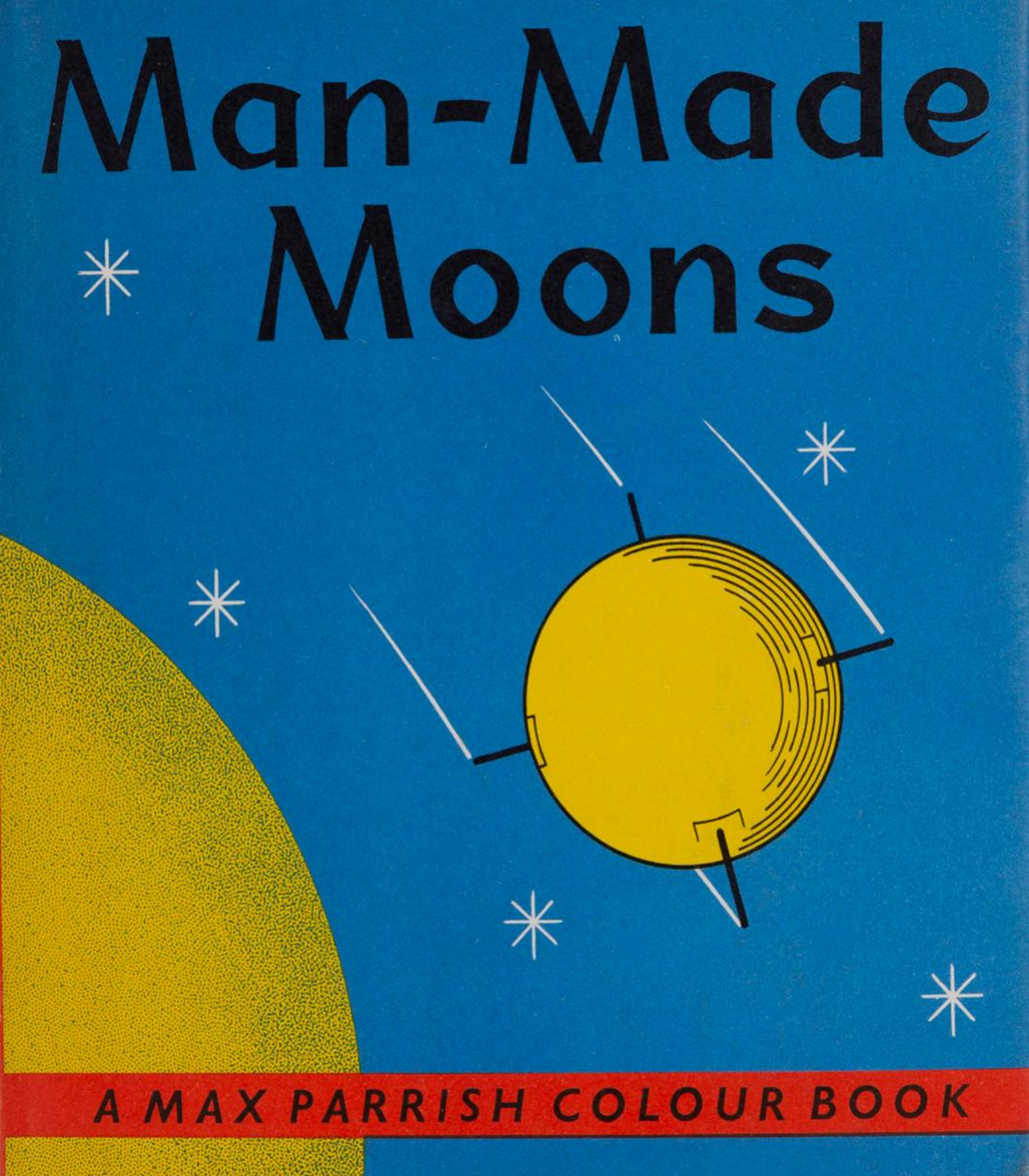
Man-Made Moons



A MAX PARRISH COLOUR BOOK

Nine Times Faster Than the Moon

The great Moon itself, travelling at 2,300 miles an hour, takes more than twenty-seven days to complete its million-and-a-half-mile journey round the Earth. The very first man-made moon travelled at over 22,000 miles an hour. In twenty-seven days it travelled more than fourteen million miles!

Every intelligent youngster is keen to know more about the many wonders of this kind which mark the opening of the Space Age. How is a man-made moon sent up? What decides its speed? How does it get electric power to work its radio? Can it discover anything new about outer space?

Such questions are here really and truly answered, in simple words and crystal-clear explanatory pictures. Look at just a few of the exciting subjects: Three Rockets Which Send a "Moon" Up—Making Electricity from the Sun —Measuring the Swift Rays of Space— Viewing the Whole Earth in One Day —Hitting and Rounding the Moon— The First Living Space Travellers.

This book is a "must" for every young person—and a boon to every parent who doesn't profess to know all the answers.

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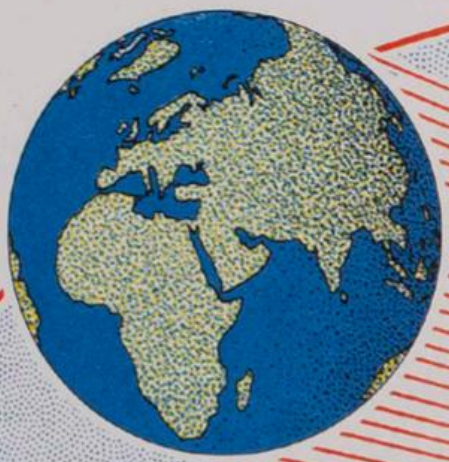
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MAN-MADE MOONS

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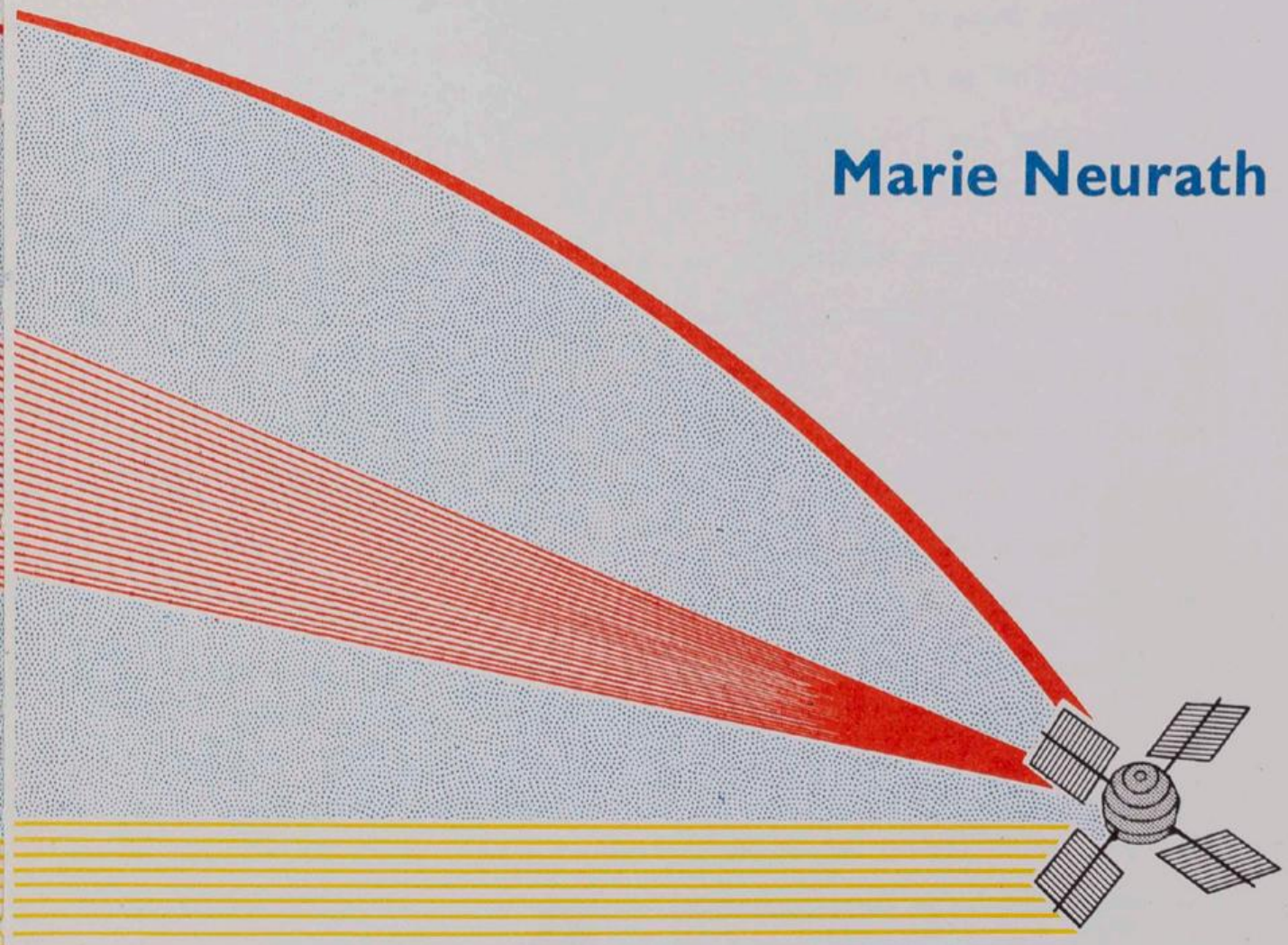
ISOTYPE

