

# Collier's

OCTOBER 18, 1952 • FIFTEEN CENTS

## MAN ON THE MOON

Scientists Tell How  
We Can Land There  
In Our Lifetime





# MAN on the MOON

**Scientists have dreamed for centuries of a lunar voyage. Now we know it can be done within the next 25 years—if we get started right away. In this symposium, a distinguished panel tells how**

**WE** WILL go to the moon in the next 25 years. We have the knowledge and the tools to do it now, but years of preparation and detailed planning are needed first. What we *can* do now is get the project started.

The first step has been taken: our scientists have developed rockets which have shot through the earth's atmosphere into airless space beyond. All we need now are better rockets—and we know how to build them.

Our trip to the moon will not be a simple nonstop flight from the earth. We'd need too large and expensive a rocket ship for that. Instead, we'll make a stopover in space. We'll change vehicles, shifting from one especially designed to break away from the earth's atmosphere into one specifically designed for a moon voyage. There will be other advantages to a two-step trip, too, among them a 15,840-mile-an-hour running start on the second leg of the journey. Here's how it's done:

Within the next 10 or 15 years, we can expect to see a permanent station erected in space, 1,075 miles high, in an orbit which will carry it around the earth once every two hours. The details of this project were given in Collier's issue of March 22, 1952.

The station will be built of materials carried to the two-hour orbit by great rocket ships—called three-stage rockets because they will have three separate batteries of motors to be used one at a time, then dropped off. At a speed of 15,840 miles an hour,

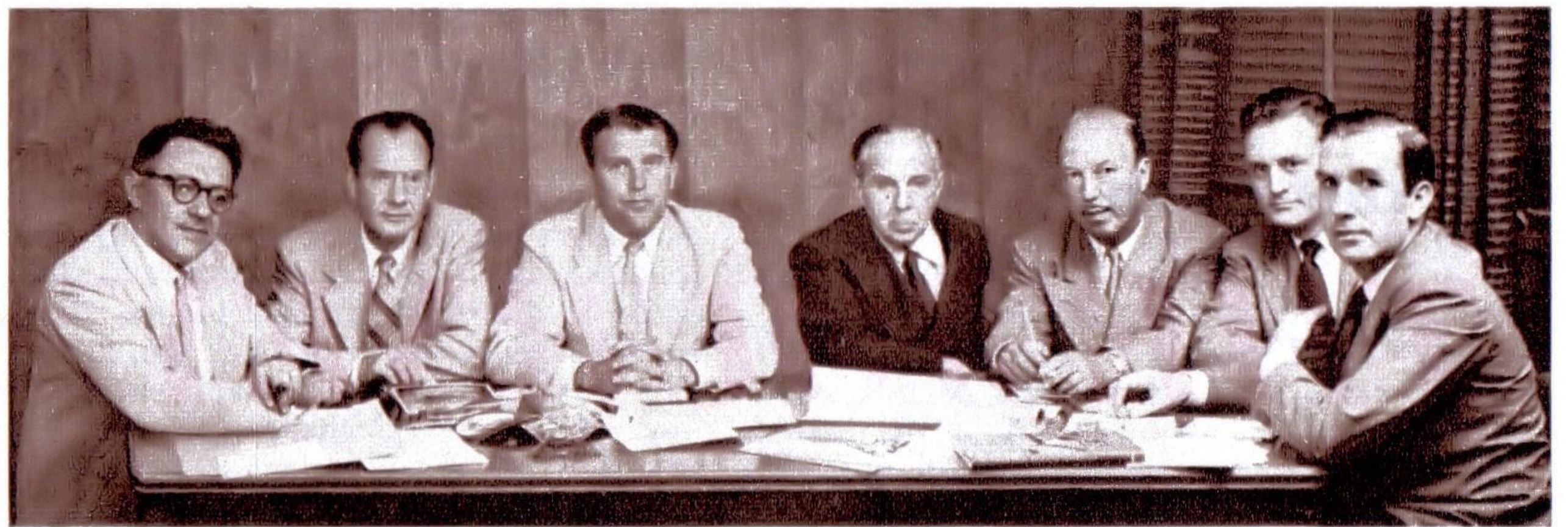
1,075 miles up, these rockets become satellites of the earth, unaffected by gravity. Without power, they will cruise around the globe as long as we let them. Their cargo will do the same, since it travels at the same speed. So we merely unload our building supplies in space and let them drift there until needed.

From these prefabricated parts, we'll build a wheel-shaped structure 250 feet in diameter, with pressurized compartments and a crew of 80. The space station's ability to scan all parts of the earth will make it one of the most powerful forces for peace ever developed—or, in the wrong hands, a terrible weapon of war. Collier's still believes that the station must be built by free men; that means the United States, the only nation which can afford the satellite's \$4,000,000,-000 cost. In 1948, the late Secretary of Defense James V. Forrestal indicated that work on an earth satellite program had already begun. It should not be allowed to lag.

For, besides serving as a roving, ever-watchful guardian of the peace, the station in space will provide the springboard for one of the greatest scientific advances in history: the lunar journey men have dreamed of for centuries. The space station should be a reality by 1967. By the time it's completed, many of the preliminary plans will be ready for the next long step into space.

By 1977, the first scientists may set foot on the ancient dust of the moon.

