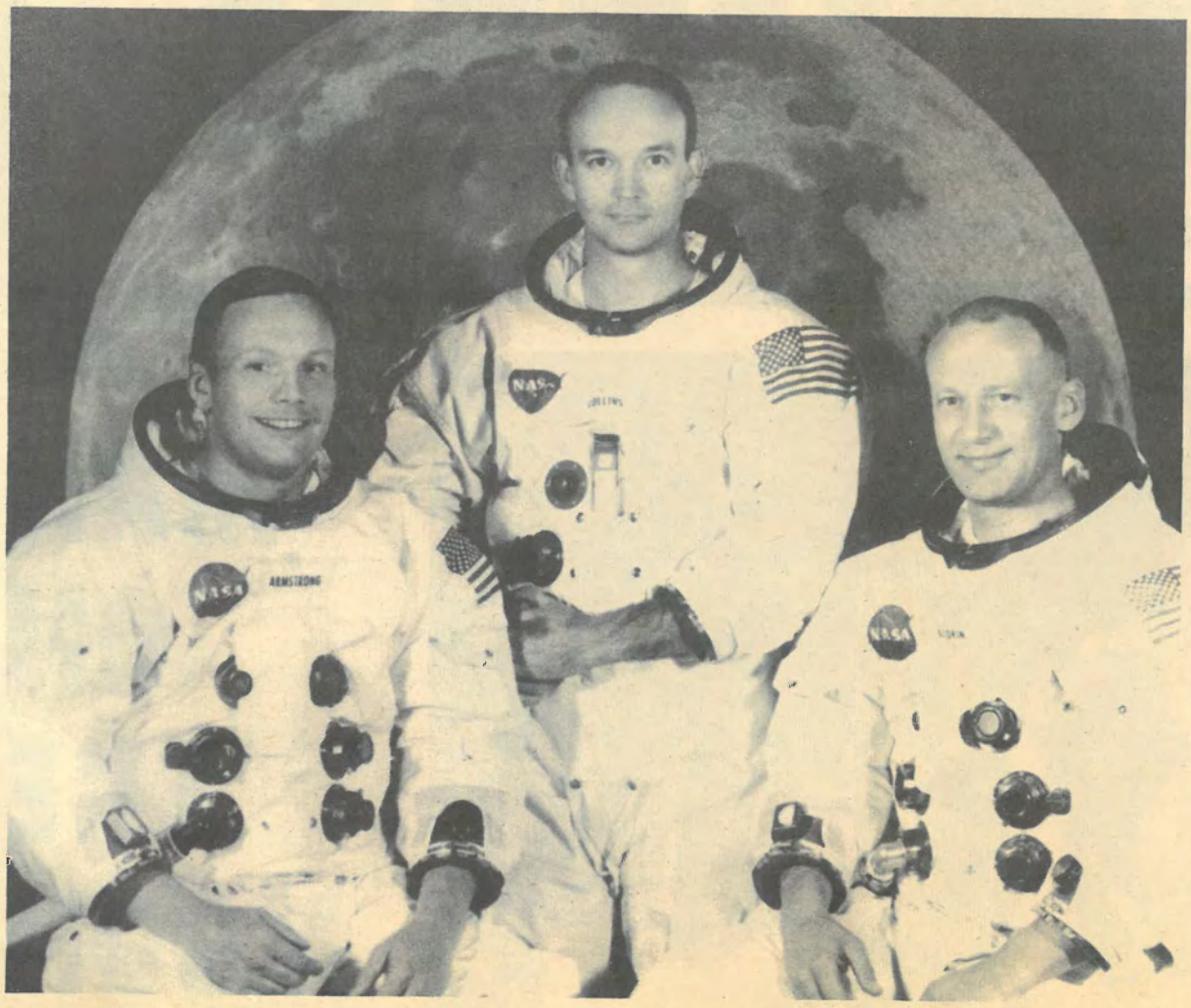
But first his foot-hold on the Moon has to be consolidated and possibly a base established.

Here, in man's first venture to an alien world astronaut Edwin Aldrin sets up scientific equipment on the lunar surface.

The craft that brought him to this new frontier is in the background.

INSIDE

Profiles



by Science Writer
WALTER FROEHLICH

of the pioneers

History will reserve a place for them—those first men to walk on the Moon. They are mankind's first emissaries to another world. The U.S. national programme to send men to the surface of the Moon is known as "Apollo." The Moon landing was achieved in a flight designated "Apollo-11," in the numerical sequence of successively more complex developmental space missions. The three astronauts who undertook this epochal voyage are (left) : Neil A. Armstrong, Mission Commander; Michael Collins, Command Module pilot; and Edwin A. Aldrin Jr., Lunar Module pilot.

ALL three Apollo 11 astronauts were born in 1930. All three are married, and they have a total of eight children. All live near the U.S. Manned Spacecraft Centre at Houston, Texas. Each of the men is a veteran pilot with about 4,000 flying hours, mostly in jet aircraft, and each had participated in one previous space flight (in the two-man Gemini series).

Armstrong was the first man to set foot on the Moon. Flight assignments are made by NASA officials primarily on technical considerations, though also on the basis of experience, training and general suitability of an astronaut.

Even among as select a group as his fellow astronauts, Armstrong stood out for the imagination, courage, skill and versatility embodied in his pioneering career.

As a test pilot, with research aircraft, he rocketed America's famed X-15 to over 200,000 feet, the very edge of Earth's atmosphere, and also accelerated the craft to about 4,000 miles an hour.

As command pilot of the Gemini-8 flight on March 16, 1966, he and his co-pilot, David R. Scott, had one of the narrowest escapes from disaster in space history. They successfully performed the world's first "docking" by catching up with and joining their own craft to another orbiting object.

But the flight, originally scheduled to last three days, had to be terminated after a few hours when a malfunctioning jet thruster caused the craft to tumble out of control. The crew was credited with demonstrating exceptional piloting skill in overcoming this problem.