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Made Moons

Marie Neurath



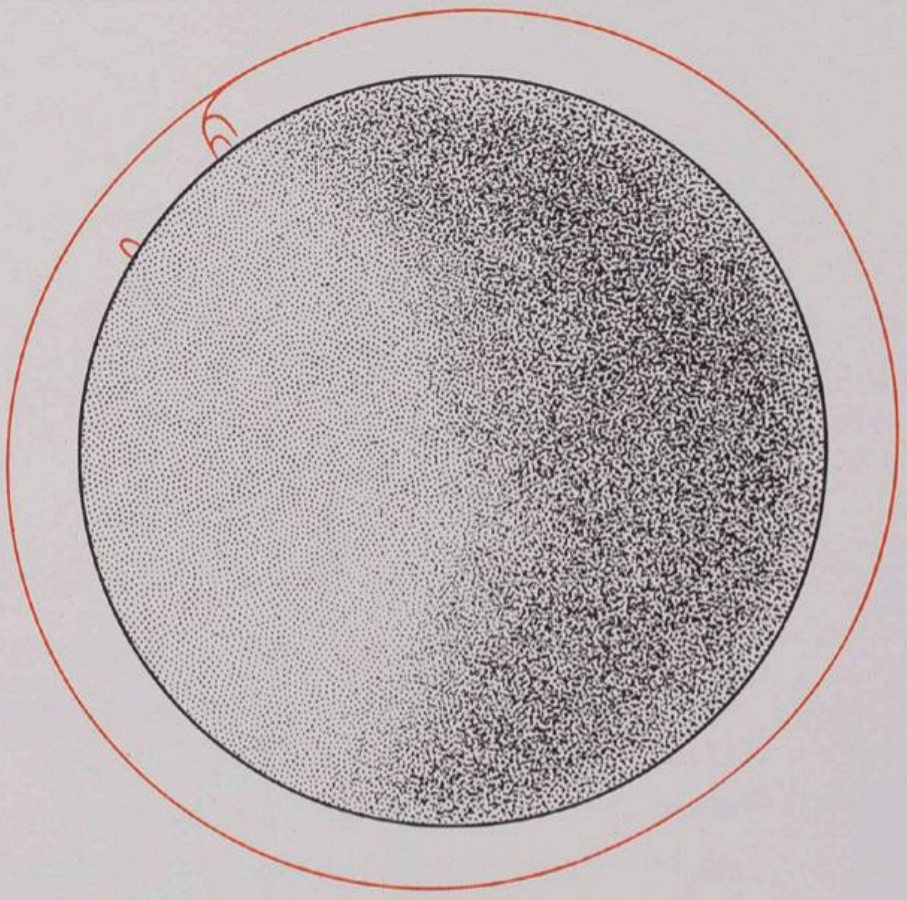
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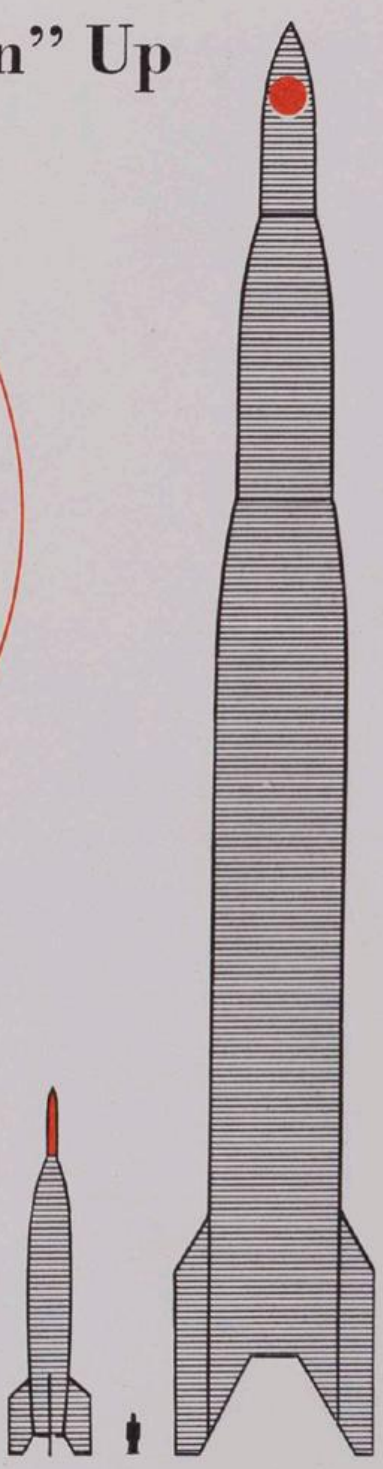
Max Parrish London

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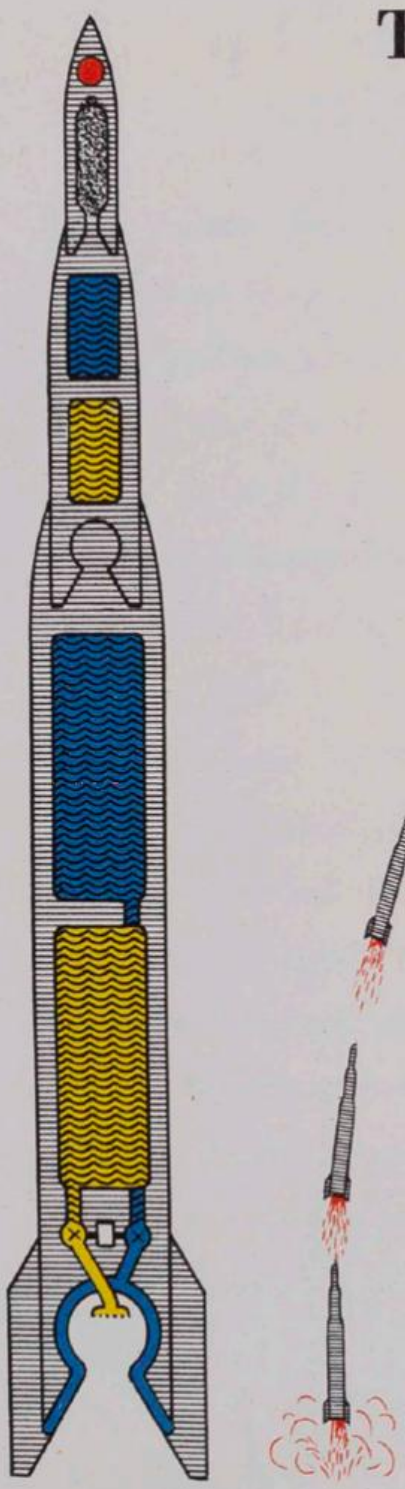
Three Rockets Send a "Moon" Up





A single large rocket can soar up many miles, pushing its way through the densest layer of air and overcoming the strongest part of the earth's pull (which weakens rapidly as we go higher and higher). A smaller rocket fired from it can then reach a height of hundreds of miles. To launch a man-made moon, we use *three* rockets. The first two carry it to a great height. The third shoots it out so that it circles the earth.