HANS KNOPF

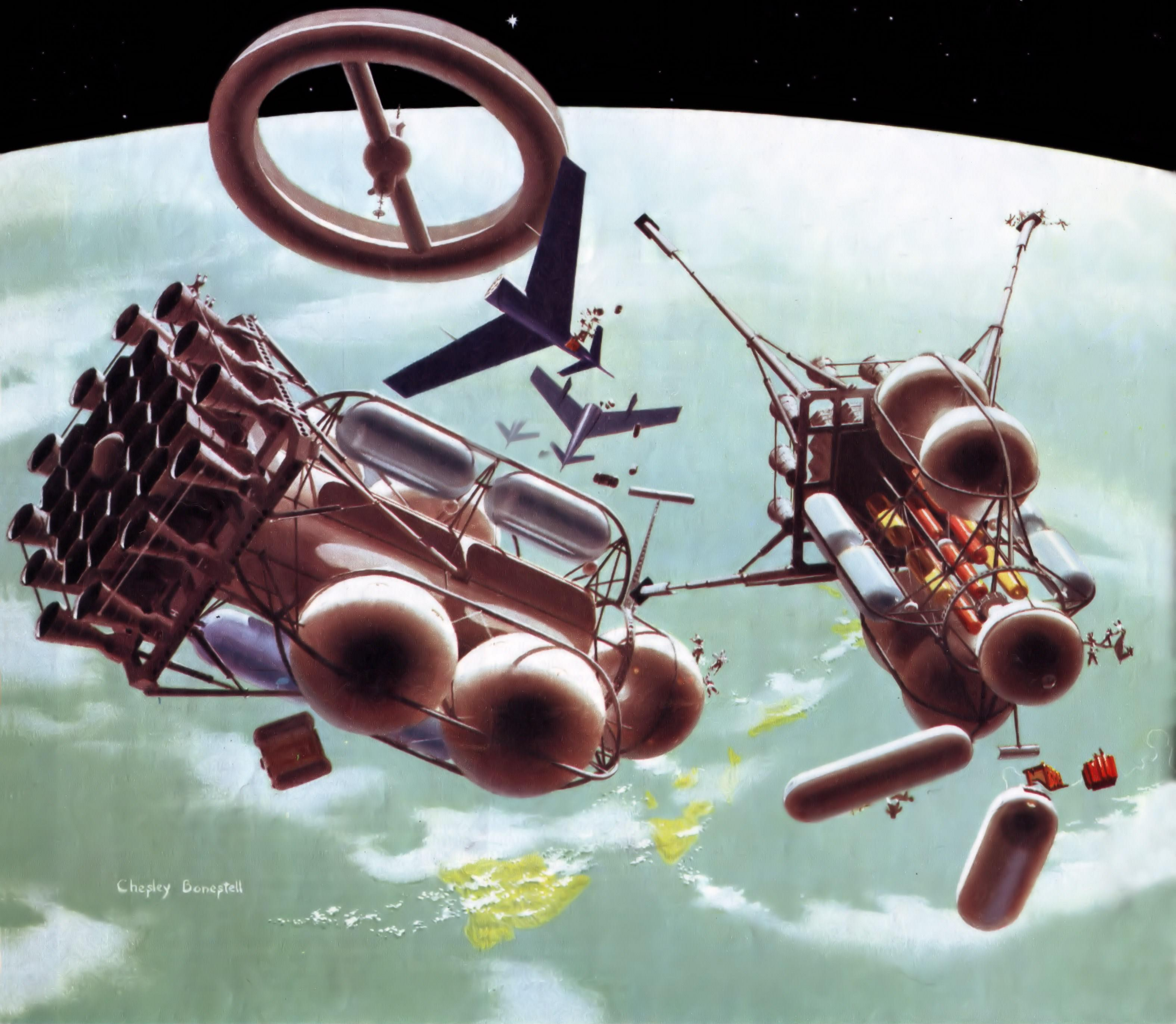


**Contributors to symposium: Willy Ley, left, writer on scientific subjects; Dr. Fred L. Whipple, chairman of Harvard University astronomy department; Dr.**

**Wernher von Braun, world's top rocket expert; artists Chesley Bonestell, Rolf Klep, Fred Freeman; associate editor Cornelius Ryan, who assembled material**

MOON PHOTO COURTESY LICK OBSERVATORY





Chesley Bonestell

Weightless in orbit 1,075 miles above earth, workers in space suits assemble three moon ships. Hawaiian Islands lie below. Winged transports unload

## Man on the Moon

# THE JOURNEY

By DR. WERNHER von BRAUN

Technical Director, Army Ordnance Guided Missiles Development  
Group, Redstone Arsenal, Huntsville, Alabama

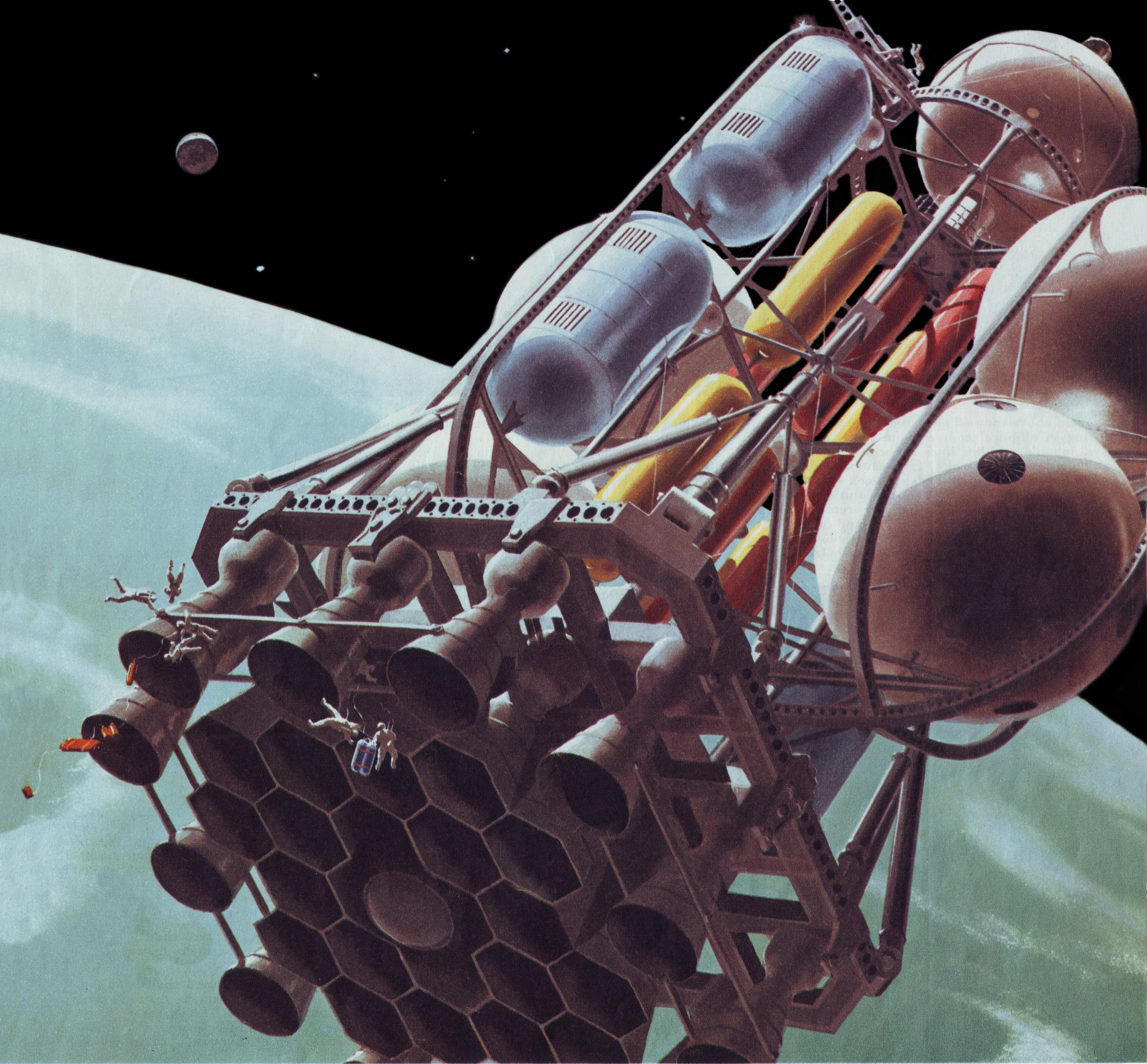
*For five days, the expedition speeds through space on its historic voyage  
—50 men on three ungainly craft, bound for the great unknown*

**H**ERE is how we shall go to the moon. The pioneer expedition, 50 scientists and technicians, will take off from the space station's orbit in three clumsy-looking but highly efficient rocket ships. They won't be streamlined: all travel will be in space, where there is no air to impede motion. Two will be loaded with propellant for the five-day, 239,000-mile trip and the return journey. The third, which will not return, will carry only enough propellant for a one-way trip; the extra room will be filled with supplies and equipment for the scientists' six-week stay.

On the outward voyage, the rocket ships will hit a top speed of 19,500 miles per hour about 33 minutes after departure. Then the motors will be stopped, and the ships will fall the rest of the way to the moon.

Collier's for October 18, 1952





supplies near wheel-shaped space station top left. Engineers and equipment cluster around cargo ship lower left, passenger ships center and right

Such a trip takes a great deal of planning. For a beginning, we must decide what flight path to follow, how to construct the ships and where to land. But the project could be completed within the next 25 years. There are no problems involved to which we don't have the answers—or the ability to find them—right now.

First, where shall we land? We may have a wide choice, once we have had a close look at the moon. We'll get that look on a preliminary survey flight. A small rocket ship taking off from the space station will take us to within 50 miles of the moon to get pictures of its meteor-pitted surface—including the "back" part, never visible from the earth.

We'll study the photographs for a suitable site. Several considerations limit our selection. Be-

cause the moon's surface has 14,600,000 square miles—about one thirteenth that of the earth—we won't be able to explore more than a small area in detail, perhaps part of a section 500 miles in diameter. Our scientists want to see as many kinds of lunar features as possible, so we'll pick a spot of particular interest to them. We want radio contact with the earth, too; that means we'll have to stick to the moon's "face," for radio waves won't reach across space to any point the eye won't reach.