On May 7, 1968, Armstrong barely rescued himself again when he parachuted from a disabled Moon-landing training craft.

Armstrong joined NASA's Lewis Research Center in 1955 as an aeronautical research pilot, and later transferred to NASA Flight Research Center in California. Earlier, as a U.S. Navy flier, from 1949 to 1952, he flew 78 combat missions during the war in Korea.

Born in Wapakoneta, Ohio, he attended secondary schools there, then earned a bachelor of science degree in aeronautical engineering at Purdue University, and did post-graduate work at the University of Southern California. He and his wife have two sons, aged 12 and six.

Record

History's second man on the Moon was Lunar Module pilot Aldrin.

Aldrin earned a doctor of science degree in astronautics from Massachusetts Institute of Technology. Early in 1963, he wrote his doctoral dissertation on orbital mechanics. He ended that dissertation by dedicating it to the astronauts and added : "Oh, that I were one of them."

After becoming one of them in October 1963, he was selected as co-pilot for the Gemini-12 in November 1966. During that four-day 59-orbit flight (with James A. Lovell, Jr., as commander), he spent 208 minutes standing on his seat in the space capsule, his head and upper body protruding into space through the craft's open hatch, while he took pictures of the Earth.

Later, on that same flight, he left the craft and "walked" through space for 129 minutes, connected to the craft only by a line. His time outside the craft remains the record for spacewalks.

Aldrin's earlier aircraft pilot experience includes 66 combat missions during the war in Korea, and he was a flight commander with the U.S. 36th Tactical Fighter Wing at Bitburg, Germany. A native of Montclair, New Jersey, he was graduated from high (secondary) school there and then earned a bachelor of science degree from the U.S. Military Academy.

He and his wife have two sons, aged 13 and 11, and a daughter, also 11.

Less fame

For the man in the middle-seat in the Apollo-11 spacecraft, Michael Collins, the journey probably entailed lesser fame.

Yet, much of the mission's success rested with Collins.

As pilot on the three-day, 44-orbit Gemini-10 flight in July 1966, Collins (and command pilot John Young) set an altitude record at that time of 475 miles, and, after "docking" in orbit with an unmanned target vehicle used that vehicle's propellant to alter their orbital path, a still unique space feat.

On the Apollo-11 flight, Collins experienced what he missed earlier and earned the fame that eluded him. He was assigned the same position, as command module pilot, on the Apollo-8 round-the-Moon flight in December 1968, but was prevented going by surgery for removal of a bone growth on his spine. His place in the Apollo-8 flight was taken by James A. Lovell, Jr.

A native of Rome, the son of a U.S. Army father, Collins graduated from schools in Washington, D.C., and the U.S. Military Academy. He served as an experimental flight test officer for the U.S. Air Force.

He and his wife have two daughters, aged 10 and seven, and a six-year-old son.

The Moon has always had a strange fascination for man. It has been the subject of songs, superstitions, legends, fears and religions throughout the ages. One ancient Greek author wrote about a flight to the Moon in a chariot drawn by swans—a simpler, but less practical, method than that used by the United States to carry out man's ambition finally to set foot on the Moon. Hindus, who bathe in the sacred Ganges River when the Moon is in eclipse, believe divine nectar spilled into the river from a pitcher of the gods during the creation of the world. Among the theories disproved by the Moon exploration are the light-hearted ones told to children that the Moon is made of green cheese and that there is a big man whose face is the face of the Moon. Ideas about the Moon's distance from the Earth have been, to say the least, underestimated in some nursery rhymes. A well-known verse begins: "Hey, diddle diddle, the cat and the fiddle, the cow jumped over the Moon. . . ." No mean feat. One negative result of man's constantly increasing knowledge of the Moon, with its bleak surface, craters and crags, has been the sapping of its romantic image. Popular song-writers had for years relied on the Moon—if only to rhyme with "June"—for love-songs, such as "Blue Moon," "How High The Moon," "By The Light of The Silvery Moon," "Shine on Harvest Moon," and the prophetic "Fly Me to The Moon." The effect of the Moon on man's mind is reflected in words such as "lunatic" and "moonstruck," while some people still believe that to sleep with the Moon on one's face can cause disfigurement. Astrologers still make out horoscopes for clients based on the position of the Moon and the planets at the time of birth. For some ancient peoples, the moon was an object of worship. Cree Indians believe the Cree wizard Cha Ka Pesh lives there with his wife. In the 17th century, Britons believed the Moon exercised great influence over human affairs. Times for slaughtering animals for food, cutting down trees and sowing seeds were all regulated by its phases. A waning Moon was looked on as an evil influence and a full or new Moon was the most auspicious time for starting new enterprises. Superstitions concerning the Moon show traces of ancient Moon-worship. In some places, it was thought unlucky to point at the Moon and, in Northern England, many believed anyone who pointed at it nine times would not go to heaven when he died. The Moon has been blamed for many things, from madness to high blood pressure. Several superstitions are connected with the new and full Moon. Some people wish on a new Moon, others believe that if they turn over silver coins in their pockets when they see it for the first time they will have plenty. According to a custom in Devon, it was unlucky to see the new Moon through trees, and in other places, through glass. Although comparatively little is still known about the possibility of habitation on the Moon, some optimistic American travel agents are already taking bookings for travel there and some people are on airline waiting lists for the day when it will be "next stop—Moon."

From Peenemunde to Tranquillity

by ROBERT JACKSON

Dr. Wernher von Braun, who opened the way to space travel by designing the V2 rocket, and finally had his dream realised with his design of the mighty Saturn V, which carried man to the Moon.

THE birds sang in the forest near Peenemunde. They had not yet been driven away by the racket of machinery, nor by the sight of the strange, alien things that had invaded their home. There was a lot of activity around the clearing on this morning of October 3 1942. Men swarmed around the complex of concrete blockhouses.

A small group stood on the roof of the assembly workshop. One of them paced backwards and forwards ceaselessly, his face lined with anxiety.