The Furious Burning Which

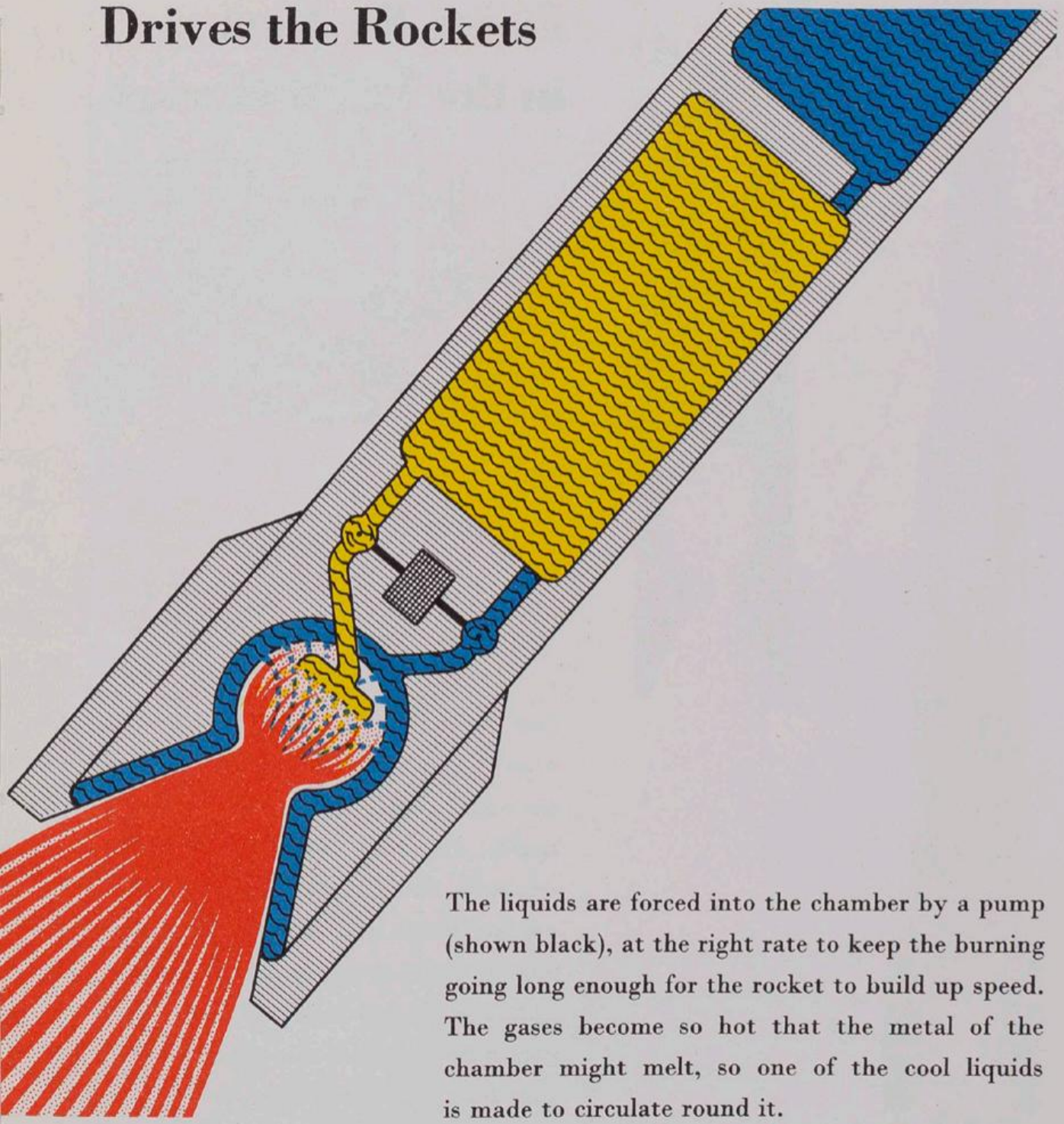




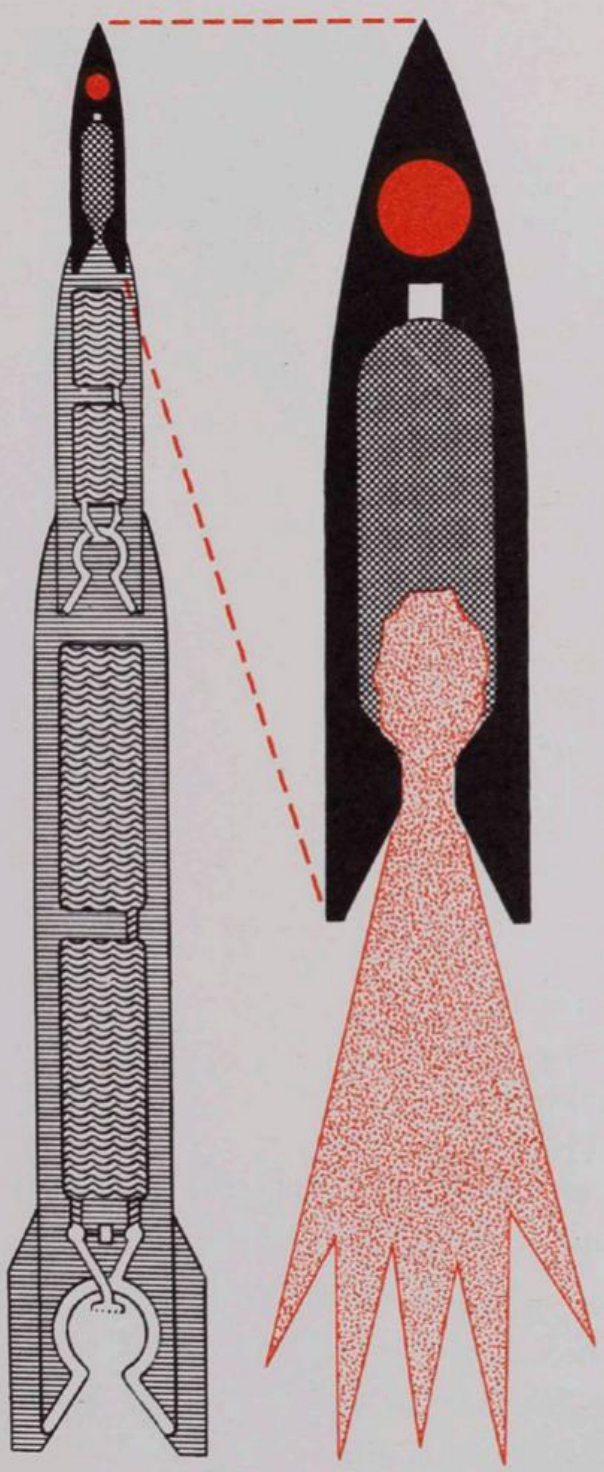


The first two rockets both work the same way. Each has two tanks holding different liquids. These are sprayed into a strong metal chamber where they burn furiously together, producing huge quantities of hot gases which push violently in all directions. The gases which escape from the bottom do not hold the rocket back, so those which thrust against the top of the chamber send the rocket hurtling upward.

