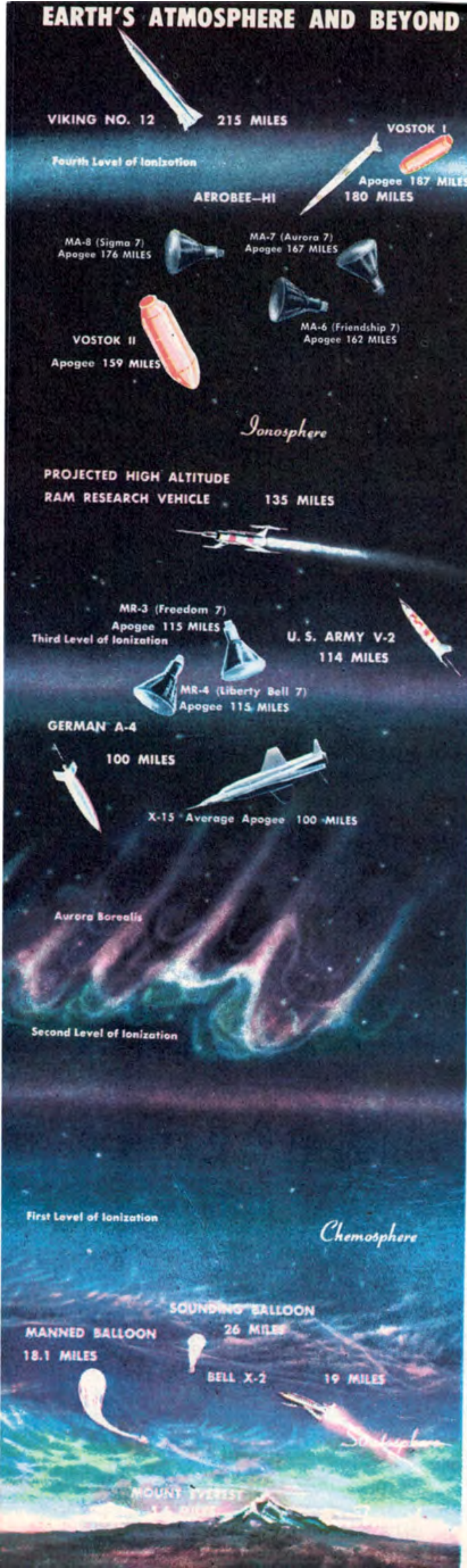
SPACE: Man's New Frontier

A GLIMPSE INTO THE EXPLORATION OF SPACE



Space . . .
Man's New Frontier

Since man first observed the moon, stars and planets, he has been fascinated and curious about them. The development of rockets now gives us the means to study at first hand the moon, planets and eventually the stars of outer space. These pages deal with the problems and our present knowledge of this great advance in man's conquest of space.

WHAT IS SPACE

Going up from the earth's surface we pass through the atmosphere which, as we know it, is quite dense compared to what is called outer space. The atmosphere is pressed down by the weight of the air above it. This weight at sea level is 15 pounds on every square inch. The farther up we go the less air there is pressing down and consequently it becomes less dense and the air molecules are more widely separated until there is a vacuum.

The atmosphere is made up of layers, each of which is quite different, but the change from one to the other is not sudden. The layers blend into each other.

Near the earth's surface is the Troposphere where most of the weather — wind and rain — takes place. It extends up about 10 miles.

Above this is the Stratosphere in which the very highest clouds and some air currents are formed. The Stratosphere reaches a height of 20 miles.

The next layer is the Chemosphere, a band of ozone gas 20 to 50 miles high, where harmful effects of the sun's ultraviolet rays are absorbed.

At a height of 30 miles there is a concentration of electrically charged air particles known as the First Level of Ionization. There are several such levels and they are a part of the region known as the Ionosphere. Each level acts as a mirror to reflect various radio wave frequencies and make possible long-distance radio transmission. The Ionosphere extends up to 600 miles and temperatures average over 2000° Fahrenheit in the upper portions.

The next layer is the recently discovered Van Allen radiation belt called the Magnetosphere. The earth's magnetic field traps streams of high-energy atomic particles shot out from the sun to form a hazardous blanket open only at the poles. The radiation belt is still being explored by satellites but it appears to extend 40,000 miles from the earth. Beyond this there is a turbulent region 12,000 miles thick with fluctuating magnetic fields and solar winds. After that, there is only interplanetary space.

ABOUT SATELLITES

A number of satellites are now circling the earth. The path of the satellite is called an "orbit." The trip around the orbit is a revolution. The time required for one revolution is called the "orbital period." If the object turns on a central axis like a wheel or spinning top, it is "rotating." These are the terms which are used in describing satellites and it is best to use them properly.

Our satellite, the moon, has been in orbit for some time—long before there was a man to see it. The others are man-made, and man has put them in orbit. Why don't they fall back to earth? Why do they revolve about the earth instead of moving off into space? The explanation is the same for all satellites including the moon, and it is also the reason why the planets revolve in regular orbits around the sun.

We are so accustomed to living in the earth's atmosphere that we take it for granted that anything moving will slow down and stop when the power that causes it to move is turned off. Actually, scientists, and you too perhaps, have known for some time that anything moving tends to stay in motion. It tends to maintain the direction of its motion as well as the velocity of its motion. This tendency is called "inertia." Usually outside forces interfere with the motion. Friction and air resistance slow the moving body down. But it is possible to add to its velocity, which process is called "acceleration." In space neither atmospheric resistance nor friction exist. There is only the force which is called "gravity."

Gravity is the force of attraction which all objects exert on each other. The earth is so much larger than any of the satellites, including the moon, that they are all pulled toward the earth's center.

Now inertia can overcome gravity if there is enough of it, and adding to inertia can be done with acceleration. As an example, visualize a ball on the end of a string the opposite end of which is held in your hand. You cause the ball to accelerate by applying energy to the string by describing a circle with your hand. The more you accelerate the motion of the ball the higher it rises from the ground until it is on a level with your own hand. If it were not for the resistance of the atmosphere to the ball and string, they might whirl forever, or as long as the end of the string is held.

The string is now acting on the ball as gravity acts on a satellite—the ball is a satellite of your hand. If the string could stretch like rubber and you were to apply more energy to the motion, thus increasing the velocity, inertia would be increased. The orbit would also increase in size until at last the string would break, the ball would go off on an "escape orbit" and would no longer be a satellite of your hand.

Now, to restate simply why the satellite does not return to earth immediately; velocity produced by the rocket engines causes the satellite to have sufficient inertia to balance gravity at the distance of its orbit. Added velocity would increase the size of the orbit until it is again balanced, or it might cause the orbit to become elliptical with its perigee (point nearest the earth) at the place where acceleration would cause it to move farther out from the earth and its apogee (point farthest from the earth) at the place where gravity overcomes inertia. Then, as the satellite begins to move toward earth, gravity acts to increase the velocity and the cycle of the orbit is started all over again.