We can't land at the moon's equator because its noonday temperatures reach an unbearable 220-degrees Fahrenheit, more than hot enough to boil water. We can't land where the surface is too rugged, because we need a flat place to set down. Yet the site can't be too flat, either—grain-sized meteors constantly bombard the moon at

speeds of several miles a second; we'll have to set up camp in a crevice where we have protection from these bullets.

There's one section of the moon that meets all our requirements, and unless something better turns up on closer inspection, that's where we'll land. It's an area called *Sinus Roris*, or Dewy Bay, on the northern branch of a plain known as *Oceanus Procellarum*, or Stormy Ocean (so called by early astronomers who thought the moon's plains were great seas). Dr. Fred L. Whipple, chairman of Harvard University astronomy department, says *Sinus Roris* is ideal for our purpose—about 650 miles from the lunar north pole, where the daytime temperature averages a reasonably pleasant 40 degrees and the terrain is flat enough to land on, yet irregular enough to hide



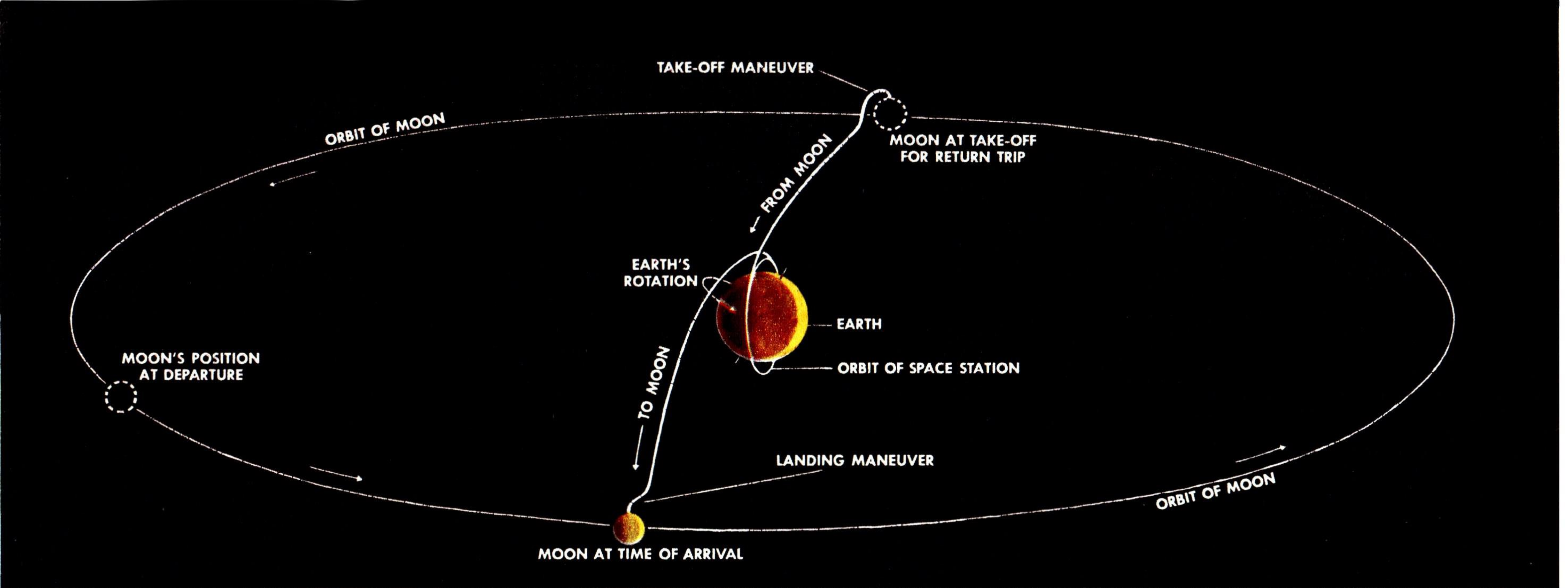
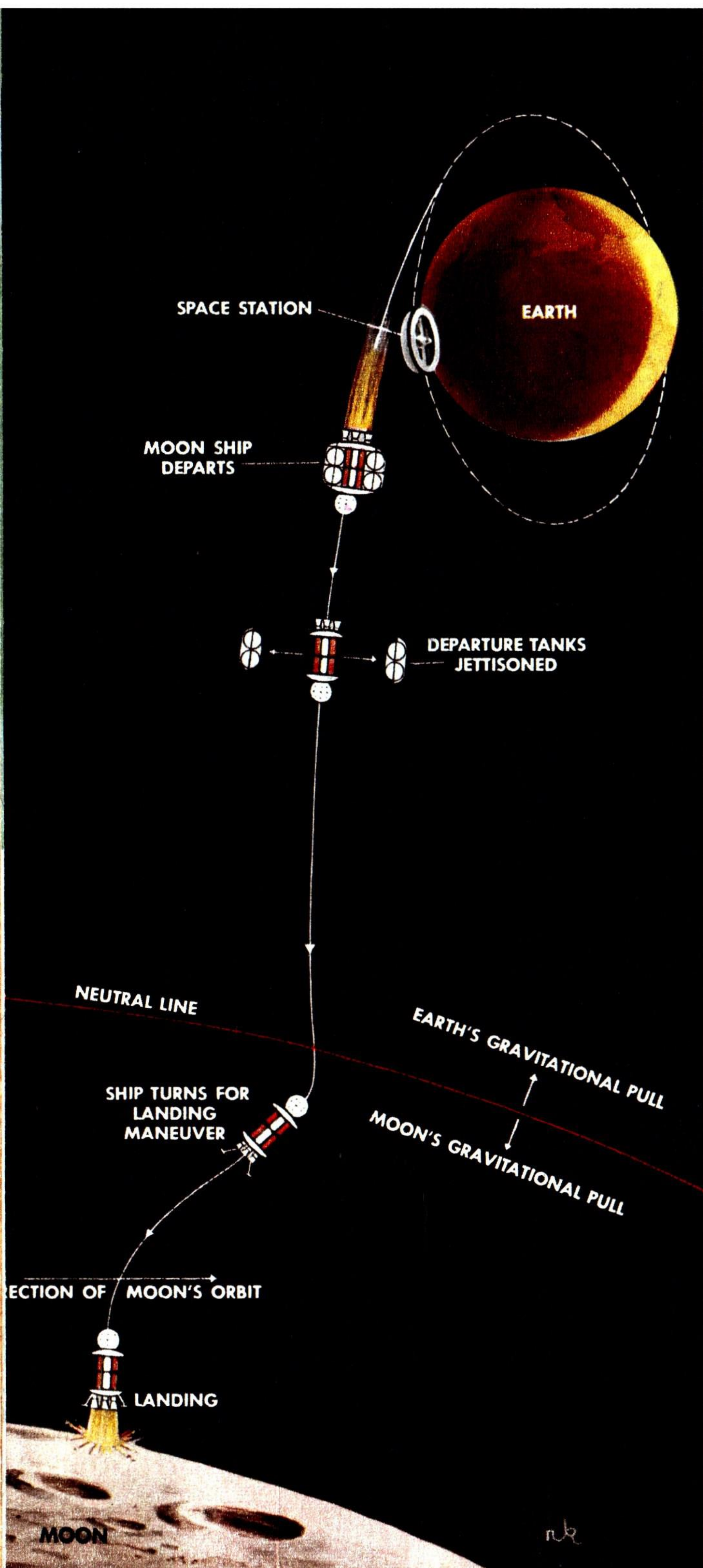


Diagram above shows flight paths to and from moon. Moving in elliptical course about globe every 27½ days, moon's position lines up with space station's orbit once every two weeks. Trips can be made only at this time. During expedition's six-week stay on lunar surface, moon will make 1½ revolutions around earth to reach correct position for return. Slight curves in flight track during landing and take-off are caused by moon's gravity. Drawing below, not in scale, shows moon-bound flight maneuvers in close-up



in. With a satisfactory site located, we start our detailed planning.