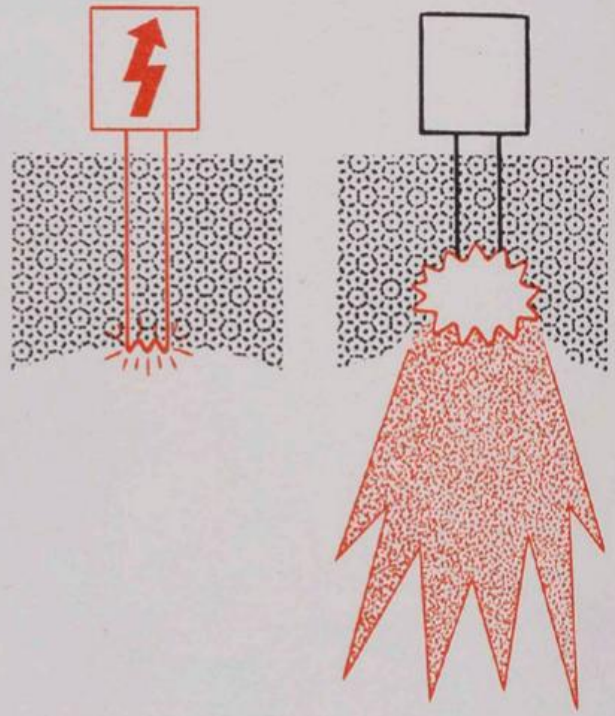
Drives the Rockets



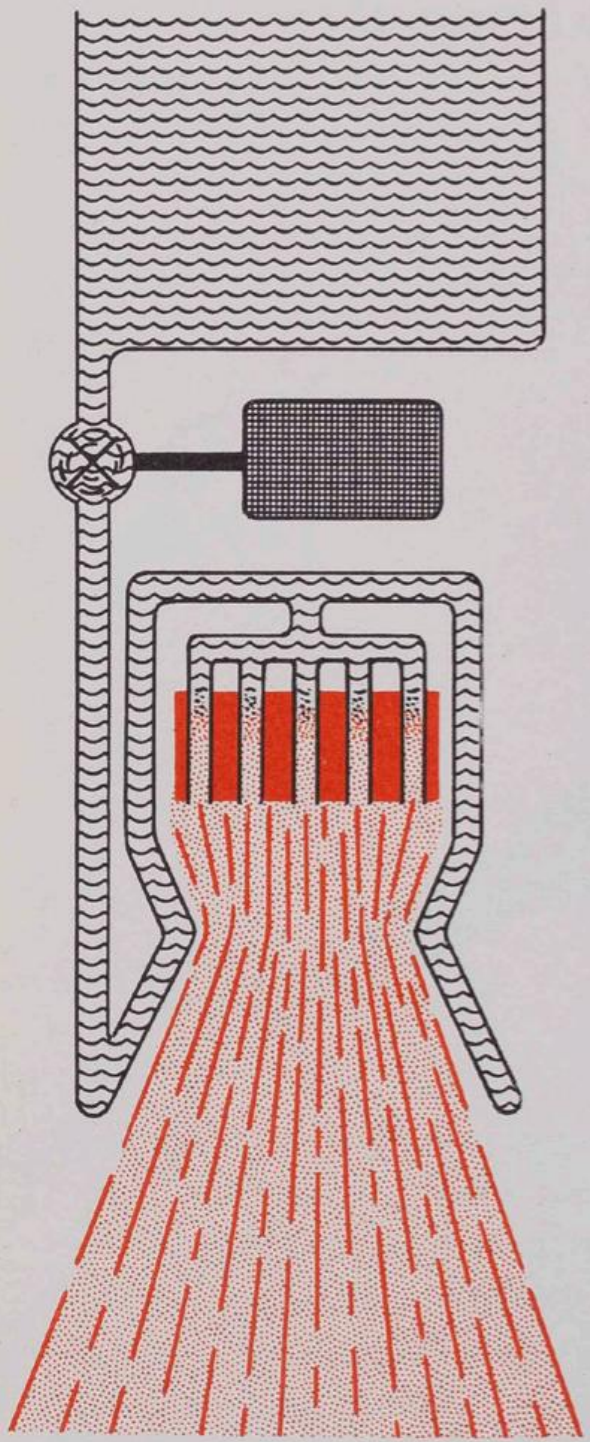
The liquids are forced into the chamber by a pump (shown black), at the right rate to keep the burning going long enough for the rocket to build up speed. The gases become so hot that the metal of the chamber might melt, so one of the cool liquids is made to circulate round it.



Firing the Fuel in the Third Rocket



Just as the second rocket reaches its highest point, an electric battery in the third and smallest one makes a spark. This sets light to a highly explosive solid fuel. Although this quickly burns out, it gives the rocket enough extra speed to take it far into space. All rocket fuels, liquid or solid, can burn without air around them, and thus can travel in space.



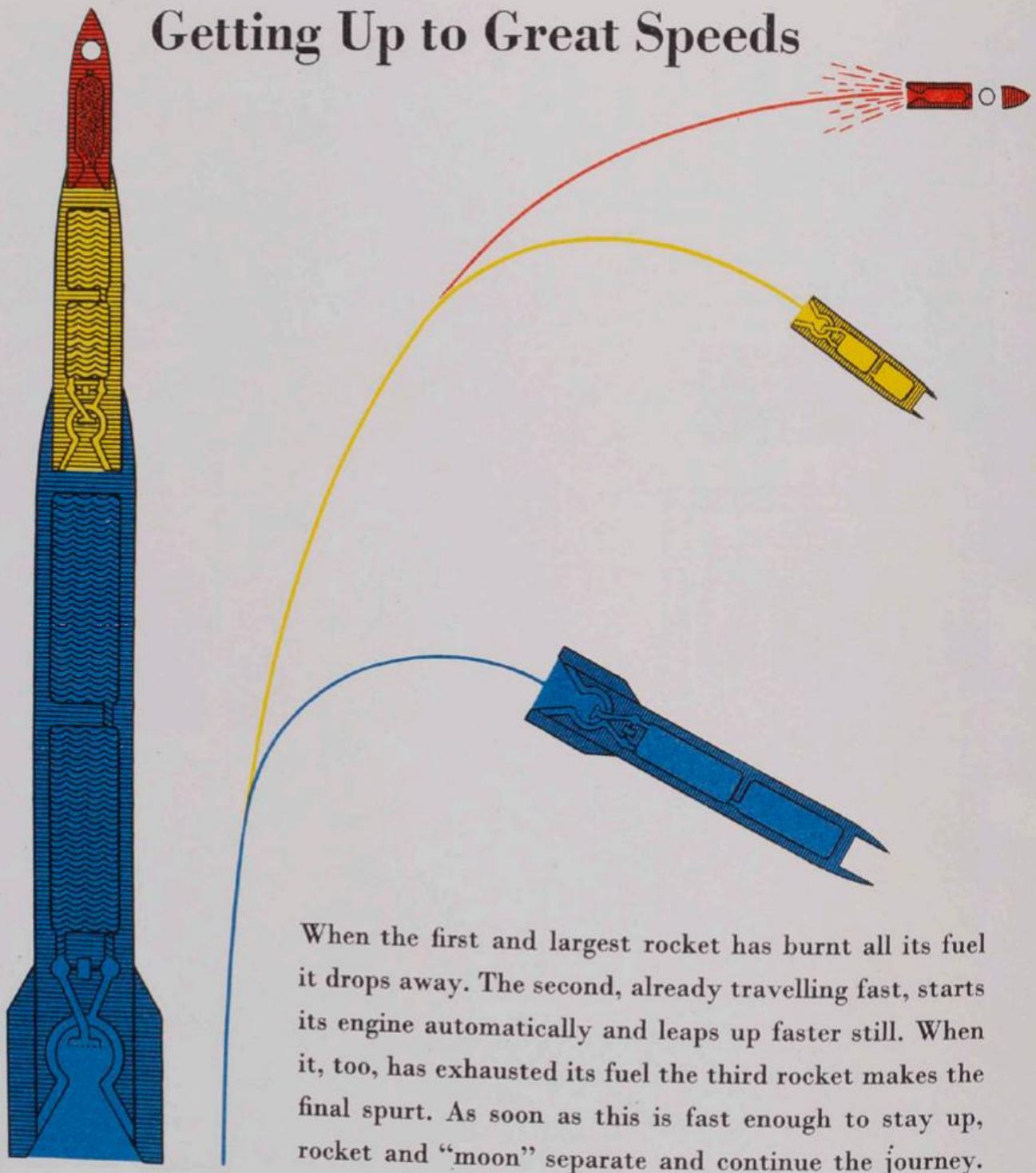
How We May Use the Atom's Power

Here is a rocket of the future, fitted with a reactor where atomic changes produce tremendous heat. This could turn liquids into large volumes of gas to thrust the rocket along.