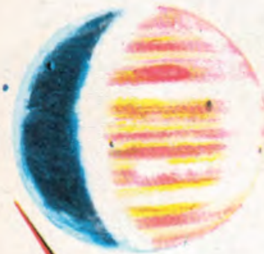
SPACE PIONEERS

The story of Man's attempt to conquer space does not begin with the successful launching of an artificial

FACTS ABOUT THE PLANETS

Legend

A. Diameter of Equator (Miles)
B. Mean Distance from Sun (Million miles)
C. Period of Revolution around Sun.
D. Period of Rotation on Axis
E. Density (Water = 1)
F. Number of Known Satellites



Jupiter

A. 88,700
B. 483.88
C. 11.862 years
D. 9 hrs. 50 min.
E. 1.3
F. Twelve

Saturn

A. 75,100
B. 887.14
C. 29.458 years
D. 10 hrs. 14 min
E. 0.7
F. Nine

Uranus

A. 32,000
B. 1783.98
C. 84.013 years
D. 10.8 hours
E. 1.3
F. Five

Neptune

A. 27,700
B. 2795.46
C. 164.794 years
D. 15.8 hrs.
E. 2.2
F. Two

Pictures above line: 1 in.=approx. 60,000 mi.

Pictures below line: 1 in.=approx. 6,000 mi.

Pluto

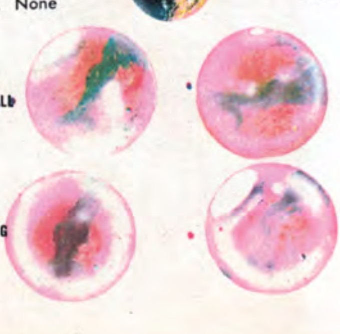
A. 3,600 (approx.)
B. 3675.27
C. 248.430 years
D. Unknown
E. Unknown
F. None

Mercury

A. 3,100
B. 36.00
C. 87.969 days
D. 87.969 days
E. 3.8
F. None

Mars

A. 4,200
B. 141.71
C. 1.881 years
D. 24 hrs. 37 min.
E. 4.0
F. Two



satellite. Actually, the story is an old one, almost as old as the history of Man himself. The astronomers of ancient Babylon who observed the planets wandering among the stars and carefully recorded their paths laid the preliminary groundwork for the exploration of space. Our modern three-stage rockets had their beginnings not in the lethal V-2 rocket of World War II, but in the free-rising rockets used by the Chinese as early as A.D. 1225. Among the early pioneers of space travel were the Montgolfier brothers, Jacques and Joseph, who in 1783 invented the balloon. Inflated with heated air, the first balloon was not large enough to lift more than its own weight above the ground. Later, as they were built larger and stronger, a sheep, a cock and a duck were carried aloft in a wire basket suspended beneath the balloon. Jean de Rozier was the first human passenger to make an ascent in these lighter-than-air craft. Rockets were the means, however, that would enable man to penetrate the vacuum of space. The American scientist, Robert H. Goddard, launched the first liquid-fueled rocket in 1926 and showed the possibilities of space flight. Other rocket pioneers in the 1930's experimented and wrote on space travel. It was World War II and the emergence of rockets as weapons, however, that pushed the world into active development of rockets. The first flights into space by man have now been made and the physical exploration of our solar system has begun.

A LOOK AT OUR SOLAR SYSTEM

Our sun is a star. A star with planets circling about it and with a number of satellites like our moon circling about the planets, plus a large number of asteroids, make up the solar system. We think other stars may have their own planetary systems but the only one we really know about is ours. The others are too far away.

Groups of millions of stars form galaxies. Our galaxy, the Milky Way, is one of fifteen which make up the Local Super Galaxy. We know there are countless additional galaxies in the Universe. Most of the stars that we can see even with the largest telescope, are in our Milky Way.

We have observed that stars are arranged in groups which seem to suggest forms. We call these groups of stars "constellations." Actually, the individual stars of these constellations are many times farther apart than the size of our solar system.

Earth

A. 7,927
B. 93.00
C. 365.256 days
D. 23 hrs. 56 min.
E. 5.5
F. One

Venus

A. 7,700
B. 67.27
C. 224.701 days
D. A few weeks
E. 5:1
F. None

A MAN'S WEIGHT HIGH JUMP AND GRAVITY ON EACH PLANET

A few pages beyond is a picture of our solar system. Imagine yourself beyond the edge of our solar system, facing toward the constellation known as the Southern Cross, and with your back toward Polaris, the North Star. This picture is an attempt to show what you would see, with certain exceptions made for artistic reasons.

The green ellipses represent the paths or orbits of the planets. Actually, these could not be seen but they are put into this picture to show the plane in which the planets move. If we did not use artistic license, the sun would just about fill the entire picture unless the planets were shown as tiny pin points. So the sun is shown a convenient size in relation to the planets' orbits. The nine planets in our solar system are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune and Pluto. They are drawn considerably larger in the picture than they would appear from our vantage point. You will notice that satellites, or moons, are shown with some of the planets. Just inside the orbit of Jupiter is the Asteroid Belt. Asteroids are sometimes called "minor planets." The plane of the orbit of Ceres, the largest asteroid, is seen to be quite inclined from the others. The orbits of two comets are also shown, each moving in closely around the sun and then out again.

In the background we see part of our Milky Way. Since this galaxy is shaped like a flat spiral, a good deal of it is also behind us. All the stars shown are in our galaxy. Behind them, shown in blue and greatly enlarged from the size they would appear, are other galaxies. These are in various forms such as spiral, barred and elliptical.

SPACE STATION

The space station is a satellite. It is a manned satellite revolving about the earth every 120 minutes at about 1000 miles above sea level, and rotating at the rate of three times a minute. It requires no power other than inertia to keep it in its orbit. The rotation once started will also continue without use of power. The rotation will give centrifugal force to the people and things inside the satellite. Centrifugal force is what keeps water in a pail when you whirl it. Its effect will cause people and things to feel and behave in a satellite as they do in the field of gravity. Man will be able to walk upright, coffee will stay in cups, and things will remain where they are placed. The centrifugal force will provide comfort for trained spacemen but they will probably feel lighter than on the earth.

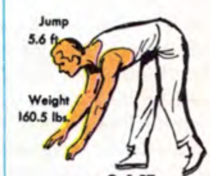
To some people travel in space means going from planet to planet—to distant stars, or at least from the earth to the moon. They are the folks who, when they think of a trip, think first of the destination. To others, travel is enjoyed for itself and a trip, regardless of destination, means a kind of freedom and an opportunity to observe new things along the way. A space station has something to offer both types. Spacemen will surely be some of each.