From a blockhouse 100 yards away, Major-General Walter Dornberger, the director of rocket development for the German Army, trained his binoculars on the pacing figure. He knew just how Wernher von Braun must be feeling.

"The rocket on the pad—the A-4—was von Braun's brainchild, the result of 10 years of effort. Two previous launch attempts had failed, and von Braun was well aware that today's attempt was the last chance.

"X minus 1." The seconds ticked slowly by. Forty-five . . . 30 . . . 20 . . . 10 . . . with a sudden hiss, a green flare shot over the forest. "Ignition!" In the fire control blockhouse, a technician pulled the first of three levers.

A cloud of white smoke billowed from the A-4's exhaust; sparks gave way to a spurting reddish flame then Dornberger and the others saw the rocket's umbilical cord fall away.

A turbo-pump started up, forcing 33 gallons of oxygen and alcohol per second into the rocket motor's combustion chamber. Within three seconds, the motor was developing 25 tons of thrust.

Suddenly, the rocket's slim nose began to rise above the smoke as the A-4 left the ground, climbing incredibly slowly at first, then gathering speed as its gleaming body rose from the forest. Slowly, the A-4 nosed over into its trajectory, then streaked out over the Baltic.

Three minutes after launch the rocket was 60 miles high, outside the atmosphere and travelling at the incredible speed of 3,000 m.p.h. When its fuel was burned it nosed over at the top of its climb.

* * *

The rocket plunged down through the atmosphere and into the Baltic 125 miles from Peenemunde.

Dornberger went to where von Braun was standing, surrounded by an elated group of technicians. Without saying a word, the two men shook hands. The experiment had been a complete success.

Many of the men who saw the launch of the A-4 that day 27 years ago were pre-occupied with turning the rocket into a weapon. It became the V-2, launched against England in the last year of the war.

But von Braun, Dornberger and their colleagues saw beyond the war. As Dornberger wrote in his diary that evening: "We have invaded space with our rocket and for the first time have used space as a bridge between two points on Earth. This third day of October, 1942, is the first of a new era in transportation: that of space travel."

* * *

Gloom hung over the United States Army's Redstone Rocket Arsenal at Huntsville, Alabama, on an October morning in 1957.

The drive to make the United States the first nation to orbit an artificial satellite had been in vain. Their hopes had been dashed by the mocking bleep-bleep of Russia's Sputnik One. . . .

Wernher von Braun was choked by anger at the petty inter-Service rivalries that had robbed the United States of the greatest technical achievement in history.

Von Braun was certain his rocket—the Chrysler Jupiter-C, developed from the V-2—could have put an American satellite into space.

The previous August, it had been fired to a height of 400 miles above the earth: its nose-cone had re-entered the atmosphere at a speed of 12,000 miles an hour and had impacted inside a target area only 400 yards in diameter.

But the rocket developed by von Braun and his team was a U.S. Army project—and it was a rocket built by the Martin Aircraft Company for the U.S. Navy, the Vanguard, which had been selected as America's first satellite launcher.

The first attempt to launch an American satellite with a Vanguard rocket took place on December 6, 1957 — two months after Sputnik One went into orbit.

Before an audience of millions of television viewers and observers, the rocket rose slowly on a pillar of flame from Cape Canaveral—then broke up and crashed.

With this setback, the Army scientists were given the green light, and for nearly seven weeks they worked night and day to convert the Jupiter rocket into a satellite-launcher.

On January 31, 1958, von Braun's Jupiter-C blasted the first United States satellite—Explorer 1—into orbit. Crammed with so many miniaturised instruments, it collected more information than the far heavier Sputnik One.

In particular, it revealed the existence of bands of radiation round the Earth. They became known as the Van Allen Belts after Dr. James A. Van Allen, von Braun's right-hand man in the Explorer programme.

Soon afterwards, von Braun's Huntsville team joined the National Aeronautics and Space Agency. The space race was on.

* * *

On February 20, 1962, a huge Atlas rocket thundered skywards from Cape Canaveral, carrying Colonel John Glenn and his Mercury capsule "Friendship 7" on the first stage of a 80,428-mile journey into space.

Nearly 11 months after Russia's Major Yuri Gagarin had streaked round the world in his Vostok spacecraft, Glenn became the first American to make a complete orbit of the Earth.

Glenn was one of a team of seven, who, in 1959, had been selected to become America's first astronauts.

Alan Shepard made a sub-orbital "hop" of 300 miles in the Mercury capsule Freedom 7 on May 5, 1961, and a similar flight was made by Virgil Grissom in Liberty Bell 7 on July 21. The rocket that launched both men into space was a Redstone — direct descendant of von Braun's wartime V-2.

The Americans had to wait for a more powerful rocket, the Atlas-D, before Glenn and his colleagues could attempt orbital missions.

With Project Mercury, the Americans laid the basis for further manned exploration of space—leading up to a landing on the Moon.

The next step was to develop and refine the complex techniques that would be necessary for the lunar mission, including the docking of two spacecraft. This was the task of Project Gemini, a series of flights by two-man spacecraft that were to be hurled into orbit by the biggest rocket the Americans had used so far, the Titan.

The Gemini series was successful and helped the Americans to prove that a spacecraft could be flown accurately; that a space rendezvous and docking could be carried out and that men could work in the hostile environment of outer space.

Everything now depended on two things—the Apollo spacecraft, which was nearing completion, and Wernher von Braun's gigantic Saturn rocket.

* * *

Meanwhile, the unmanned reconnaissance of the Moon to find a suitable landing-site was already well under way.

With photos provided by Ranger lunar probes, the scientists responsible for planning a manned landing on the Moon had something to work on, and the next steps in reconnaissance were "soft landing" a probe and placing a series of unmanned probes in lunar orbit.