To save fuel and time, we want to take the shortest practical course. The moon moves around the earth in an elliptical path once every 27½ days. The space station, our point of departure, circles the earth once every two hours. Every two weeks, their paths are such that a rocket ship from the space station will intercept the moon in just five days. The best conditions for the return trip will occur two weeks later, and again two weeks after that. With their stay limited to multiples of two weeks, our scientists have set themselves a six-week limit for the first exploration of the moon—long enough to accomplish some constructive research, but not long enough to require a prohibitive supply of essentials like liquid oxygen, water and food.

Six months before our scheduled take-off, we begin piling up construction materials, supplies and equipment at the space station. This operation is a massive, impressive one, involving huge, shuttling cargo rocket ships, scores of hard-working handlers, and tremendous amounts of equipment. Twice a day, pairs of sleek rocket transports from the earth sweep into the satellite's orbit and swarms of workers unload the 36 tons of cargo each carries. With the arrival of the first shipment of material, work on the first of the three moon-going space craft gets under way, picking up intensity as more and more equipment arrives.

The supplies are not stacked inside the space station; they're just left floating in space. They don't have to be secured, and here's why: the satellite is traveling around the earth at 15,840 miles an hour; at that speed, it can't be affected by the earth's gravity, so it doesn't fall, and it never slows down because there's no air resistance. The same applies to any other object brought into the orbit at the same speed: to park beside the space station, a rocket ship merely adjusts its speed to 15,840 miles per hour; and it, too, becomes a satellite. Crates moved out of its hold are traveling at the same speed in relation to the earth, so they also are weightless satellites.

As the weeks pass and the unloading of cargo ships continues, the construction area covers several littered square miles. Tons of equipment lie about—aluminum girders, collapsed nylon-and-plastic fuel tanks, rocket motor units, turbopumps, bundles of thin aluminum plates, a great many nylon bags containing smaller parts. It's a bewildering scene, but not to the moon-ship builders. All construction parts are color-coded—with blue-tipped cross braces fitting into blue sockets, red joining members keyed to others of the same color, and so forth. Work proceeds swiftly.

In fact, the workers accomplish wonders, considering the obstacles confronting a man forced to struggle with unwieldy objects in space. The men move clumsily, hampered by bulky pressurized suits equipped with such necessities of space-life as air conditioning, oxygen tanks, walkie-talkie radios and tiny rocket motors for propulsion. The work is laborious, for although objects are weightless they still have inertia. A man who shoves a

one-ton girder makes it move all right, but he makes himself move, too. As his inertia is less than the girder's, he shoots backward much farther than he pushes the big piece of metal forward.

The small personal rocket motors help the workers move some of the construction parts; the big stuff is hitched to space taxis, tiny pressurized rocket vehicles used for short trips outside the space station.

As the framework of the new rocket ships takes form, big, folded nylon-and-plastic bundles are brought over. They're the personnel cabins; pumped full of air, they become spherical, and plastic astrodomes are fitted to the top and sides of each. Other sacks are pumped full of propellant, and balloon into the shapes of globes and cylinders. Soon the three moon-going space ships begin to emerge in their final form. The two round-trip ships resemble an arrangement of hourglasses inside a metal framework; the one-way cargo carrier has much the same framework, but instead of hourglasses it has a central structure which looks like a great silo.

#### Dimensions of the Rocket Ships

Each ship is 160 feet long (nine feet more than the height of the Statue of Liberty) and about 110 feet wide. Each has at its base a battery of 30 rocket motors, and each is topped by the sphere which houses the crew members, scientists and technicians on five floors. Under the sphere are two long arms set on a circular track which enables them to rotate almost a full 360 degrees. These light booms, which fold against the vehicles during take-off and landing to avoid damage, carry two vital pieces of equipment: a radio antenna dish for short-wave communication and a solar mirror for generating power.

The solar mirror is a curved sheet of highly polished metal which concentrates the sun's rays on a mercury-filled pipe. The intense heat vaporizes the mercury, and the vapor drives a turbo-generator, producing 35 kilowatts of electric power—enough to run a small factory. Its work done, the vapor cools, returns to its liquid state and starts the cycle all over again.

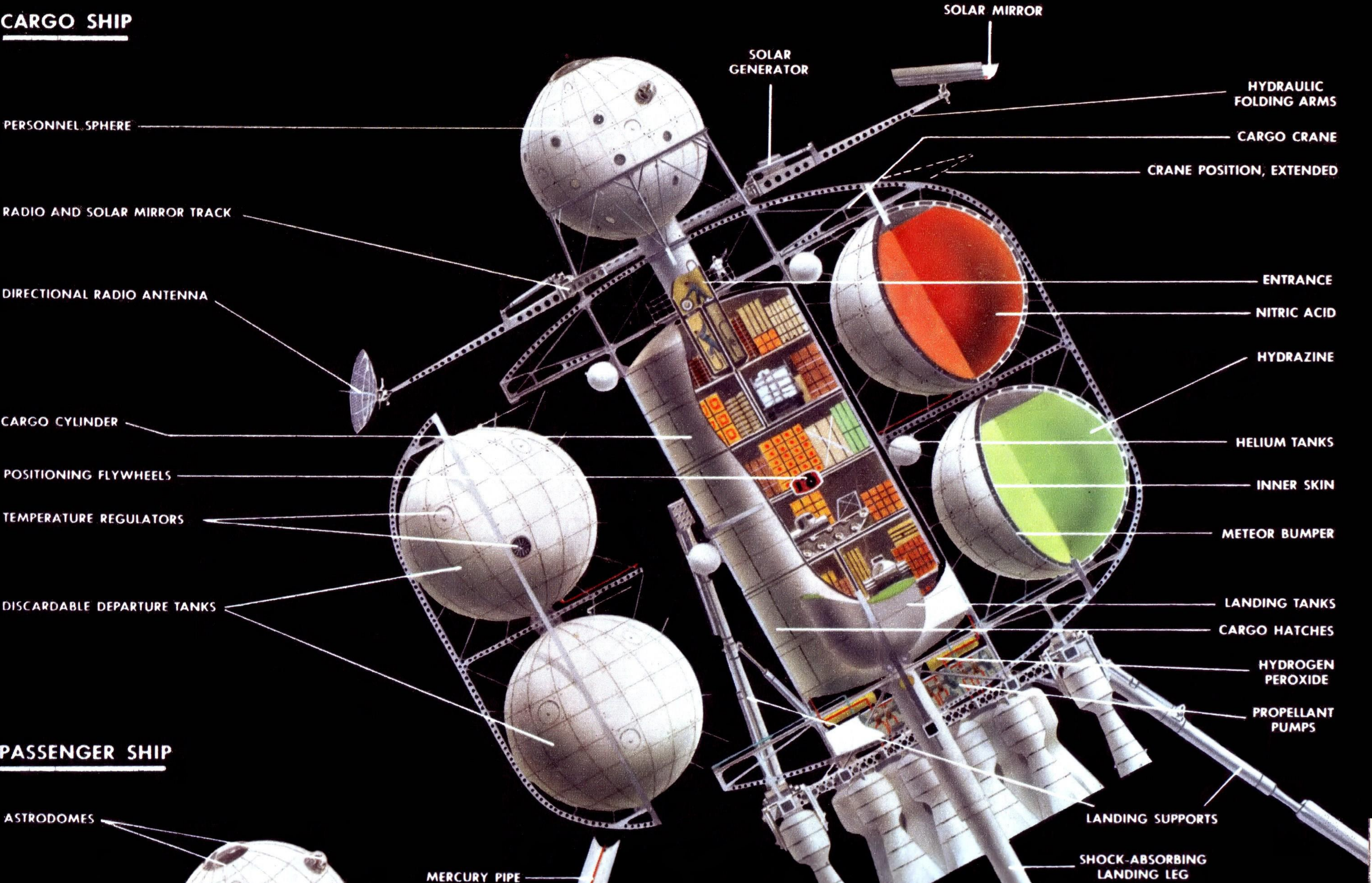
Under the radio and mirror booms of the passenger ships hang 18 propellant tanks carrying nearly 800,000 gallons of ammonialike hydrazine (our fuel) and oxygen-rich nitric acid (the combustion agent). Four of the 18 tanks are outsized spheres, more than 33 feet in diameter. They are attached to light frames on the outside of the rocket ship's structure. More than half our propellant supply—580,000 gallons—is in these large balls; that's the amount needed for take-off. As soon as it's exhausted, the big tanks will be jettisoned. Four other large tanks carry propellant for the landing; they will be left on the moon.