Since by far the most uncertain, dangerous and costly part of a trip through space is the part that passes through the atmosphere, a space station 1000 miles above the earth would have an advantage. Nearby would be a good take-off place for more distant space voyages, some of which could be years in duration and would require more fuel than could be practically rocketed through the atmosphere in one vehicle. When the interplanetary ships themselves could be more readily built out in space, the consideration for streamlining could be kept to a minimum and the ratio of power plant to pay load could be considerably decreased. Also, the actual construction could be simpler in space because the most massive parts would have almost no weight.

In addition to being used as a space port, the space station would be a place where spacemen and scientists could much better study the problems of space travel and exploration. Just as the air age began with the first balloon ascension, we are now in the space age. Discoveries and improvements in air travel are still being made and will be for some time to come. So too, although we accept as possible and practical the space age with all its implications, the opportunities and needs for more knowledge are almost

Jupiter*

Saturn



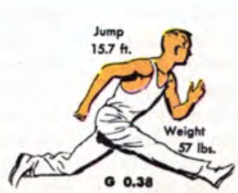
Uranus

Neptune

Pluto

Venus

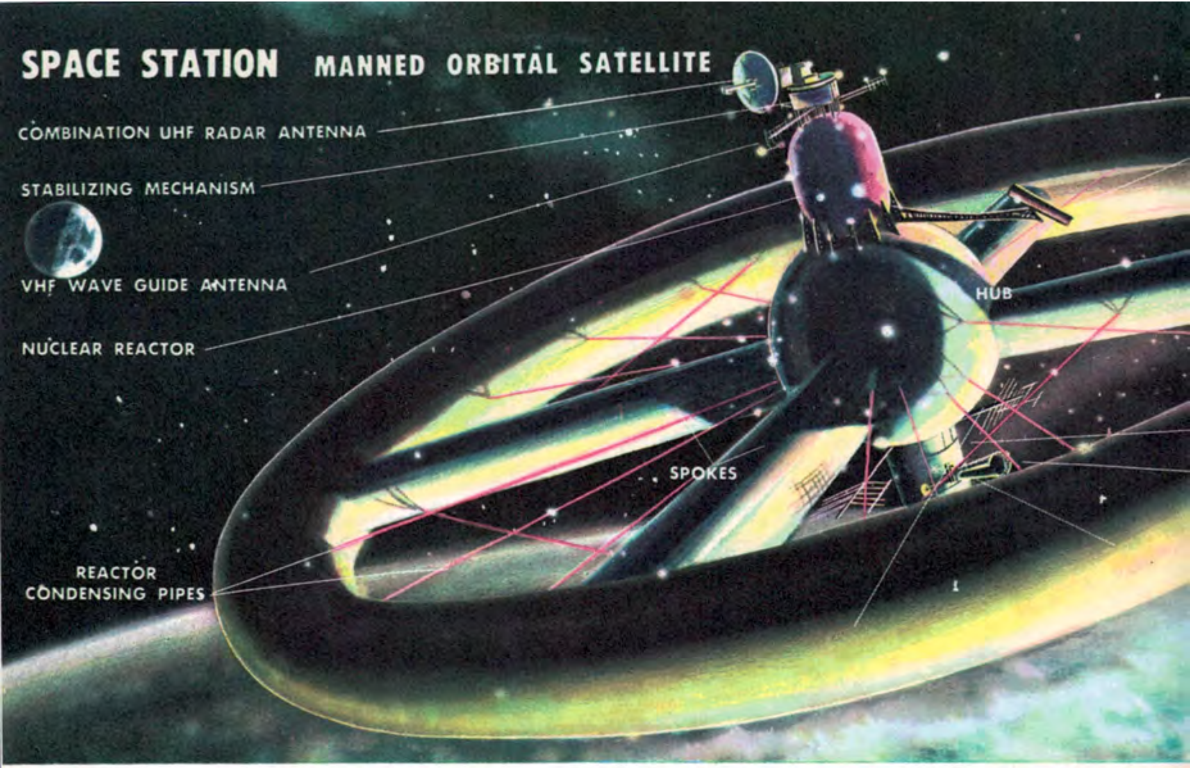
Earth



Mars

Mercury

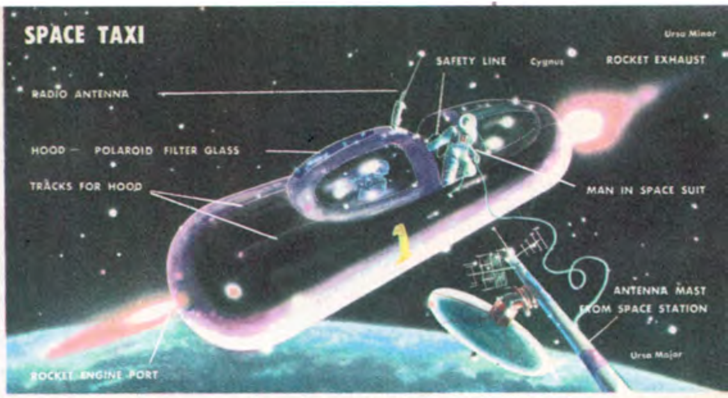
G. Surface Gravity (Earth=1)

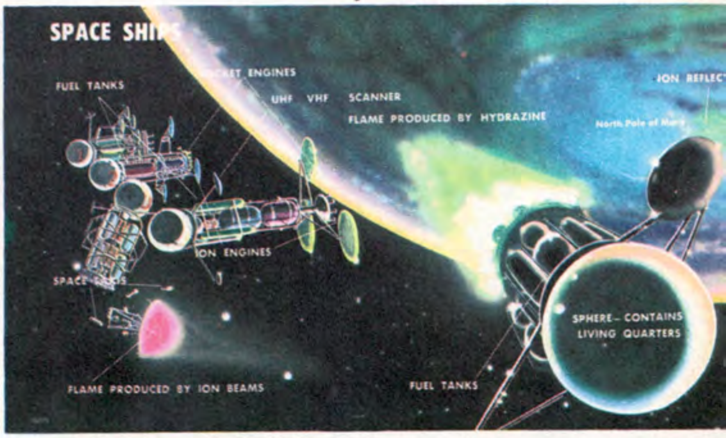


limitless. In addition to being rewarded with the wonderful view of the earth from more than a thousand miles away, the space man who goes no further than the space station will have countless opportunities to study and discover more about the earth, the solar system, the universe and about space travel itself, including the human problem of survival in environments totally different from that on earth. Concerning the earth we will discover much still unknown about our weather, about radio and other forms of electronic communication, about cosmic rays and their effect on our lives, about the auroras, how the sun's rays are processed for our benefit. There will be a host of developments in the problems of survival in space.