Although the Russians stole a march in February 1966, with their soft-landing space-probe Luna 9 and the orbiting Luna 10 two months later, the American Surveyor 1 landed safely on the Moon on June 2, 1966, and began to send back the first of 11,000 television photographs. Instruments fitted to its landing-gear also transmitted information about the Moon's surface.

By the beginning of 1967, American scientists had obtained high-class, close-up photographic coverage of virtually every square inch of the Moon's surface.

Construction of the huge 350-foot Saturn V for the lunar mission was well under way. Everything was ready for a manned Apollo flight around the Earth in the early part of 1967.

Then, on January 27, 1967, Virgil Grissom, Edward White and Roger Chaffee sealed themselves inside Apollo 012 to carry out ground tests atop the Saturn launch vehicle at Cape Kennedy.

Suddenly, there came the cry: "We have a fire in the spacecraft!" Eleven seconds later it was all over. Grissom, White and Chaffee had died in the searing flash-fire that swept through the capsule's atmosphere of pure oxygen.

* * *

The American Moon programme took 10 months to get going again, but on November 9, 1967, the unmanned Apollo 4 spacecraft was placed in orbit round the Earth by the first of the mighty Saturn V rockets.

Success was a triumph for Dr. Wernher von Braun who had pushed through Saturn's development against considerable opposition in the early 1960s.

Two more unmanned flights took place in 1968, and the spacecraft's systems, mostly redesigned after the fire, were found to be highly efficient.

Then, in October 1968, a two-stage launch vehicle consisting of a Saturn 1B and a Saturn 4B rocket blasted Apollo 7 into orbit. The spacecraft carried a full crew of three astronauts. Walter Schirra, Walter Cunningham and Don Eisele.

Apollo 7 opened the way for Apollo 8. Suddenly, the miracle of man's achievement in space was brought home to millions as they saw the surface of the moon through the eyes and cameras of Frank Borman and his fellow astronauts from a height of only 60 miles.

Two more flights had to be made before the lunar landing—one to test the Lunar Landing Module and the docking of Module and Command Ship in earth orbit, the other to test the rendezvous of the Lunar Module and the Command Module in orbit around the Moon and to carry out a close reconnaissance of the landing-site.

The first mission was accomplished last February by James McDivitt, Dave Scott and Russell Schweickart in Apollo 9; the second in May by Thomas Stafford, Eugene Cernan and John Young in Apollo 10.

Then came Apollo 11. . . . It has been a long way from Peenemunde to the Moon, and to the fulfilment of a man's dream.

BLAST OFF

THE 16th of July, 1969, and at Cape Kennedy (picture far right), necks crane as thousands of people watch mankind embarking on his greatest journey. A journey that has as its eventual destination — the Universe.

This was the step to man's first outpost in space — the Moon.

Atop the mighty Saturn V rocket shown here blasting off were three men whose names will go down in history: Neil Armstrong, Apollo II Mission Commander; Mike Collins, Command Module pilot; and Edwin Aldrin, Lunar Module pilot.

And below is a picture of glory that will also go down in history. Man has achieved the first aim and has landed on the Moon.

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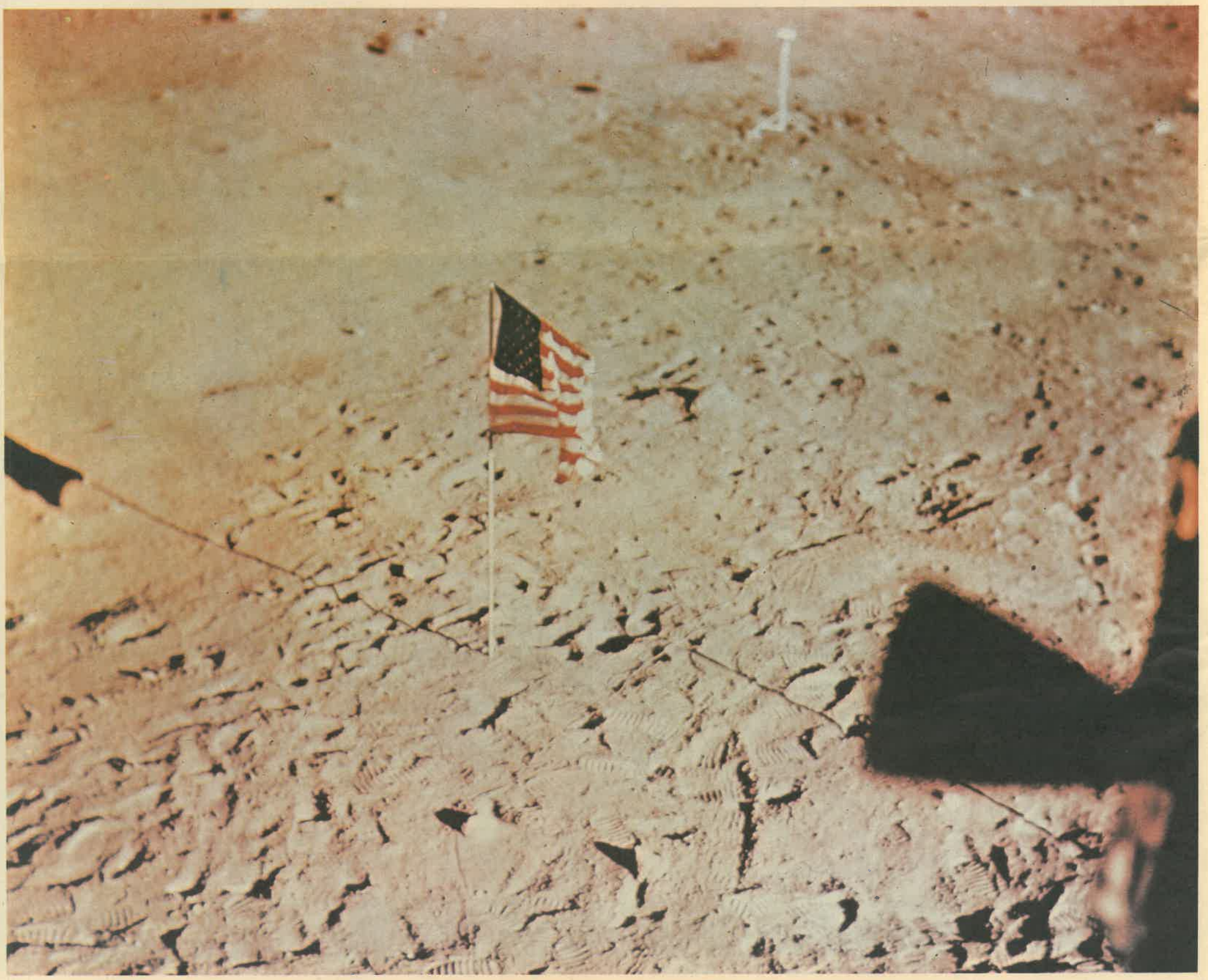
TO GLORY