We also carry a supply of hydrogen peroxide

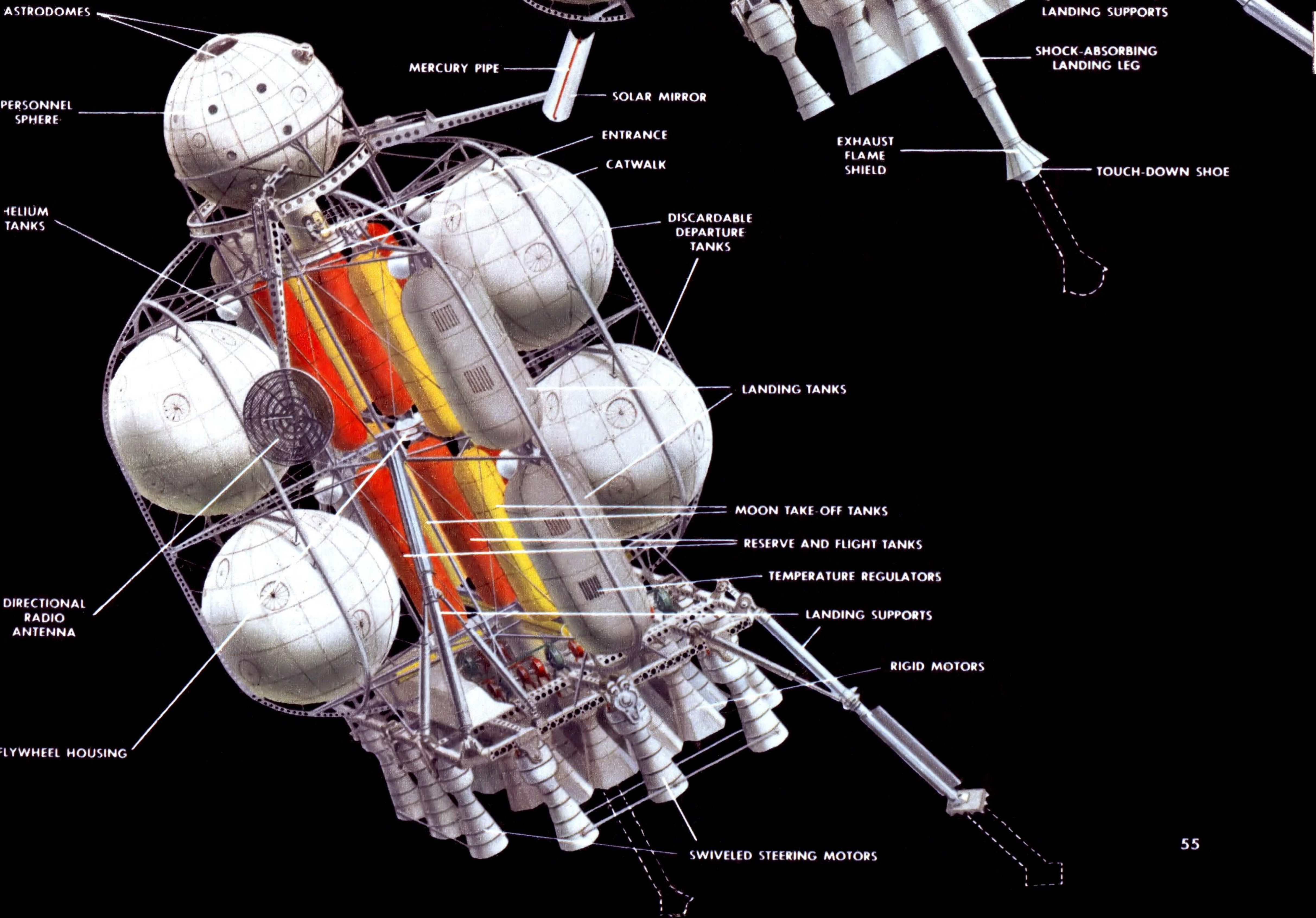
Vehicles, right, have same dimensions: 160 ft. long, 110 ft. wide; weigh 4,370 tons. Cargo ship carries 10 men, passenger ships 20 each



**CARGO SHIP**



**PASSENGER SHIP**





to run the turbopumps which force the propellant into the rocket motors. Besides the 14 cylindrical propellant tanks and the four spherical ones, eight small helium containers are strung throughout the framework. The lighter-than-air helium will be pumped into partly emptied fuel tanks to help them keep their shape under acceleration and to create pressure for the turbopumps.

The cost of the propellant required for this first trip to the moon, the bulk of it used for the supply ships during the build-up period, is enormous—about \$300,000,000, roughly 60 per cent of the half-billion-dollar cost of the entire operation. (That doesn't count the \$4,000,000,000 cost of erecting the space station, whose main purpose is strategic rather than scientific.)

The cargo ship carries only enough fuel for a one-way trip, so it has fewer tanks: four discardable spheres like those on the passenger craft, and four cylindrical containers with 162,000 gallons of propellant for the moon landing.

In one respect, the cargo carrier is the most interesting of the three space vehicles. Its big silo-like storage cabin, 75 feet long and 36 feet wide, was built to serve a double purpose. Once we reach the moon and the big cranes folded against the framework have swung out and unloaded the 285 tons of supplies in the cylinder, the silo will be detached from the rest of the rocket ship. The winch-driven cables slung from the cranes will then raise *half* of the cylinder, in sections, which it will deposit on trailers drawn by tractors. The tractors will take them to a protective crevice on the moon's surface, at the place chosen for our camp. Then the other lengthwise half will be similarly moved—giving us two ready-to-use Quonset huts.

Now that we have our space ships built and have provided ourselves with living quarters for our stay on the moon, a couple of important items remain: we must protect ourselves against two of the principal hazards of space travel, flying meteors and extreme temperatures.

#### For Protection Against Meteors

To guard against meteors, all vital parts of the three craft—propellant tanks, personnel spheres, cargo cabin—are given a thin covering of sheet metal, set on studs which leave at least a one-inch space between this outer shield and the inside wall. The covering, called a meteor bumper, will take the full impact of the flying particles (we don't expect to be struck by any meteors much larger than a grain of sand) and will cause them to disintegrate before they can do damage.