With so much to be accomplished, a space station becomes very important. The number of problems existing will require the attention of many space men. They will be isolated from home (although there will be radio and television communication, and a return trip in an atmosphere re-entry glider would require only about one hour) so they will need a comfortable roomy environment. Therefore, the space station must be quite large. It has been estimated that it will be from 250 to 300 feet across and the outer rim will be 30 feet in diameter. We really don't know exactly what it will look like. Our illustration seems to be a practical design from the standpoint of construction and function. Construction will begin with the use of the final stage of a rocket. This will be provided with an artificial atmosphere to house the workers who will probably also carry individual oxygen supplies with them. Whether they are inside or outside the satellite during its construction, they and the structure will be weightless—the workers will be able to handle heavy pieces they could not lift on earth. Parts will be launched into space with more and more equipment, all revolving around the earth in orbits until the space station is finally assembled.

The outer rim will have the living and working quarters. The four large spokes will contain elevators leading to the hub which is in the shape of a sphere. The hub will always seem to be up at the top of each spoke because this is where the centrifugal force will be the least felt. This is where the auxiliary machinery—power generators for light, heat, air conditioning, communication and other power needs — will be located. Above it, looking like a tank, is the nuclear reactor power plant which furnishes the power to drive the generators. At present this seems as the most likely source of power because it gives the maximum of energy with the smallest amount of weight to be lifted into an orbit. Above the reactor are the communication antennae. They are attached to a platform which can be held stationary while the rest of the satellite rotates for the greatest efficiency in sending and receiving signals. Below the hub is an entrance air lock. This is designed to prevent the escape of the precious atmosphere from the space station. In this lock is mounted a funnel-shaped berth to receive the space taxis which will shuttle from rocket ship to satellite carrying men and supplies. The air lock can also be held stationary while the station rotates to make it easier for the taxis to make contact, and a radar guid-





ance system will direct their movements. There will probably be some kind of airtight seal to hold the space taxi to the satellite while personnel are being transferred, but this would not be absolutely necessary. It would be possible to step into space, push off quickly from the taxi and seemingly float or drift to the satellite.

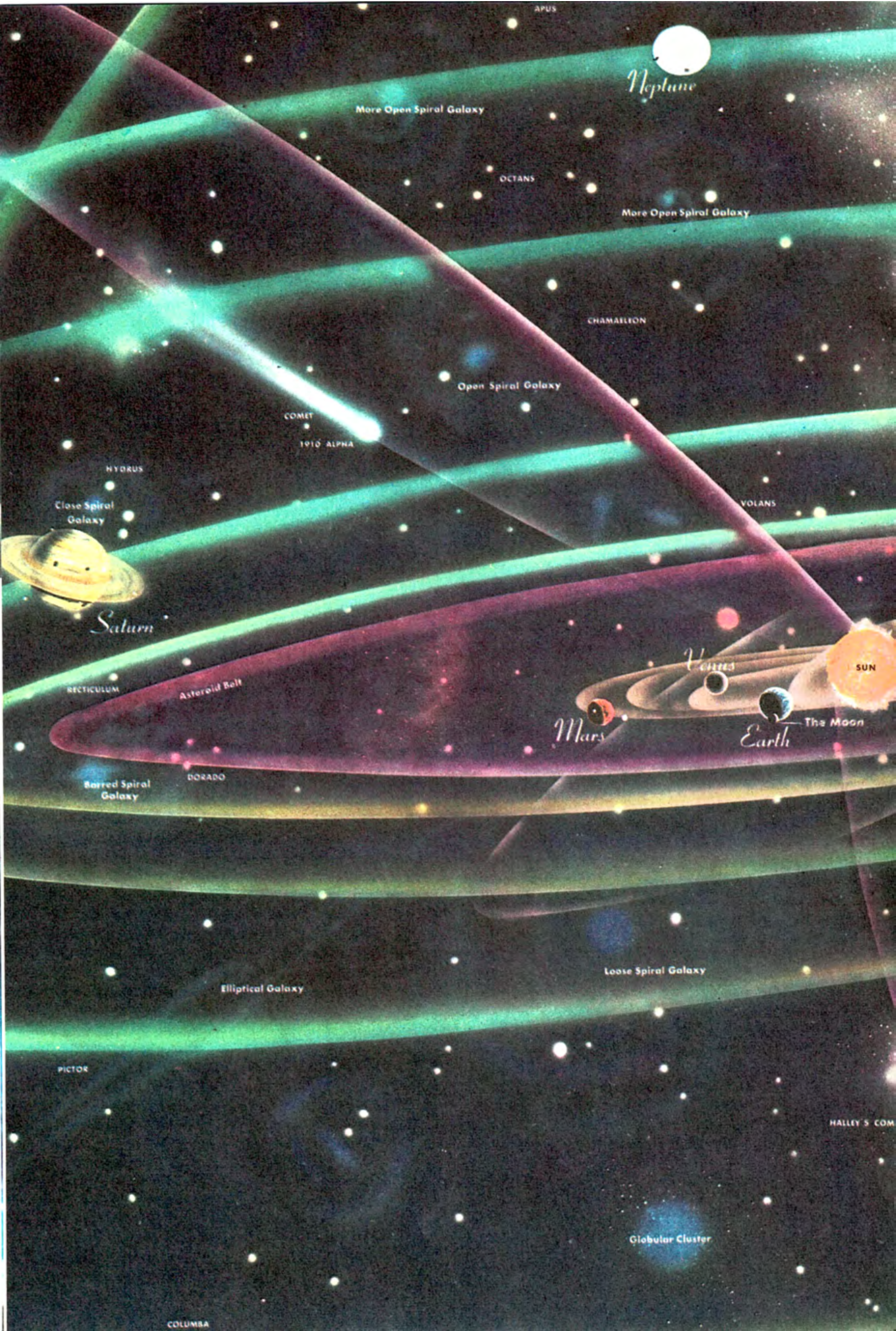
The spectro heliograph extending from the side of the hub is a device for studying solar energy and making observations for navigation. If the space station is finally built, it will be interesting to see how nearly it resembles our present illustration. It is quite possible that young people now living will tell their children, "I can remember when there was only one moon in the sky."