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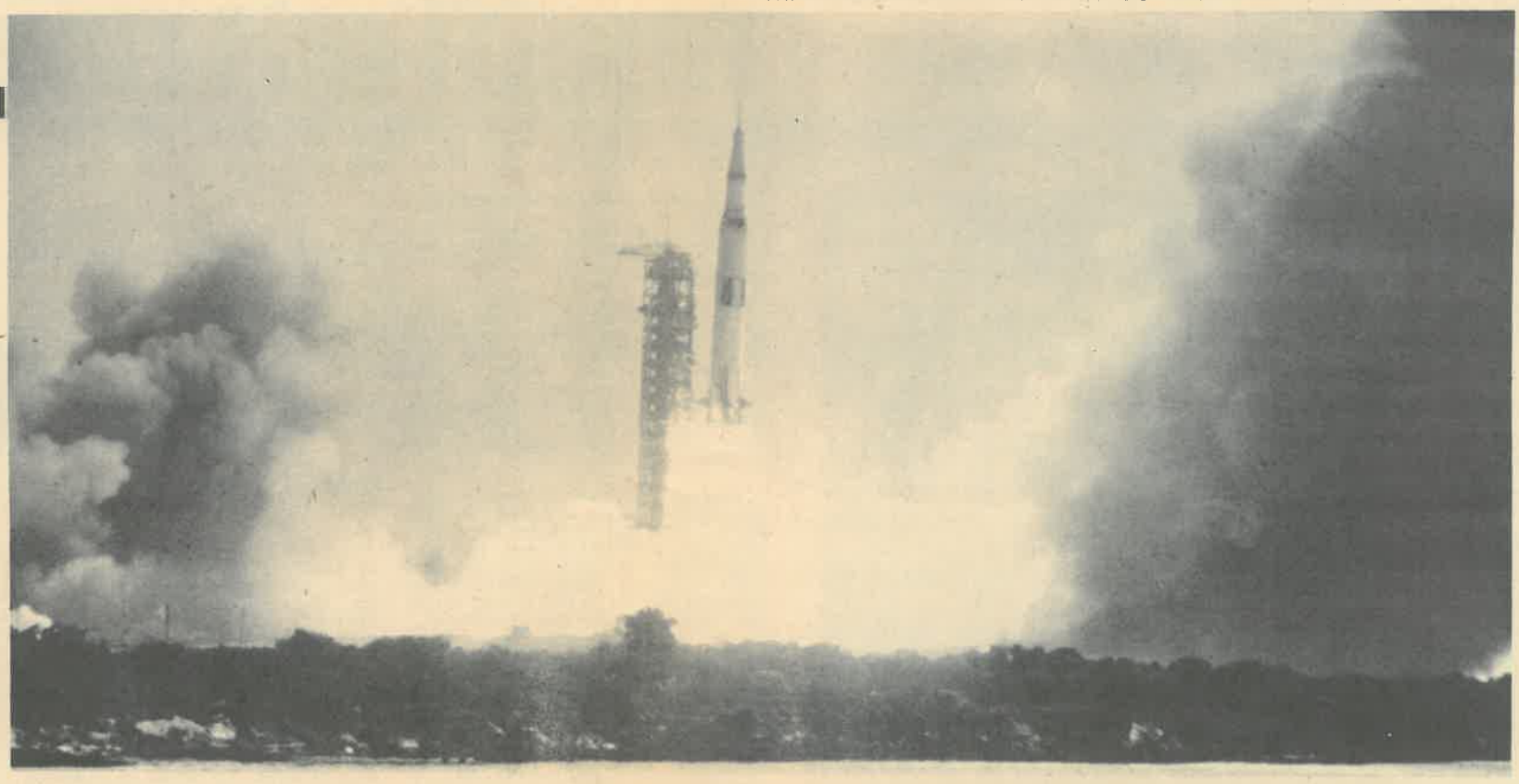


and a welcome for the (lonely) heroes

ON their return to Earth, the astronauts had to accept the plaudits in isolation. Below: President Nixon welcomes (from left) Neil Armstrong, Michael Collins and Edwin Aldrin, who were sealed in an isolation chamber on board the Hornet.

THE COST IS SKY-HIGH TOO

Is it worth it?

THE success of the Apollo 11 mission is only the beginning. Inevitably man will now respond to the challenge of the distant planets in our solar system. And the £10,000 million (nearly one-third of Britain's estimated national debt) spent on reaching the Moon will be peanuts in the context of a planetary programme.

Can the continued expense of such astronomical sums be justified?

On balance, perhaps it can. What Dr. Thomas O. Paine, NASA administrator, describes as "the technological fallout" from space research programmes has been impressive. Medicine, agriculture, communications and meteorology have been the principal and immediate beneficiaries.

And in the area of employment, the United States uses some 400,000 skilled workers in 20,000 industries and 150 universities and research institutions in support of sending man out into space. The corresponding figures in the Soviet Union are likely to be no less significant.

The network of involvement at this level reaches out to Britain, France and Australia, where scientists and technologists are making their contributions.