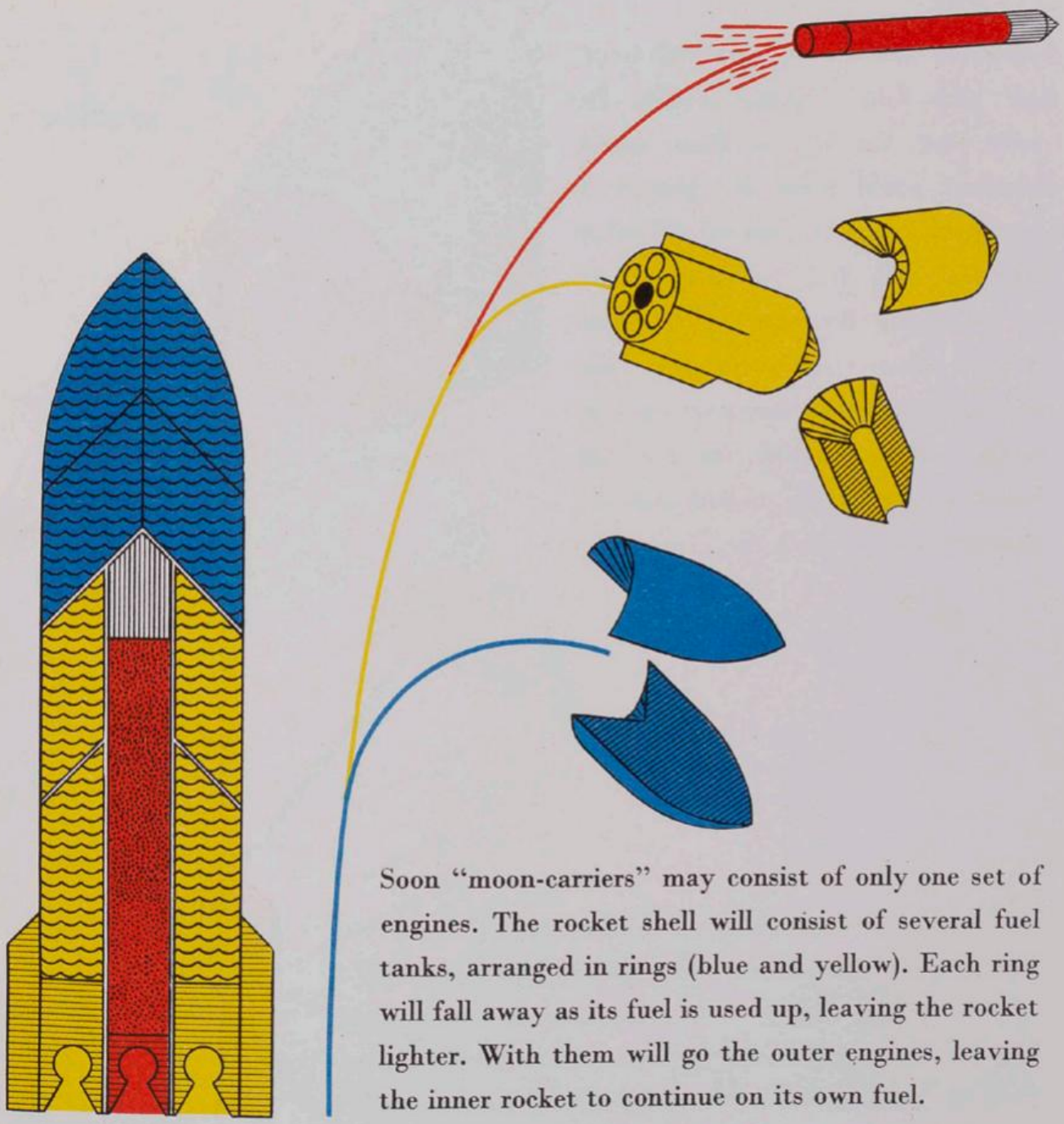


To fly far would need too much liquid, but a small weight of atomic fuel goes on producing great heat for a long time, so atomic rockets may some day be invented to fly millions of miles.

Getting Up to Great Speeds



When the first and largest rocket has burnt all its fuel it drops away. The second, already travelling fast, starts its engine automatically and leaps up faster still. When it, too, has exhausted its fuel the third rocket makes the final spurt. As soon as this is fast enough to stay up, rocket and "moon" separate and continue the journey.



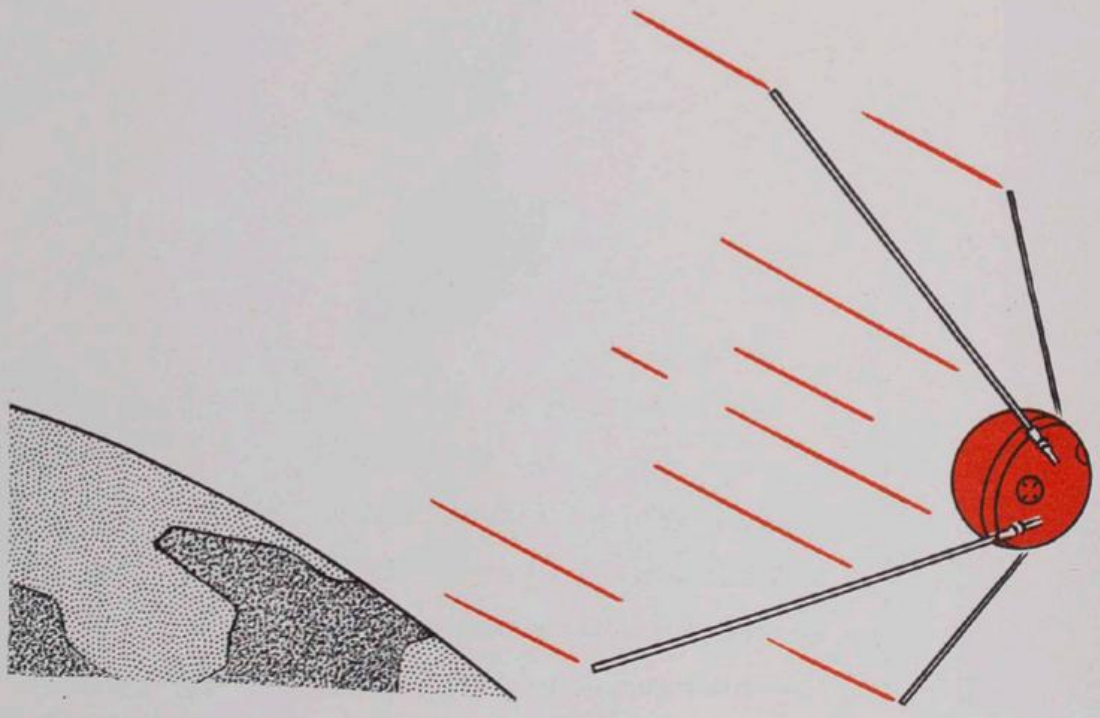
Soon "moon-carriers" may consist of only one set of engines. The rocket shell will consist of several fuel tanks, arranged in rings (blue and yellow). Each ring will fall away as its fuel is used up, leaving the rocket lighter. With them will go the outer engines, leaving the inner rocket to continue on its own fuel.

The First Man-Made Moons

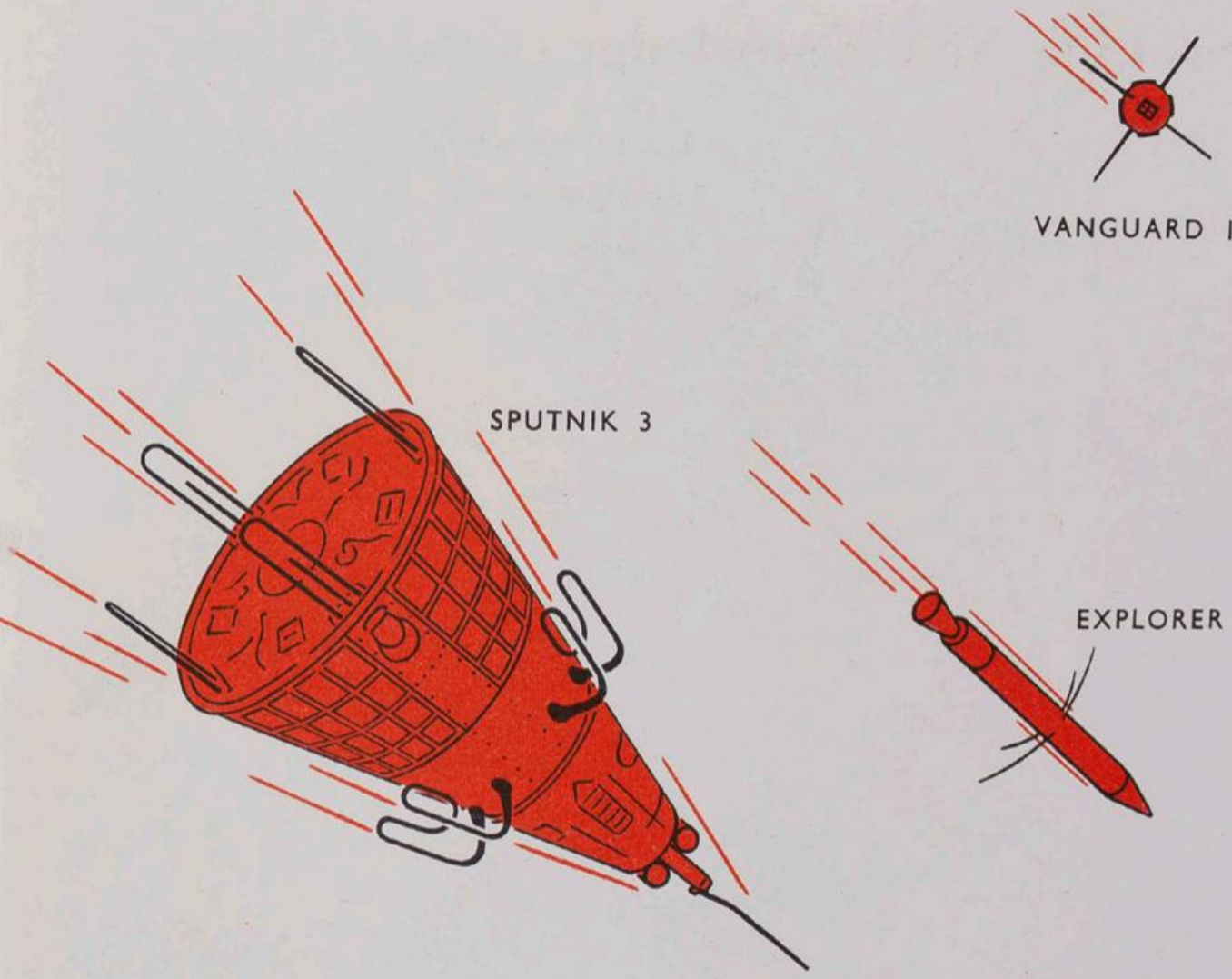
Sputnik 1 was a small polished metal ball with four rod-like aerials. Its radio sent out signals from which scientists could track it. Sputnik 2 was much bigger and travelled farther from the earth. It carried instruments for measuring the rays which travel through space, radio (in the ball) which sent the measurements back to earth, and a chamber for the dog Laika, whose journey proved that live creatures can survive the shock.