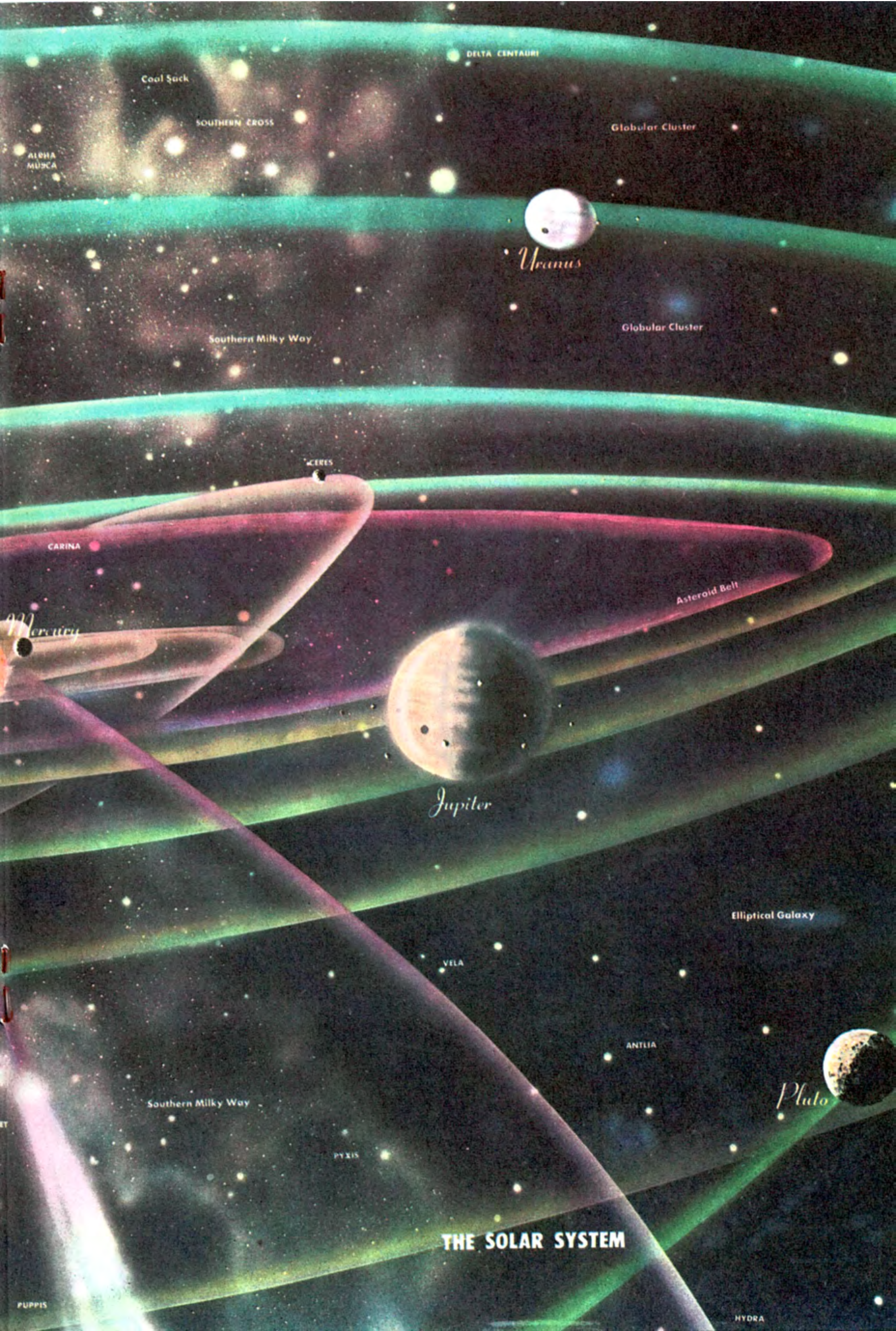
SPACE TAXI

We have already mentioned the space taxi. Our illustration is based on the probability that these little man-carrying satellites will be launched from earth as fuel tanks to be converted to taxis in space. It has a movable canopy of polaroid to shield the occupants from solar and cosmic rays. It does not have an artificial atmosphere so the occupants must carry their own air supply. This may be oxygen and helium. At each end of the taxi is a small rocket motor mounted so that they can be turned in any direction within 15° away from the central axis. By turning the motors and regulating the duration of a blast, the space taxi can be made to turn in any direction—even end over end—but it will remain in its orbit. The movement of a space taxi is somewhat like walking around inside a flying airplane. Everything inside it including yourself and the pressurized atmosphere has just the required inertia to move with the plane. In the case of the plane itself the velocity is maintained by the energy of the motors. This energy is transmitted to the plane's contents by contact. While accelerating you might have felt the push of the seats against your back. You thought your body was pushing back into the seat. As soon as the cruising speed is reached, however, there is no sensation, and you and your brief case and the lunch served to you, all move merrily along on their inertia. You can walk forward or backward or even up and down stairs as easily as in your home, as long as there is no resistance. Out in space there is no resistance, so the space taxi and its contents move at the velocity necessary to keep them in orbit. If a space man steps out of the space taxi, he moves with it unless he pushes himself away. If he should take a wrench out of his pocket and let go if it, it would continue in orbit. He could increase the distance between himself and the wrench by pushing on it. For all practical purposes the bigger body is considered stationary.

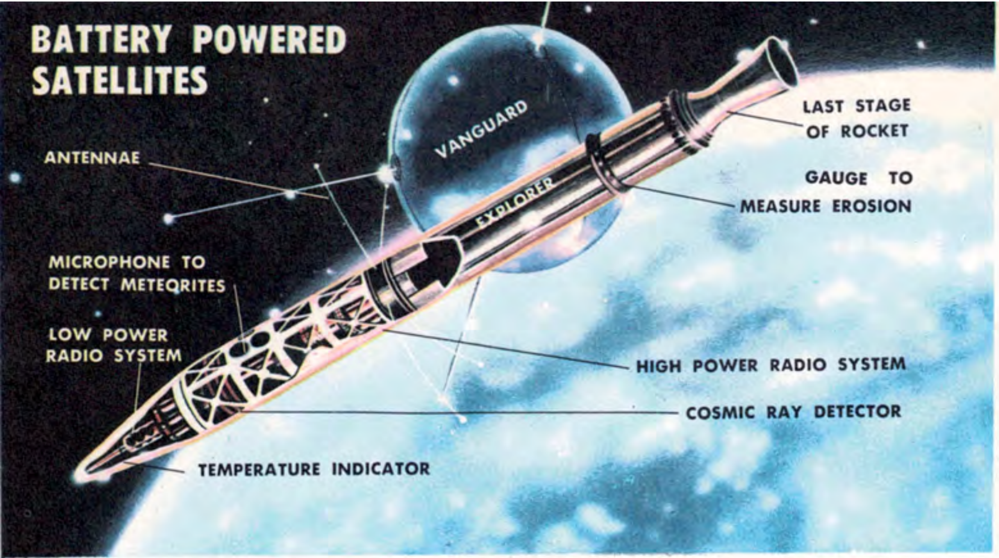
SPACE SHIPS

Space travel to the moon or to other planets will require space vehicles which can carry sufficient fuel and supplies for the round trip. Everything necessary to provide an environment in which the


APUS
Neptune
More Open Spiral Galaxy
OCTANS
More Open Spiral Galaxy
CHAMAELEON
Open Spiral Galaxy
COMET
1910 ALPHA
HYDRUS
Close Spiral Galaxy
VOLANS
Saturn
Venus
SUN
RECTICULUM
Asteroid Belt
Mars
Earth
The Moon
Barred Spiral Galaxy
DORADO
Loose Spiral Galaxy
Elliptical Galaxy
PICTOR
HALLEY'S COM
Globular Cluster
COLUMBA



THE SOLAR SYSTEM



passengers and crew can survive must also be taken along.