A study-group of the United States National Academy of Sciences has said that "space research offers enormous economic benefits to society." The group reported that the potential benefits appear to be larger than anticipated and much larger than the cost of achieving them.

The "spin-off" from space research has already reached sizeable proportions.

Many alloys, plastics and ceramics able to withstand extreme temperatures are in common use today; they were developed originally to meet the requirements of space travel. Miniaturised instruments now widely used in medicine had their beginnings in meeting the demands of small space satellites.

The NAC predicts "a substantial gain in the future from the use of satellites for public communications, long-range weather forecasting, map-making, global crop-yield surveys and natural resources management."

But it is progress in the field of medicine that will most benefit man.

Writing in World Health, the magazine of the World Health Organisation, Professor F. Violette, of the Faculty of Medicine at Nantes, France, says that until recently medicine tended to concern itself only with sick people.

"When the time came to select astronauts, it was realised that we knew too little about healthy individuals. Intensive efforts were then made to identify the characteristics and physiological limits of the healthy man. . . .

"In (this) hitherto neglected field, the study of the healthy person, progress has been such as to raise medicine once and for all from the intelligent use of trial and error to that of the rational application of physiological knowledge," writes the professor.

Case histories in support of Professor Violette's thesis include the four-month-old baby recovering from throat surgery. It wears a miniaturised sensor and radio transmitter that sounds an alarm when medical attention is required.

The device was developed to monitor the physical reactions of subjects in space research tests.

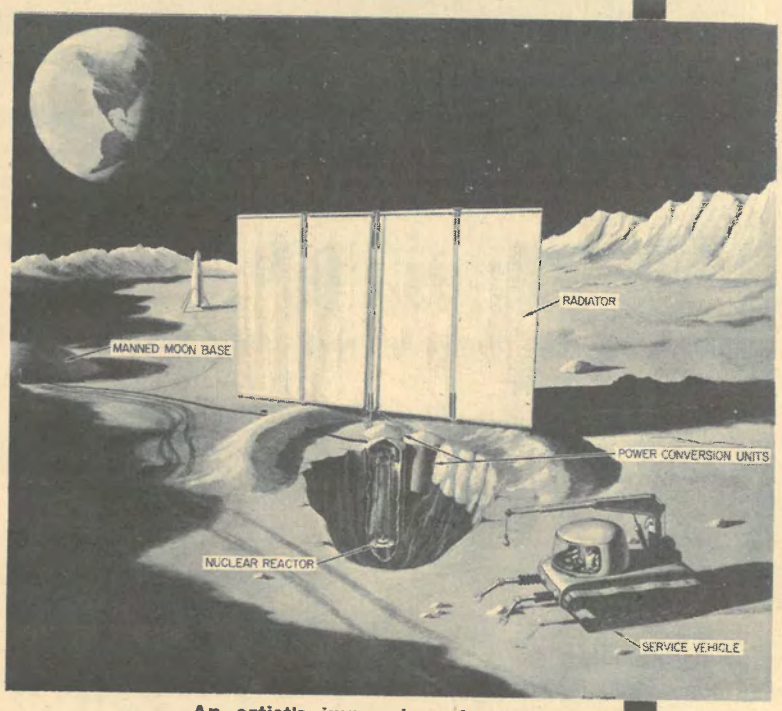
The measurement of blood pressure and pulse rate can be done automatically every two minutes by gear worn on a patient's head. This, too, came out of the space laboratories.

Space research has also added greatly to knowledge of the healthy man's tolerance of adverse factors in his environment. For example, more intensive studies of the toxicity of oxygen have been undertaken, since astronauts are exposed for long periods to pure oxygen at low pressure.

"The spectacular progress of space medicine has already been instrumental in saving many lives and will save many more," concludes Professor Violette. "Space research has thus produced real benefits, not only in its own field, but also in terms of greater well-being, a better life and improved health care for many people."

Future on the Moon

TWO questions that have troubled and intrigued man since his evolution could well be answered — at least partially — by the astronomers who will be taking up residence on the Moon within the next 20 years. Astronomical observations of unprecedented detail could unlock the secrets that have been withheld from man for so long: Are there other intelligent civilisations in our galaxy? How was the universe created?



An artist's impression of a possible Moon base. Nuclear power plants below the lunar surface could provide energy boosts for planet-bound spaceships.

by BRUCE SANDHAM

The future Moon colonies, which will begin to appear on the lunar surface in a few years' time and reach "Moon city" proportions by the late 1980s, will have three major functions.

There will be a thorough examination of Earth and a detailed survey of the Moon itself, but at least 60 per cent of all money spent by both Russia and America on lunar research in the next two decades will go on projects that probe the dark reaches of space and pose the question: Is there anyone out there . . . ?

The "dark side" of the Moon will be an astronomer's dream. No atmosphere will disturb his observations, and the size of telescopes and other detection equipment will be almost limitless.

Young stars

But it will be on radio-telescopes that lunar astronomers are expected to rely for the routine data they will need. These, it is thought, will be used in conjunction with a number of orbiting observatories, flying perhaps 20 miles above the lunar surface.

Last January America put a two-ton flying observatory into orbit around the Earth. Its 11 telescopes have already pinpointed dozens of "young stars" obscured by the atmosphere from Earth-based telescopes.

A laboratory in lunar orbit would see far more—one estimate puts the number of stars that could be photographed and charted in one year at over 100,000.

To see

With much of the routine "star-gathering" left to satellites and radio telescopes, astronomers will be able to fulfil the basic function for which man was sent to the Moon in the first place: to use his eyes and assess the importance of what he sees.

The Milky Way will be seen twice as clearly from the Moon, and optical instruments will enable astronomers to make an accurate count of distant galaxies. Their movement and development could hold important clues both to the validity of Einstein's Theory of Relativity, and to the possible accuracy of the "steady state" theory of creation.

But the lunar laboratories will also be used for many projects designed to directly benefit Earth.