For protection against excessive heat, all parts of the three rocket ships are painted white, because white absorbs little of the sun's radiation. Then, to guard against cold, small black patches are scattered over the tanks and personnel spheres. The patches are covered by white blinds, automatically controlled by thermostats. When the blinds on the sunny side are open, the spots absorb heat and warm the cabins and tanks; when the blinds are closed, an all-white surface is exposed to the sun, permitting little heat to enter. When the blinds on the shaded side are open, the black spots radiate heat and the temperature drops.

Now we're ready to take off from the space station's orbit to the moon.

The bustle of our departure—hurrying space taxis, the nervous last-minute checks by engineers, the loading of late cargo and finally the take-off itself—will be watched by millions. Television cameras on the space station will transmit the scene to receivers all over the world. And people on the earth's dark side will be able to turn from their screens to catch a fleeting glimpse of light—high in the heavens—the combined flash of 90 rocket motors, looking from the earth like the sudden birth of a new, short-lived star.

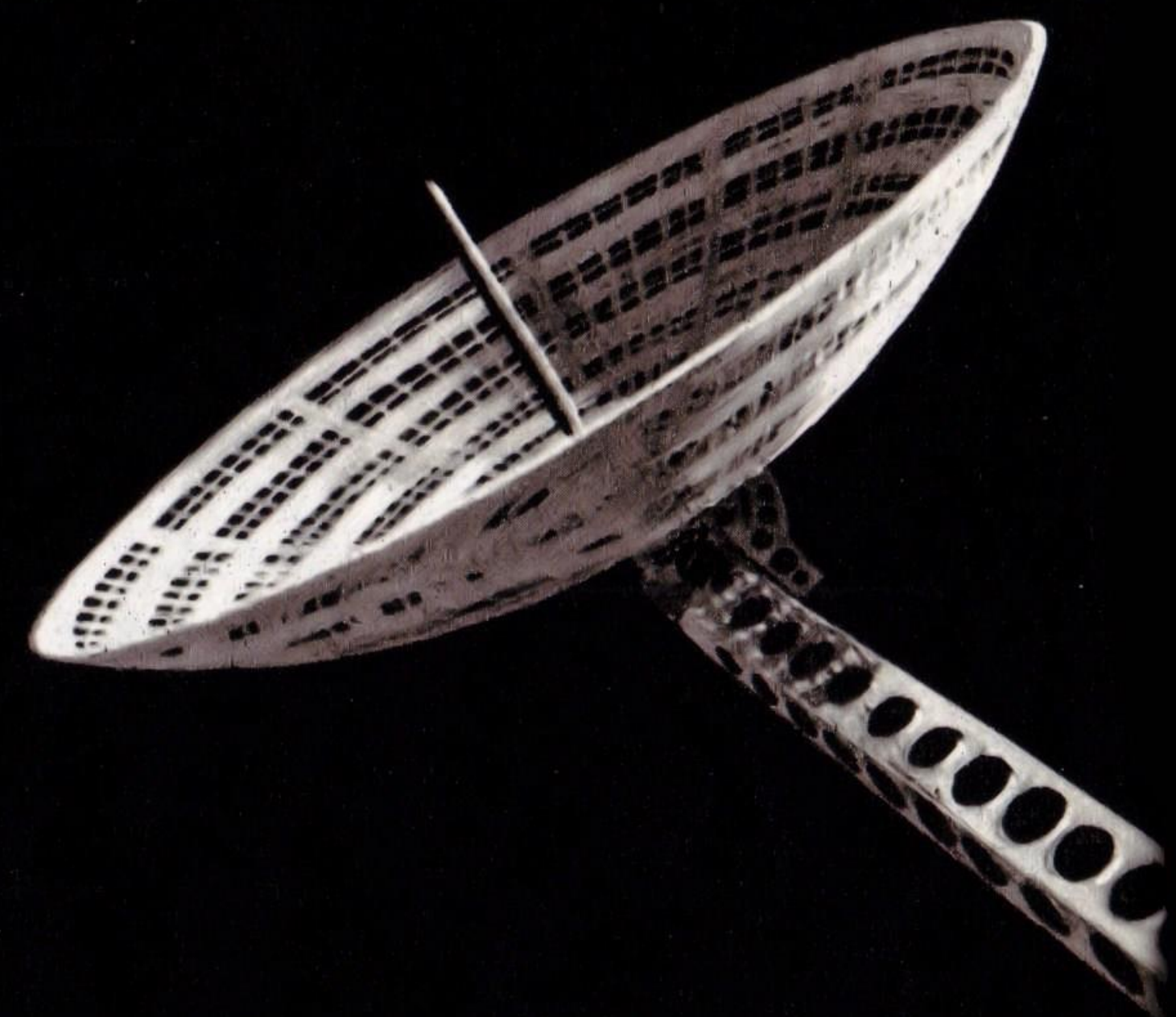
Our departure is slow. The big rocket ships rise ponderously, one after the other, green flames streaming from their batteries of rockets, and then they pick up speed. Actually, we don't need to gain *much* speed. The velocity required to get us to our destination is 19,500 miles an hour, but

we've had a running start; while "resting" in the space station's orbit, we were really streaking through space at 15,840 miles an hour. We need an additional 3,660 miles an hour.

Thirty-three minutes from take-off we have it. Now we cut off our motors; momentum and the moon's gravity will do the rest.

The moon itself is visible to us as we coast through space, but it's so far off to one side that it's hard to believe we won't miss it. In the five days of our journey, though, it will travel a great distance, and so will we; at the end of that time we shall reach the farthest point, or apogee, of our elliptical course, and the moon should be right in front of us.

The earth is visible, too—an enormous ball, most of it bulking pale black against the deeper black of space, but with a wide crescent of daylight where the sun strikes it. Within the crescent, the continents enjoying summer stand out as vast green terrain maps surrounded by the brilliant



## Inside the Moon Ship

By WILLY LEY

**A**BOARD the moon ships, living is cramped, but not uncomfortable. Each of the two passenger vehicles holds 20 men en route to the moon, 25 on the return trip (the 10 men on the one-way cargo ship will split up coming back). For added safety, each passenger ship carries enough oxygen (three pounds per man per day), water (four pounds per man per day) and food for the *entire* expedition.

The top floor of the personnel sphere is the control deck. At the far left, an engineer keeps watch over fuel, temperature, pressure, oxygen and other gauges. Next to him, the radio operator maintains contact with the other two ships and the space station. At center, a member of the navigation staff, using a combination telescope-celestial camera, sights on a star. (When not in use, astrodomes are closed off by shutters to block the sun's blinding glare.)

To the right of his position is the rocket motor instrument panel and, underneath, the automatic pilot and the reels of tape which operate it during landing. The man at extreme right is the crew captain, strapped into a swivel seat which enables him to watch either the master controls, as he's doing now, or the motor instruments behind him (for comfort, all seats are contour seats; personnel must be strapped in so they won't float away in the weightless ship). A control board at the captain's position enables him to operate the rocket motors, and the intercom unit by his hand keeps him in communication with the rest of the ship.

The next floor down is primarily a navigation deck, although a sponge-bath stall (there are no showers, because the water won't fall properly) and extra bunks are also installed here. Next to the bathing stall, a navigator operates a mechanical computer. The chief navigator and two assistants are working at the dead-reckoning tracer, a device which automatically records the space ship's course. The clock on the wall shows elapsed time since departure, and the three screens at the right indicate the attitude of the ship, as determined by an artificial horizon mechanism in the astrodome at far right.

On the central, and largest, deck are the ship's living quarters. Bunks line the walls and hang from stanchions (the sleeping men are members of the off-duty watch), and a cooking-dining area occupies most of the floor space. At center is an automatic dining unit: table, short-wave food heater and dishwasher.