Let us assume that such a space ship will be built in space near a space station. A sphere to house the cargo and crew seems logical because it requires the minimum of outer surface for a given cubic content. The fuel which must be sent by rocket from the earth to the space station orbit will be contained in tanks which may as well be joined directly to the space ship. Rocket engines will be arranged in symmetrical groupings at the ends of the fuel tanks. They will be mounted in gimbals which makes it possible for them to be turned slightly in any direction to thus enable the ship to be kept on its course. The space ships in our illustration have ion engines as well as rockets. These are the disc shapes which would be attached to the main structure with girders.

While the ships are being built, fueled, loaded, manned and launched, they will of course be revolving about the earth in an orbit at about 16,000 miles per hour. But since everything is moving at the same velocity, the space workmen will not be aware of it. The inertia which brought the parts, crew and supplies together, keeps them in orbit. Now they must depart from it and reach an orbit which will contact the orbit of their destination at the precise time their destination reaches the contact point. As you can cause the ball on the end of the stretching string to swing farther out by accelerating it, the rocket engines accelerate the spaceships and they swing out in a curved course toward their destination.

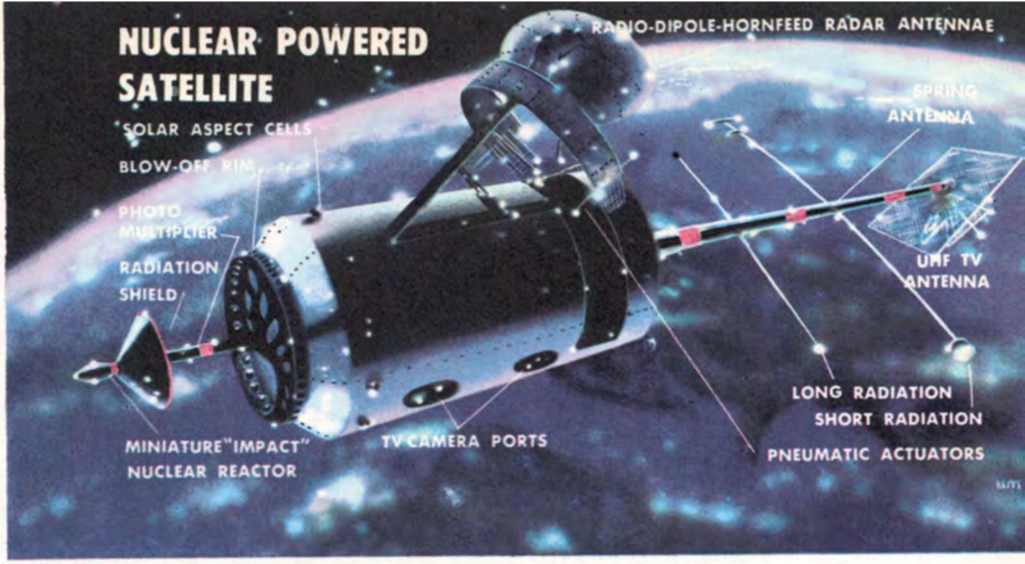
In our illustration, six spaceships are in orbit around Mars, approximately twelve hundred miles above its surface. Even Columbus used three ships for his voyage into the Unknown, so it seems advisable not to ask one lone ship to go it alone on such a distant and unfamiliar trip.

These spaceships are equipped with ion engines which produce the magenta glow seen near their reflectors. These reflectors eject ions in such quantities that the ship reacts with increased acceleration. One ship has turned on its chemical rocket engines which accounts for the green plume. It will use the rockets to push it into an orbit six hundred miles from Mars' surface to have a closer look.

Another ship has moved out of position and its crew is out detaching the ion engines. All the space ships are now satellites of Mars and until rockets are used to alter their course, they will remain in orbit.

BATTERY POWERED SATELLITES

Before interplanetary spacecraft are built, a great deal of testing and telemetering of information from space to earth will have been carried out. In fact, it is being carried out now. Satellites in orbit around the earth are recording and sending information by battery power. The batteries are marvels of efficiency and methods of conserving their energy are employed, but they do wear out



and the satellite ceases to give some of the information it was built to record.

So many pictures, articles and news items have been published about the United States Army's "Explorer" and the United States Navy's "Vanguard" that nearly everyone is familiar with them. These, as was the first "Sputnik," are battery powered. By storing information throughout the orbit (a process consuming low power) and sending it all to earth (which uses higher power) only when triggered to do so by the sun when in a position favorable to the tracking stations, the battery power is conserved. Very interesting among the facts received and analyzed by our tracking stations is the information that within the satellites temperature ranges only from 45° to 85°—a range well within the endurance of man. This fact with all the other information gleaned from instrumented satellites is advançing the exploration of space.

NUCLEAR POWERED SATELLITE

This satellite is an artist's conception designed as part of the final stage of a rocket. A streamlined cone which had covered the nuclear and electrical components has been separated from it by explosive bolts, at the blow-off ring. At the same time the antennae have sprung out and unfolded while the radar screen, shaped like a dish, is raised by the expansion of gas in the pneumatic actuators.

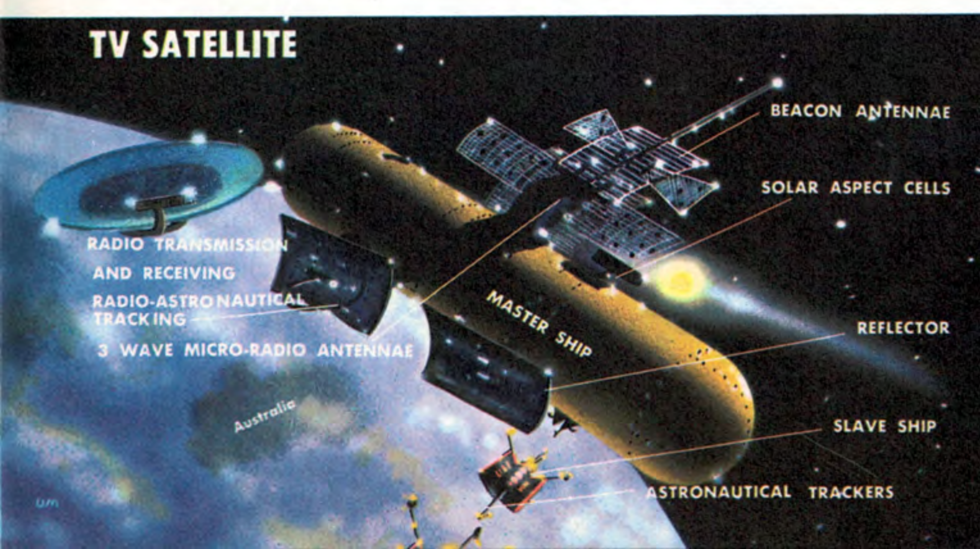
According to the designer's theories, power is developed when energy, radiated by the nuclear material passing through an opening in the shield, strikes a scintillating crystal causing it to glow with light. This light, converted to electrical energy in photo multiplier tubes, would be a constant source of power without moving parts.