For instance, weather forecasting should improve enormously, thanks to lunar observations of clouds in the earth's atmosphere. And infra-red photography will show up underground water supplies, life patterns in the ocean and even crop disease.

But ever since space research began seriously in the early 'sixties, the use of the Moon as an eventual staging post to the stars has been the main—if often sub-conscious—target.

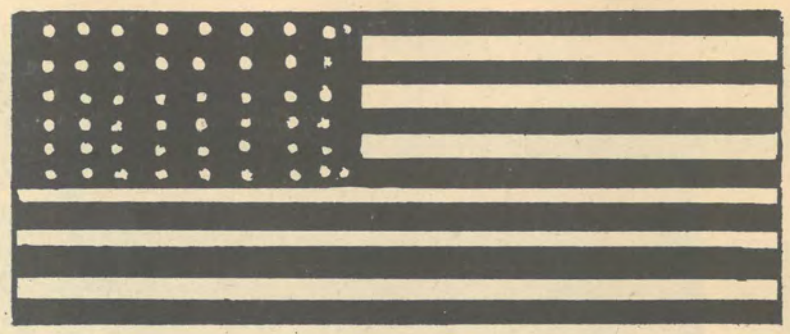
Colonies

America's Advanced Mission Programme planners under Dr. John Hodge are already studying what they call "space options" — the alternatives available to man during the next 15 to 20 years—and the setting up of a Moon colony large enough to be able to service and re-launch planet-bound spaceships is high on the list.

Certainly, using the Moon as a major space terminal—perhaps by the year 2000 — seems to make economic sense.

NASA calculations show that great refuelling tankers filled with lunar-produced hydrogen could be put into Moon-orbit to refuel and service Earth-launched spacecraft more cheaply than if fuel was sent up from Earth.

Wernher von Braun, Director of NASA's George C. Marshall Space Flight Centre, sees the Moon as a vital staging post in man's flight to the stars. He envisages vast nuclear power plants on the lunar surface, used to supply power not only for space flights but also transmitted into energy and beamed to Earth for industrial and domestic use.



The Space Race

THE space race has been largely a see-saw affair between the two contestants, America and Russia. The Soviet Union got off to a good start and although apparently trailing now after the American Moon landing, should not be dismissed as an also-ran.

Here are some of the major developments in the bid to put man in space.

1957

October : The Soviet Union's Sputnik 1, first man-made satellite, launched into orbit round Earth.

November : Sputnik 2 took dog Laika into space.

1958

January : Explorer 1, the United States' first satellite, launched.

1961

April : World's first spaceman, Major Yuri Gagarin, went into orbit in Russia's Vostok 1.

May : America's first spaceman, Commander Alan Shepard, launched, but not into orbit.

1962

February: American Lieut. Colonel John Glenn orbited Earth three times in Friendship VII.

1963

June. Russian Lieutenant Valentina Treshkova became first—and so far, only—woman in space, orbiting 48 times in Vostok 6.

1964

October : First multi-seater spacecraft, the Soviet Union's Voshkod, took three men into orbit.

1965

March : Soviet Alexi Leonov took first "walk" in space (10 minutes).

June : American Edward White "walked" in space (21 minutes).

December : Two double-manned U.S. Gemini spaceships made rendezvous coming to within one foot of each other.

1966

February : Soviet Luna 9 made first soft landing on the Moon. Two Russian dogs sent through the Van Allen radiation belt — the highest flight at that time by living creatures.

March : U.S. Gemini craft with two men aboard docked with an unmanned Agena rocket. Emergency splashdown after craft developed a roll.

June : Surveyor 1 made first U.S. soft landing on Moon, sending back thousands of TV pictures.

1967

April : Soviet Soyuz 1 crash-landed on return to Earth when braking parachute failed to open, killing Cosmonaut Vladimir Komarov—the first man to die while on a space mission.

(Note : Three American astronauts, Virgil Grissom, Edward White and Roger Chaffee were killed in a fire on January 27, 1967, during a rehearsal for a manned flight in the Apollo programme.)

October : Venus 4 Soviet spacecraft made first soft-landing on Venus and sent back scientific information. Two unmanned Soviet satellites automatically linked up in space and afterwards automatically separated — the first unmanned space link-up.

1968

September: Soviet Zond 5—first ever Earth craft to go around the Moon and return to Earth.

December : U.S. Apollo 8, with Colonel Frank Borman, Captain James Lovell and Major William Anders aboard, was first manned space craft to leave the influence of Earth gravity. It completed 10 orbits of the Moon.

1969

January : Soviet Soyuz 4 and 5 effected first personnel transfer in space, following the first docking of manned craft.

March : James McDivitt, David Scott and Russell Schweickhart in Apollo 9 made Earth orbital flight lasting eight days three minutes to test the Lunar Module, which descended to 8.2 nautical miles above the Moon.

July: Apollo 11 and Moon landing.

DINING IN HIGH STYLE

COMPARED with early spacemen, astronauts Michael Collins, Neil Armstrong and Edwin Aldrin dined royally in Apollo 11.

Today's space menu has grown from limited paste-like food to something far more attractive.

Shrimp cocktail, a salad, beef pot roast, strawberry cubes and a cup of tea is a typical space dinner. But that is only one of dozens of variations.

Chicken and gravy, beef and vegetables, meat and spaghetti, a wide variety of sandwiches, desserts and soft drinks are among the 52 foods approved by the space administration.

Sterilised, dehydrated and packed in plastic vacuum bags, much of the food looks like a kitchen sponge, but after adding water, vegetables expand to look like vegetables and the beef and chicken dishes give off a home-cooked aroma.

On Apollo 11, "hot dogs" and other familiar dinners were eaten with a spoon from an open package, despite the zero gravity environment. But dehydrated and freeze-dried food, compressed into bite-size squares, were the main part of the space menu.

Although not as tasty and attractive as the "moist-packed" dinners eaten with a spoon, the dried food offers the same nutritional value and extra convenience.