It works this way: the "cook" (background) has taken a packaged, precooked meal from the deep freeze and is placing it on a conveyer belt. It enters the short-wave heater and is deposited in a spring-lidded dish (so it won't float away). The dish is locked into one of the two outer conveyer tracks on the table (one for solids, the other for liquids) and the diner draws the food toward him along a slot. When he's finished, he slides his dish back to the third, or inner, track, which carries it to the dishwashing unit. Straps hold the diners in their seats, making their snap-equipped belts unnecessary. At far right is a snack dispenser for quick meals, particularly for crewmen standing watch.

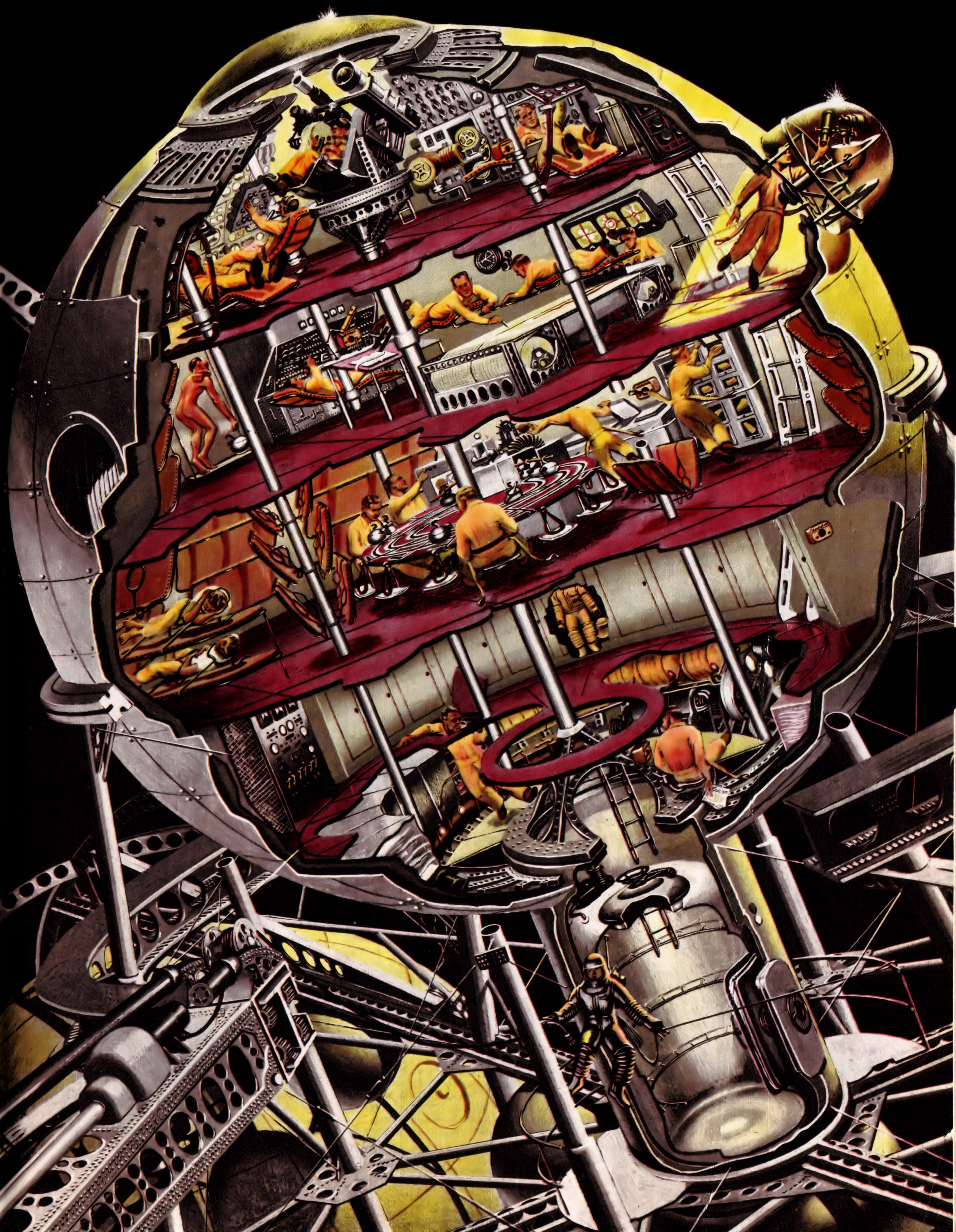
The fourth floor down, or stowage deck, houses the main electrical switchboard, storage cupboards and a washroom (next to the stairway).

The engineering deck is at the bottom of the sphere. Lining the walls, directly below the ceiling, are water tanks (left), yellow oxygen tanks (center), air blower pump (behind the large gauges) and tanks for water recovered from the ship's atmosphere. Below this ring are the brown electric storage batteries and the ship's air-conditioning and water-cleansing systems. Sewage tanks are under the floor.

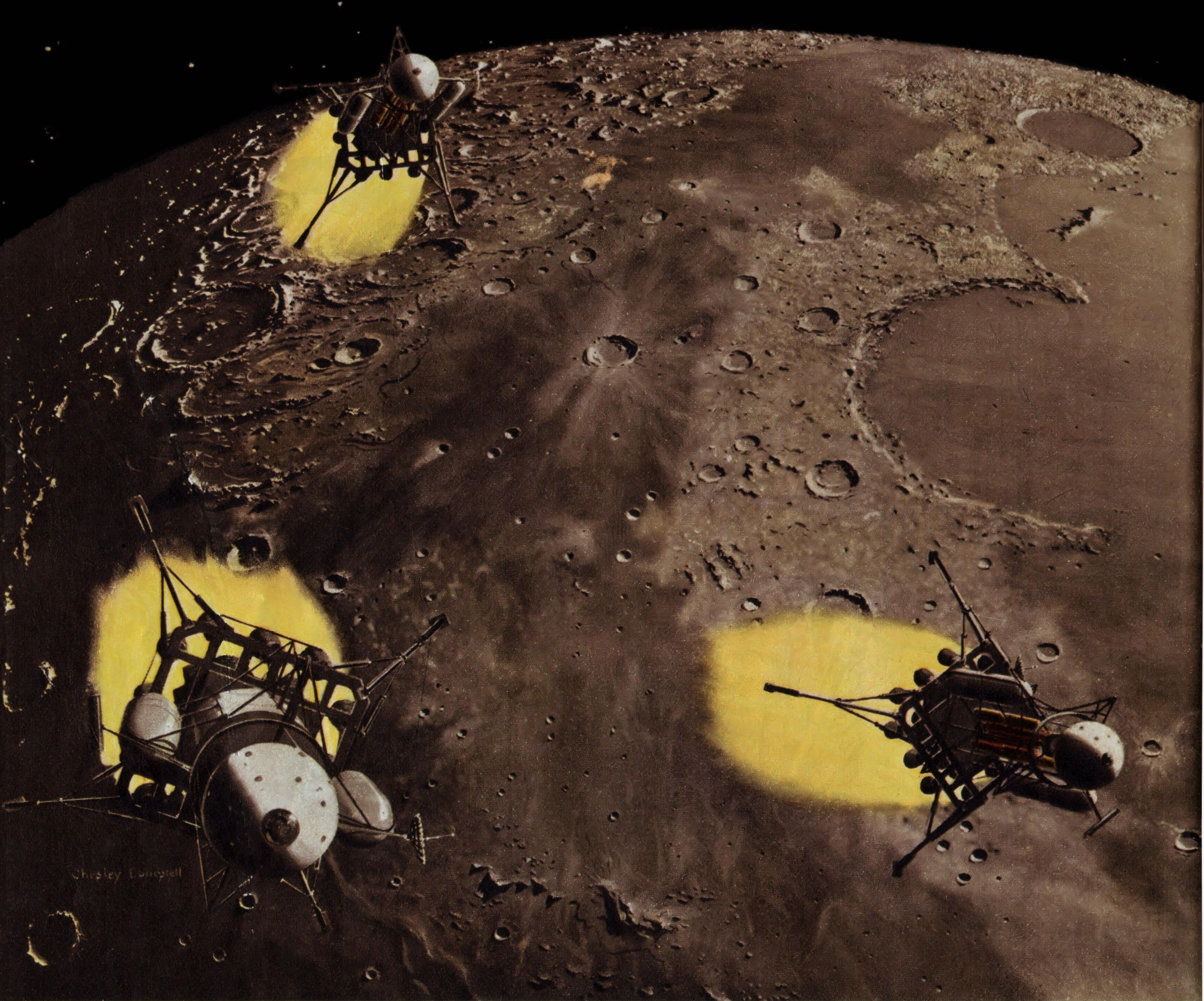
The space-suited engineer outside the ship's air lock holds the main power line, which connects with the power-producing solar mirror (off picture at lower left). He's about to plug the line into the black distributing box, shown on the catwalk between his feet, half hidden by the air-lock tower.