SPUTNIK 2

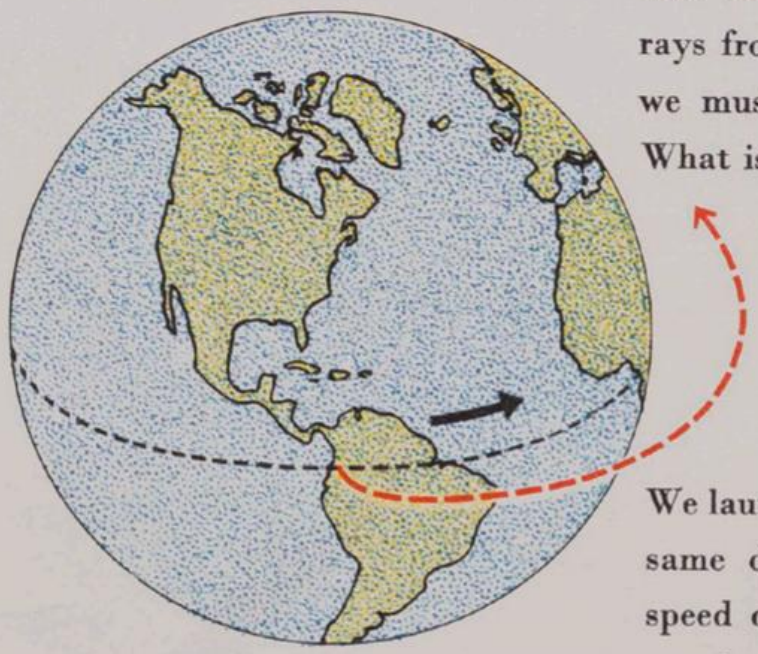


SPUTNIK 1



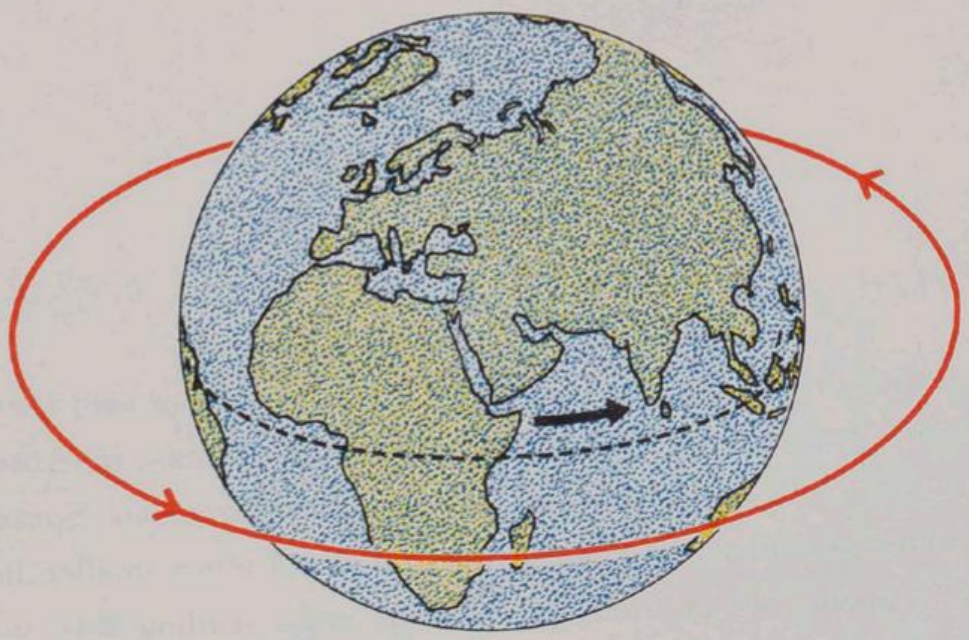
The next satellites to be sent up could signal back how hot or cold they were, in sun and shadow; how much dust was hitting them; how intense were the rays and particles in space and how strong was the earth's magnetism. Sputnik 3 was large, with many instruments, Explorer and Vanguard 1 much smaller, but packed with skilfully made tiny instruments. All had radio sending sets and aerials.

Seeking New Knowledge of the Stars



The earth's air-cover stops some of the rays from the stars. To study these rays, we must send a satellite above the air. What is the simplest way?

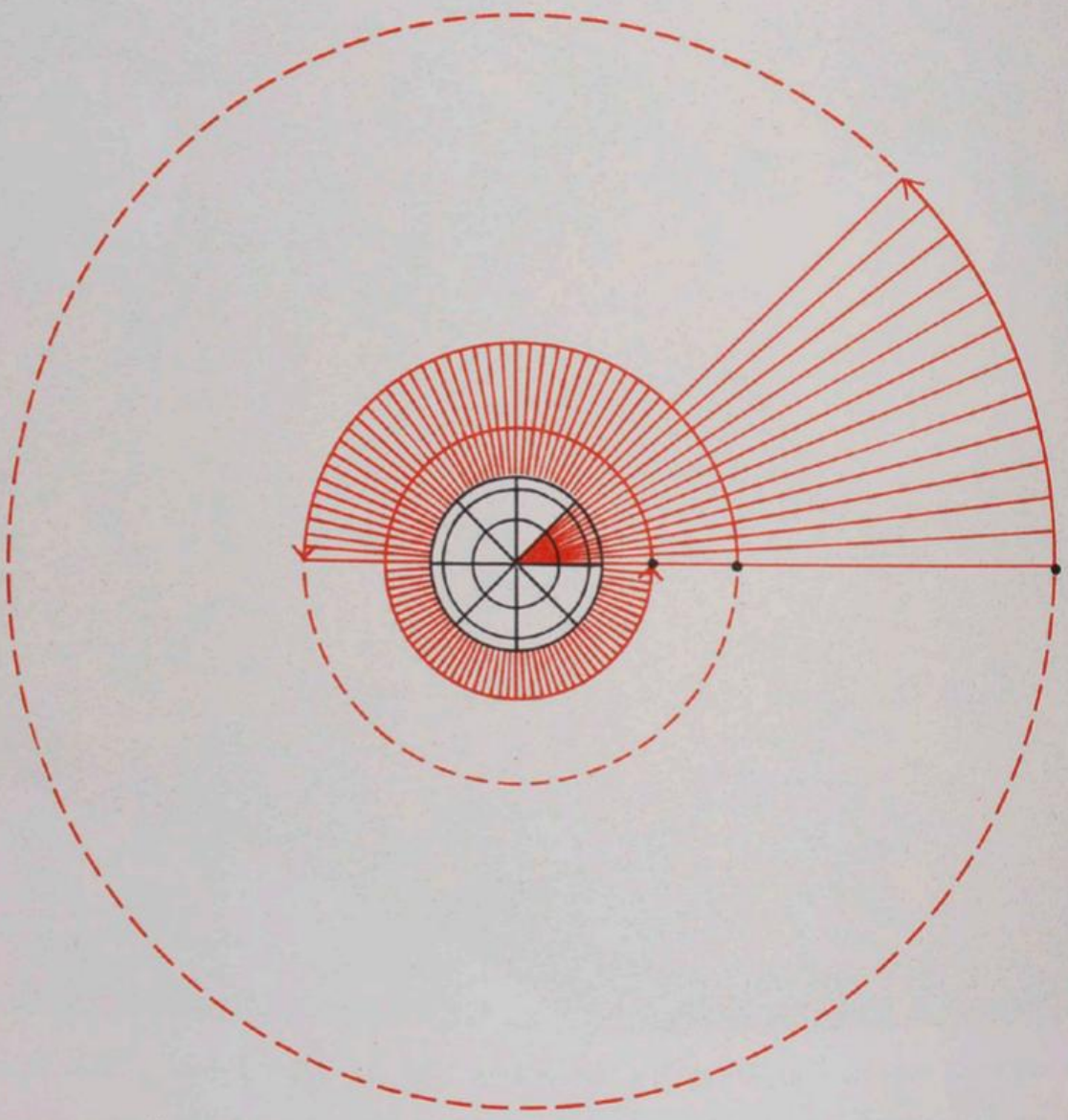
We launch it from near the equator, in the same direction as our earth spins. The speed of the turning earth added to the speed of the rocket helps to carry it up.