The long and short radiation antennae are parts of detecting devices for measuring part of the sun's infrared and ultraviolet rays, which may not penetrate the atmosphere.

TV SATELLITE

It is easy to imagine the advantages to be gained by having television and television relay satellites.

Since television signals must have a straight line from sender to receiver, even the highest tower on earth can cover only a limited area. A relay in



space which receives broadcasts from the earth and rebroadcasts them back will greatly increase the range of television stations.

This artist's conception shows a master TV satellite with a series of slave satellites. The "slaves" would be needed only in case it were desirable to cover a very large part of the earth's surface at the same time.

Such a communication satellite program is being considered for both television and telephone transmission on a worldwide basis. One proposal is to place three relay satellites into a very distant orbit of 23,000 miles. Each relay station would have a 24 hour revolution which would keep it in a fixed position above the earth. Any point on the earth's surface would then be in viewing position for one of the satellites.

Several TV satellites which scan the surface of the earth are now in orbit and are being used for cloud studies and the tracking of storms.

THE TRACKING CAMERA

On page 10 is an illustration of a tracking camera. These cameras, each mounted at an established point in latitude and longitude, are used to observe the movement of satellites. They are telescopic cameras equipped to "take a fix." This means to move with a moving object and photograph it as if it were standing still. When fixed on a satellite, the picture made shows it as a dot while all the stars in the picture are shown as dashes because of the earth's rotation. When the camera is synchronized to the earth's rotation, and as a result fixed on the stars, in the picture they will appear as dots and the satellite will appear as a dash. A series of these pictures, taken alternately, when analyzed by a trained observer tells the direction and speed of the satellite.

The radio range-finding antennae shown in the background are stretched over a large area. They record the different angles from which radio messages are sent from the satellite. This information assists the camera in getting a fix on the satellite position. At the same time the radio receivers also record on tape the other coded information sent from the satellite such as the interior and exterior temperatures, amount of erosion by meteoric dust and the cosmic ray bombardment. The complete information from a number of these stations in various parts of the world is teletyped to the Minitrack

Control Center in Washington, D. C. Here, part of the information is used in plotting the next day's performance of the satellite for further guidance of the observation stations. The other information is stored in machine tabulators for eventual evaluation.

ROCKETS

Space vehicles are designed to travel through the earth's atmosphere; therefore they are streamlined to reduce atmospheric friction as much as possible. The rockets are built in stages to obtain the acceleration necessary for orbit velocity. After the first-stage has burned out — a matter of minutes and seconds — it is separated and drops away. The second-stage fires and, with the weight of the first-stage removed, the smaller rocket will add considerably to the acceleration. For a successful orbit the final-stage must depart on a course very nearly parallel to the earth's surface. Spinning gyroscopes, which tend to remain in the same plane, guide the rocket into the proper course by controlling the angle of the rocket engines.

Shown in the composite illustration are several rockets in launch position. The first, on the left, is a multi-stage cargo and man-carrying rocket as it might appear. Such a rocket has not been built. Our picture shows the outer shell cut away to reveal the placement of the fuel tanks and power units. Next to this large rocket is the Jupiter "C" which carried the Explorer satellite into orbit and the sleek Vanguard, another early United States spacecraft.

At the right is a proposed rocket with a manned space glider. It is designed to carry men into space and return to earth again. Special high-strength and high-temperature materials will be needed to enable such a craft to withstand the tremendous speeds and high temperatures upon re-entry into the atmosphere. Special insulation must be provided to protect the passengers. After the craft drops to a level where the atmosphere can give the glider support, the pilot can reduce its speed and bring it to a fully controlled landing on earth.

Next to the glider vehicle is an Atlas missile, now being used for orbital flights of U.S. astronauts. The engine develops a 360,000 pound thrust to lift the Mercury capsule into space. The missile to the far right is the Mechta which was especially designed for the Russian moon probe of 1959. Larger rockets are being tested for future use in carrying a three man capsule into orbit around the moon.

The diagram showing how a rocket works describes the use of liquid propellant fuels. Solid fuels which have the oxygen combustion agent built into them may be found easier to handle. The principle of the thrust and reaction, however, remains the same.

INTERPLANETARY SHIP CENTRAL CONTROL

By the time interplanetary vehicles are in use, the organization of the controls may have altered considerably from the concept illustrated here. This picture shows the controls arranged about a central column containing the wiring and electronic computor systems.

The inner walls of the area are lined with soft rubber weblike material which would immediately seal any breaks in the outer wall caused by collision with a meteor. This is extremely unlikely, but any leak in the pressurized cabin would be disastrous.

Within the control area are instruments and controls relating to the observation, communication and operation of the ship. Electronic computors determine what response if any is called for by the observations, and instruments with electronic-indicating screens show whether the responses are being properly carried out. The director of the expedition lying in his contour chair observes on the large screen overhead the position of the ship in space, its speed and direction of movement. Optical and radar data radioed from earth and the space station via ultra long wave narrow beam navigation will give added checks on the observation. Symbols representing this information will appear on the director's screen as will also data relating to the operation of the ship itself.

Electronics engineers, all in touch with the director by intercom phone, will monitor the three control stations in ships.

When approaching their destination, the crew acting as a team will guide the ship into the proper orbit with the aid of radar. Three gyros all spinning at different angles will show through instruments the angle of the ship as relative to its directional path. Electronic screens called display plotters will show just how to correct whatever derivation from the best course exists. The actual control is accomplished through the regulation of the angle of the gimbal-mounted motors and the amount of power used. Because of the velocity of the ship, every response must be accurate and properly timed, so all the calculations will be by electronic computors and the men will be highly trained.