The sphere will be home to the voyagers not only for the five-day trip, but for several days after, while lunar quarters are being constructed. ▲▲▲









**Landing on the moon.** Ten minutes before touchdown, rocket motors are switched on to slow down ships' high-speed fall caused by the moon's gravity. Vehicles are maneuvering 550 miles above landing area known as *Sinus Roris* (Dewy Bay), dark plain above cargo ship in lower left

blue of the oceans. Patches of white cloud obscure some of the detail; other white blobs are snow and ice on mountain ranges and polar areas.

Against the blackness of the earth's night side is a gleaming spot—the space station, reflecting the light of the sun.

Two hours and 54 minutes after departure, we are 17,750 miles from the earth's surface. Our speed has dropped sharply, to 10,500 miles an hour. Five hours and eight minutes en route, the earth is 32,950 miles away, and our speed is 8,000 miles an hour; after 20 hours, we're 132,000 miles from the earth, traveling at 4,300 miles an hour.

On this first day, we discard the empty departure tanks. Engineers in protective suits step outside the cabin, stand for a moment in space, then make their way down the girders to the big spheres. They pump any remaining propellant into reserve tanks, disconnect the useless containers, and give them a gentle shove. For a while the tanks drift along beside us; soon they float out of sight. Eventually they will crash on the moon.

There is no hazard for the engineers in this operation. As a precaution, they were secured to

the ship by safety lines, but they could probably have done as well without them. There is no air in space to blow them away.

That's just one of the peculiarities of space to which we must adapt ourselves. Lacking a natural sequence of night and day, we live by an arbitrary time schedule. Because nothing has weight, cooking and eating are special problems. Kitchen utensils have magnetic strips or clamps so they won't float away. The heating of food is done on electronic ranges. They have many advantages: they're clean, easy to operate, and their short-wave rays don't burn up precious oxygen.

#### Difficulties of Dining in Space

We have no knives, spoons or forks. All solid food is precut; all liquids are served in plastic bottles and forced directly into the mouth by squeezing. Our mess kits have spring-operated covers; our only eating utensils are tonglike devices; if we open the covers carefully, we can grab a mouthful of food without getting it all over the cabin.

From the start of the trip, the ship's crew has

been maintaining a round-the-clock schedule, standing eight-hour watches. Captains, navigators and radiomen spend most of their time checking and rechecking our flight track, ready to start up the rockets for a change in course if an error turns up. Technicians back up this operation with reports from the complex and delicate "electronic brains"—computers, gyroscopes, switchboards and other instruments—on the control deck. Other specialists keep watch over the air-conditioning, temperature, pressure and oxygen systems.

But the busiest crew members are the maintenance engineers and their assistants, tireless men who have been bustling back and forth between ships since shortly after the voyage started, anxiously checking propellant tanks, tubing, rocket motors, turbopumps and all other vital equipment. Excessive heat could cause dangerous hairline cracks in the rocket motors; unexpectedly large meteors could smash through the thin bumpers surrounding the propellant tanks; fittings could come loose. The engineers have to be careful.

We are still slowing down. At the start of the fourth day, our speed has dropped to 800



miles an hour, only slightly more than the speed of a conventional jet fighter. Ahead, the harsh surface features of the moon are clearly outlined. Behind, the blue-green ball of the earth appears to be barely a yard in diameter.

Our fleet of unpowered rocket ships is now passing the neutral point between the gravitational fields of the earth and the moon. Our momentum has dropped off to almost nothing—yet we're about to pick up speed. For now we begin falling toward the moon, about 23,600 miles away. With no atmosphere to slow us, we'll smash into the moon at 6,000 miles an hour unless we do something about it.

#### Rotating the Moon Ship

This is what we do: aboard each ship, near its center of gravity, is a positioning device consisting of three flywheels set at right angles to one another and operated by electric motors. One of the wheels heads in the same direction as our flight path—in other words, along the longitudinal axis of the vehicle, like the rear wheels of a car. Another parallels the latitudinal axis, like the steering wheel of an ocean vessel. The third lies along the horizontal axis, like the rear steering wheel of a hook-and-ladder truck. If we start any one of the wheels spinning, it causes our rocket ship to turn slowly in the other direction (pilots know this "torque" effect; as increased power causes a plane's propeller to spin more rapidly in one direction, the pilot has to fight his controls to keep the plane from rolling in the other direction).

The captain of our space ship orders the longitudinal flywheel set in motion. Slowly our craft begins to cartwheel; when it has turned half a revolution, it stops. We are going toward the moon tail-end-first, a position which will enable us to brake our fall with our rocket motors when the right time comes.

Tension increases aboard the three ships. The landing is tricky—so tricky that it will be done entirely by automatic pilot, to diminish the possibility of human error. Our scientists compute our rate of descent, the spot at which we expect to strike, the speed and direction of the moon (it's traveling at 2,280 miles an hour at right angles to our path). These and other essential

statistics are fed into a tape. The tape, based on the same principle as the player-piano roll and the automatic business-machine card, will control the automatic pilot. (Actually, a number of tapes intended to provide for all eventualities will be fixed up long before the flight, but last-minute checks are necessary to see which tape to use—and to see whether a manual correction of our course is required before the autopilot takes over.)

Now we lower part of our landing gear—four spiderlike legs, hinged to the square rocket assembly, which have been folded against the framework.

As we near the end of our trip, the gravity of the moon, which is still to one side of us, begins to pull us off our elliptical course, and we turn the ship to conform to this change of direction. At an altitude of 550 miles, the rocket motors begin firing; we feel the shock of their blasts inside the personnel sphere and suddenly our weight returns. Objects which have not been secured beforehand tumble to the floor. The force of the rocket motors is such that we have about one third our normal earth weight.

The final 10 minutes are especially tense. The tape-guided automatic pilots are now in full control. We fall more and more slowly, floating over the landing area like descending helicopters. As we approach, the fifth leg of our landing gear—a big telescopic shock absorber which has been housed in the center of the rocket assembly—is lowered through the fiery blast of the motors. The long green rocket flames begin to splash against the baked lunar surface. Swirling clouds of brown-gray dust are thrown out sideways; they settle immediately, instead of hanging in air, as they would on the earth.

The broad round shoe of the telescopic landing leg digs into the soft volcanic ground. If it strikes too hard, an electronic mechanism inside it immediately calls on the rocket motors for more power to cushion the blow. For a few seconds, we balance on the single leg. Then the four outrigger legs slide out to help support the weight of the ship, and are locked into position. The whirring of machinery dies away. There is absolute silence. We have reached the moon.

Now we shall explore it. ▲▲▲



**NEXT WEEK**

## The Exploration of the Moon