Where to from here?

THE Moon is not man's ultimate destination. Now, says DON RISEBOROUGH, his sights are set on even more ambitious targets—the planets, and Mars is the first on the list. Men are expected to set foot on Mars in 1982, and many scientists are confident that life will be found on this desert planet — which may even one day be colonised. Riseborough lists the exciting projects leading to the Mars flight, including mooted large floating space-stations and permanently manned space bases on the Moon.

MARS THE LIKELY TARGET

WITH the Moon almost behind them, American scientists are now chasing after Venus and Mars, and they feel there is a good chance that life may exist on one or the other.

When astronaut Neil Armstrong put man's first foot on the Moon on July 21, it was only the beginning. Scientists see the flight of Apollo 11 as the first step towards man's eventual settlement on another planet.

A manned expedition to land spacemen on the surface of Mars in 1982 is now part of a proposed U.S. space flight programme recommended by a board of scientists and engineers.

True goal

As the exuberant National Aeronautics and Space Administration chief Thomas O. Paine, said recently: "While the Moon has been the focus of our efforts, the true goal is far more than being the first to land men on the Moon, as though it were a celestial Mount Everest to be climbed. The real goal is to develop and demonstrate the capability for interplanetary travel."

Mars, says Paine, is the logical next target. And Mars is within the range of the Space Agency. This year two U.S. Mariner probes have been sent within 2,000 miles of the planet to take photographs of the Martian surface.

Soft landings

In 1973, two unmanned Viking spacecraft — a brand-new design — will be shot to Mars and soft-landed on the planet. These probes will search for life that scientists think may be found there and, in the words of Paine, "give us a much better understanding of conditions on the surface of Mars."

Primarily, of course, the '70s will be focused on the moon. NASA will send another nine Apollo flights to its surface over the next three years. Some of them may land in the rugged terrain or in the craters such as Copernicus and Tycho.

By Apollo 20 in 1972, astronauts may stay on the Moon as long as two weeks, according to the amount of oxygen that can be transported there.

Ultimately, of course, the Space Agency would like Moon bases, a gigantic stride from Armstrong's first tentative steps.

NASA not only wants the Moon, but also has its eyes on large, floating space stations orbiting the Earth some 300 miles away.

The board of scientists, now considering a Mars landing, has also recommended that a number of these space stations be set up to study meteorology, oceanography and for solar and stellar observations. They could also be used as a stop on the way for a Mars or Venus mission.

Shuttle system

The space stations, with crews initially of about 12 men, are part of the Apollo applications programme which has, as its field director, astronaut Frank Borman, who successfully piloted Apollo 8 around the Moon last Christmas.

Also part of this applications programme is a low-cost space shuttle system which could be operated by trained personnel, not necessarily astronauts.

The shuttle system could be used for land recoveries with the ability to land in water in emergencies. Studies now under way for this system will be completed next month.

As the early 1970s give way to the late '70s and early '80s the agency's attention will shift from the explored Moon to the forbidding heat of Venus and the freezing cold of Mars. The latter seems to be the more inviting of the two with the best possibility of life.

Three years

"It has the kind of temperature and atmosphere and surface conditions that would make it possible for man to operate, although with difficulty," said Dr. Paine.

"He would have to wear a heated spacesuit, but it is a possible place for man to go and explore—and eventually even to colonise."

The NASA administrator envisages a trip to the "red" planet of between 400 and 1,100 days.

He prefers the longer voyage of about three years—about a year to get to Mars and a year orbiting the planet, descending to the surface, analysing samples and thoroughly examining the planet, then taking another year to return.

NASA is already working on a nuclear rocket programme which would provide a propulsion system for such lengthy trips.

The NASA chief thinks such a voyage of exploration is certainly worthwhile and said that the chance of life in other solar systems is "absolutely 100 per cent."

It was not conceivable that Earth was the only planet to originate life. "I'm sure that conditions leading to the formation of life have occurred in many parts of the universe. We certainly are not alone."

He added: "Surely, one of the great discoveries of mankind will be its first contact with life of an extraterrestrial nature and — even more dramatic, of course—if the day ever comes, man's first contact with intelligent life in some other part of the universe."

Water vapour

Dr. Robert Jastrow, the director of the Goddard Institute for Space Studies, one of the divisions of NASA believes life may be found on Mars.

He is one of a group of scientists who feel that life—at least, life as we know it—could not exist much closer to the sun than Venus or much farther from the sun than Mars.

The temperature on Mars ranges from just above freezing, at the equator in the summer, to 150 degrees below zero, at the winter pole.

Vegetation

Dr. Jastrow said recently that the amount of water vapour on the Martian surface is probably inadequate to cover the planet with anything but a film of water.

There is not enough moisture on Mars for life to originate there now, he said, but there may be enough to support any life that began during a wetter period in the planet's history. He mentioned a seasonal darkening that sweeps across the planet's face like vegetation leafing in the springtime.

Fly-by space probes are not likely to answer the question of life on Mars, but, Dr. Jastrow said, a soft-landing unmanned spacecraft might help.

He sees this spacecraft equipped with a sticky string that will be shot out on to the ground, reeled back and exposed to a culture medium in which living organisms could grow. These would be detected by a small geiger counter which, in turn, would radio the evidence back to Earth.

The only way

Even this would probably not settle the dispute about life on Mars. In fact, said Dr. Jastrow, "the only way we can settle the matter is to send a man to Mars."

And a manned space mission to Mars seems inevitable. As Dr. Paine pointed out, most of the other planets have limitations in temperature, gravity and pressure for man to land.

"The surface of Venus appears much too hot for men to endure," he said. "Although it might be possible to balloon around in the upper atmosphere.

"On Jupiter, the gravity would be too high for men to sustain, although some of the moons of Jupiter might be places that men could explore."

So, after Apollo 11's conquest of the Moon, space exploration heads towards the post-Apollo programme with all eyes turning to an even bigger prize—Mars.

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