SPACE SUIT

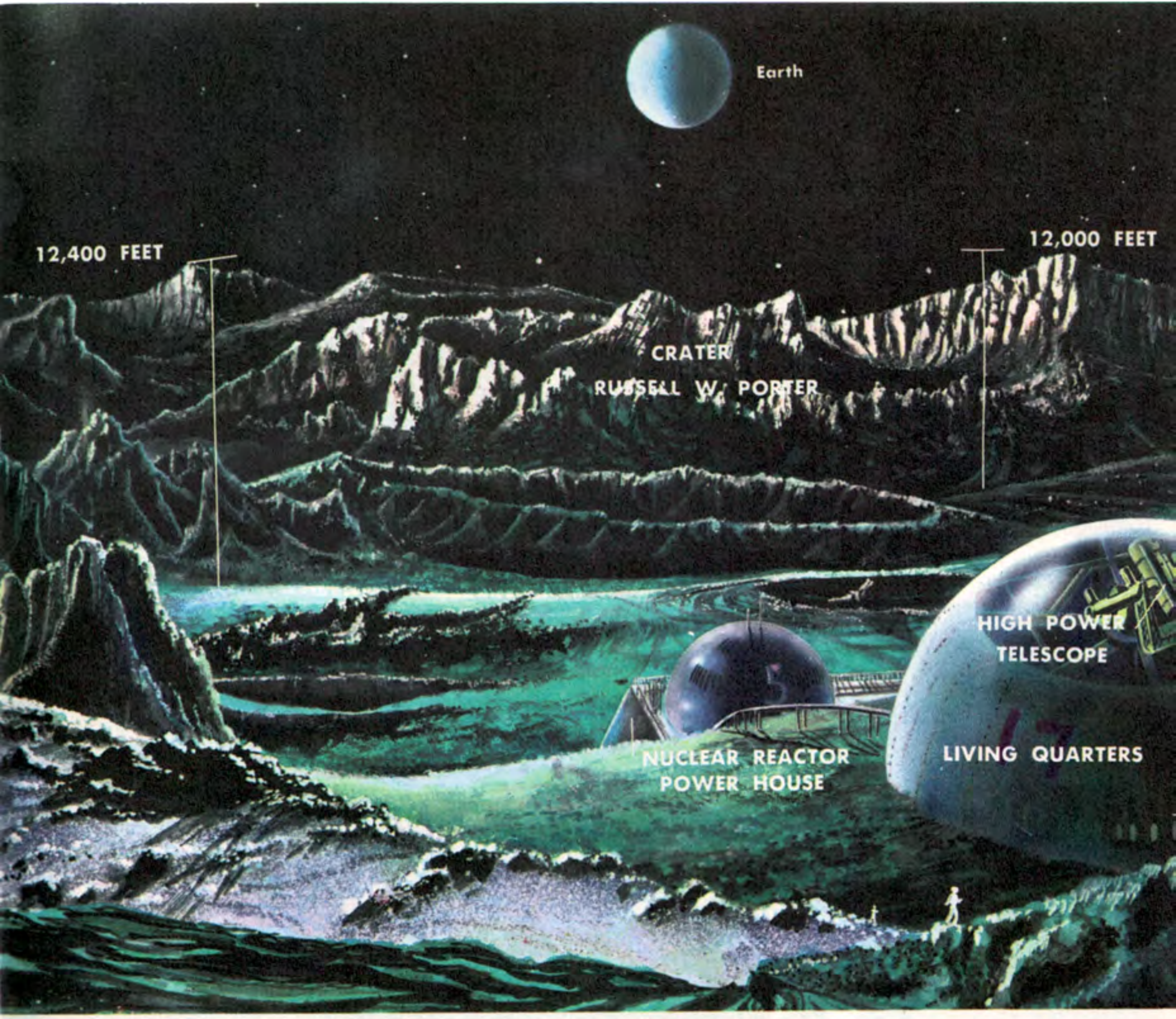
The problems relative to man's adaptability to living and working in space have been given a great deal of attention, for the understanding and solution of these problems will be vital to the advancement of the exploration of space.

The suit illustrated is an artist's conception made of semi-rigid plastic-impregnated cloth. The parts are joined together with combined plastic internal and metal external zippers.

The helmet is made of rigid material of high impact strength. It has a double window of polaroid to shut out the sun's rays and yet let the wearer see out. Within the helmet is a complete ultra-high frequency two-way radio with the microphone near the wearer's mouth. Attached to the back of the helmet and hanging down the wearer's back are the artificial atmosphere tanks. They have air purifying valves attached which release the carbon

SPACE SUIT

1. OUTER SHELL
2. INNER HOOD
3. SWEAT CAP
4. ATMOSPHERE PACK
5. ATMOSPHERE TUBE
6. AIR PURIFICATION VALVES
7. HELMET RIM JOINED TO SUIT BY BAYONET MOUNT & ZIPPPER
8. PRESSURE INDICATING DISC
9. HANDLE, TV ANTENNA, FOCUSING KNOB
10. UHF RADIO RECEIVER-TRANSMITTER
11. TV CAMERA LENS
12. ADD-ON JOINT
13. COMBINED INTERNAL AND EXTERNAL ZIPPERS
14. CAMERA MECHANISM AND FILM PACK
15. POLAROID FACE PLATE
16. MAGNETIC SOLE PLATES



A SETTLEMENT ON THE MOON

dioxide which is given off by the wearer, as it is replaced by fresh artificial atmosphere. The entire helmet is joined to the suit by a bayonet-type mounting. A pressure-indicating disc just below the wearer's armpit warns him with a gentle tickle when the pressure within the suit becomes too low.

Strapped to his shoulders the space man carries a portable television camera complete with battery power pack. Within the camera's handle, which serves as focusing knob, is the the antenna. Attached to the opposite side is a removable film camera which can make photographs as the television image is being transmitted.

On his feet the space man wears shoes with magnetic sole plates. These magnets are only powerful enough to keep the man in touch with metal surfaces when in a weightless state in orbit.

SETTLEMENT ON THE MOON

We can see the moon quite well from the earth, and with the largest telescopes excellent photographs of it have been taken. The illustration showing the surface of the moon was made by consulting a photograph made at the Mt. Wilson observatory. It depicts a large crater area with smaller craters within it. One of these is named "Russel W. Porter."

Low sloping areas resembling sandy beaches at the base of the mountains are piles of granulated rock—the result of years of erosion.

If the exploration of space should develop a means of surviving on the moon, a settlement there may consist of an observatory including living quarters with artificial atmosphere and a nuclear power plant to provide heat, light and refrigeration as well as power for communication with the earth.

There are reasons to believe that a settlement on the moon would be desirable if it should prove possible. It would be an excellent place for astronomic observation, because of its lack of atmosphere, and from it additional information about the earth could be obtained. It has been mentioned that there may be deposits of precious metals on the moon. If so, it would hardly pay to haul them to earth, although they might be utilized on the moon.

Alan Shepard, Jr.

Virgil Grissom

John Glenn, Jr.

Leroy Gordon Cooper, Jr.

Malcolm Scott Carpenter

Donald Slayton

Walter Schirra, Jr.