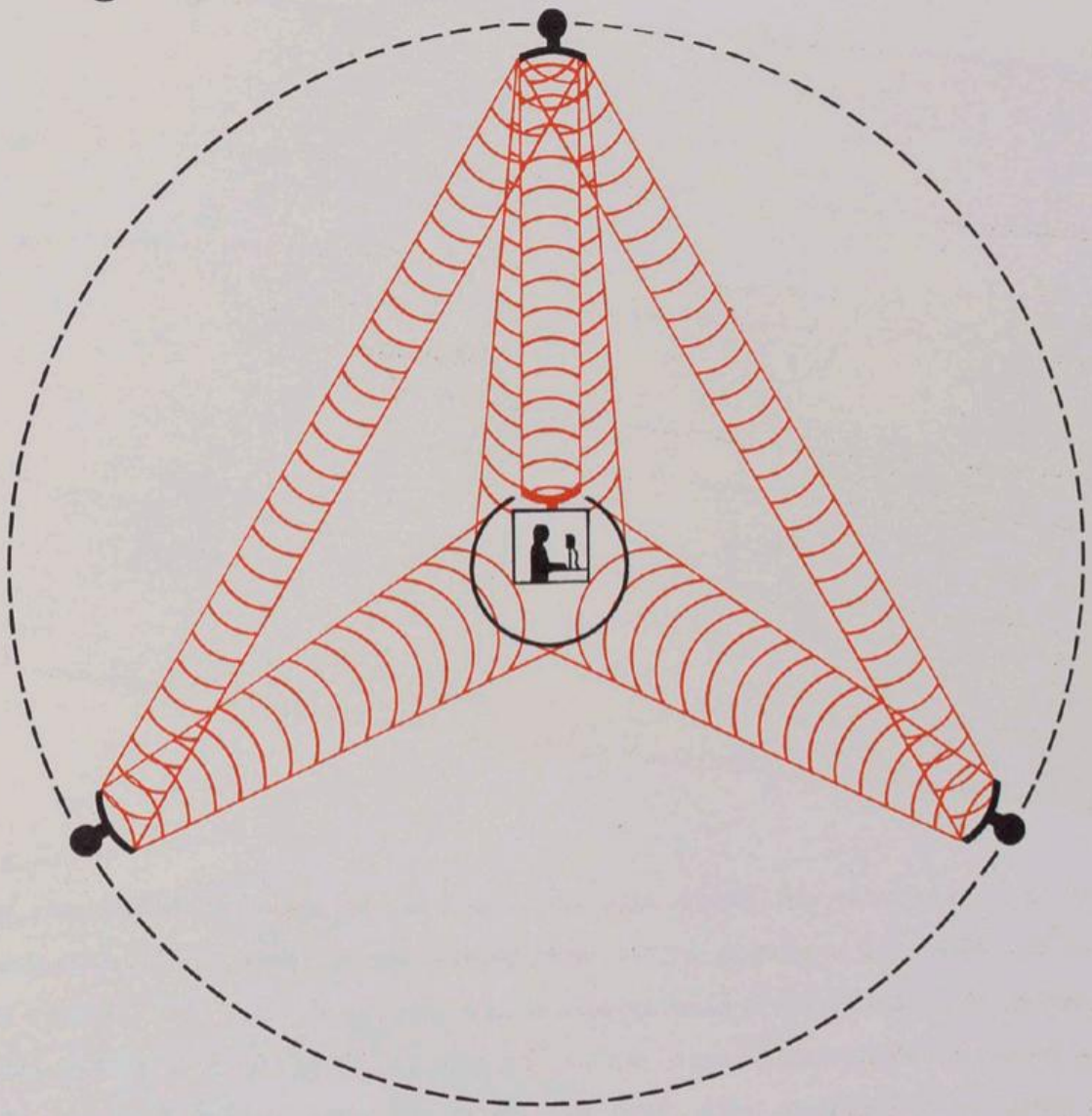
To someone outside the earth's air-cover, the sky would look black. It looks blue to us only because the air catches the blue rays in the sun's light. By studying the rays from the sun and the stars we can find out what they are made of, how hot they are, how they are born, grow and die. Especially those rays which are shorter than blue light can best be studied from above the air.

How Fast Must a "Moon" Travel?



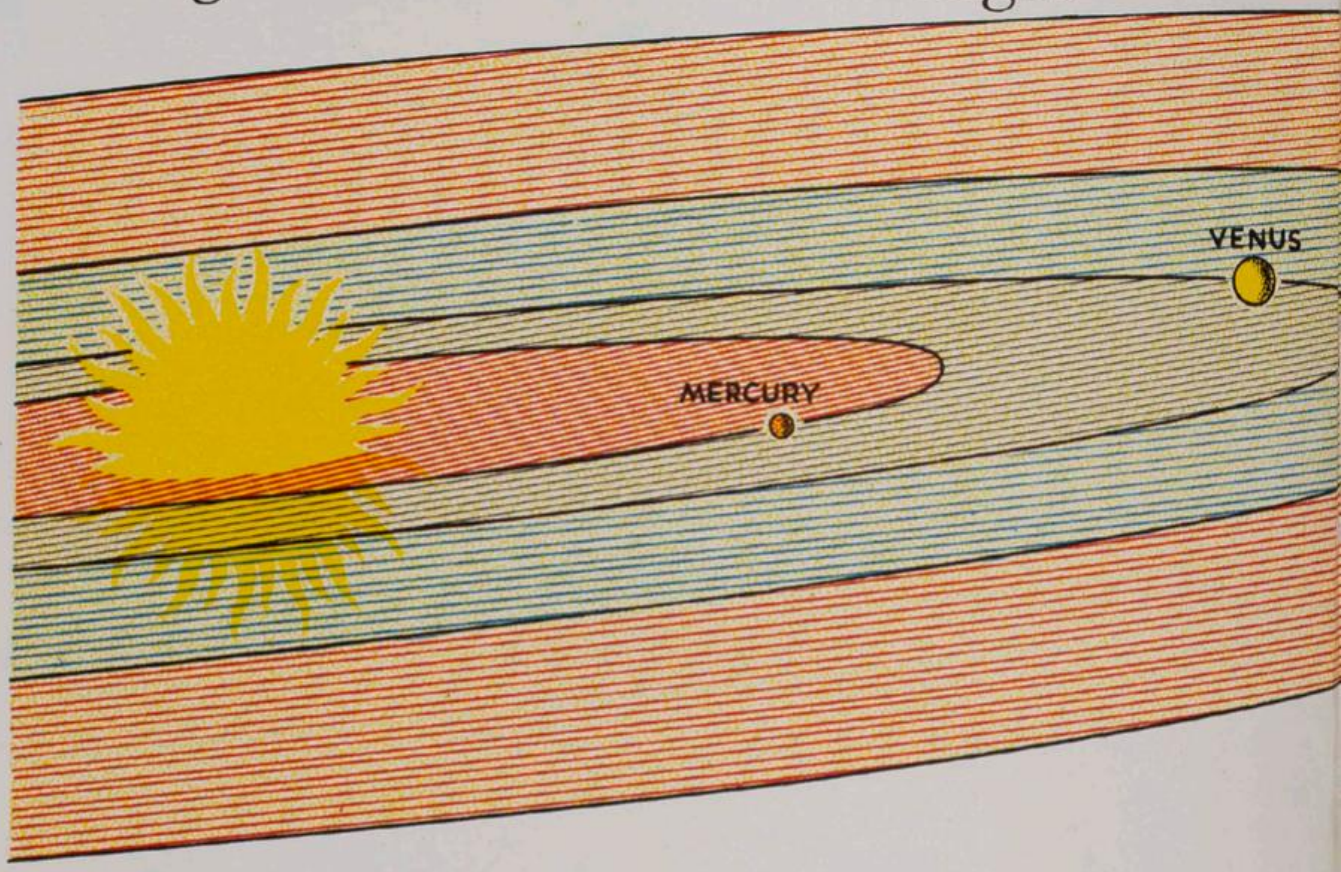
The nearer to the earth a satellite circles, the faster it must travel to stay up. If it is 2,000 miles up, it must travel over 12,000 miles per hour, circling the earth in three hours. If it is 6,000 miles up, it must go half round in three hours; if 22,000 miles up, one eighth round, or once round in 24 hours.

Seeing the Same TV Anywhere on Earth

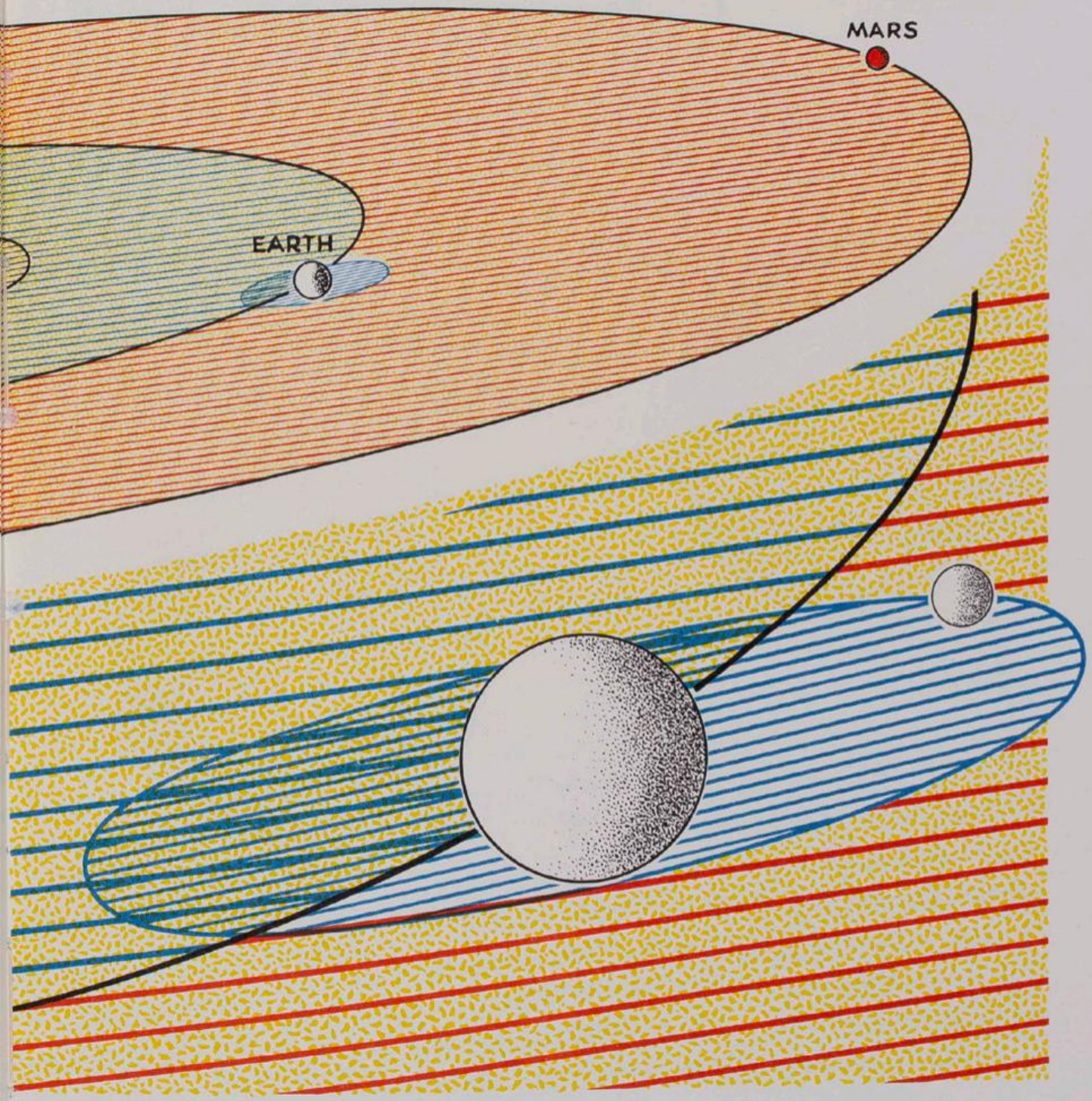


Our earth turns round once every 24 hours. So if a satellite like the last were above the equator and moved the same way, it would seem to us to stand still. With *three* like it, we could broadcast TV to one, which would reflect it to the others. The three together would reflect it back to all parts of the earth.

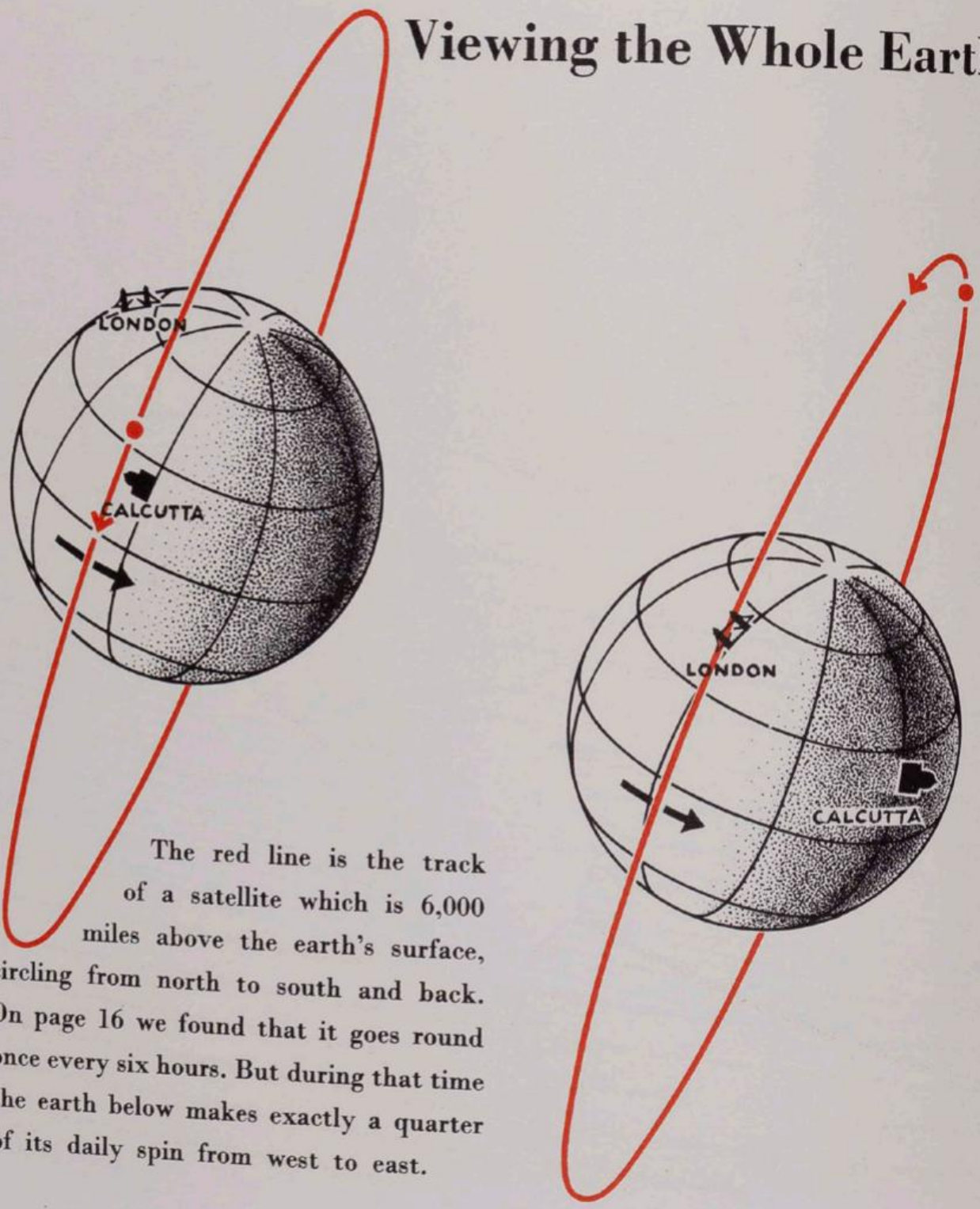
Aiming the "Moon" to Hit a Target



A satellite can circle the Earth any way we wish to make it. But if we want to hit the Moon, or a planet, or to circle round one of them, we must not only remember that the Earth is turning round and circling the Sun, but also we must know how the Moon and planets move. We can think of the Sun as the spindle of a giant record-player, with discs put on at different angles. The disc round the edge of which Mercury moves is tilted a different way from the one which marks the path of Venus. Earth and Mars both lie on yet another disc tilted at another angle. The path of the Moon round the Earth tilts another way still. Imagine the difficulty of aiming the rocket for a round trip to Venus!

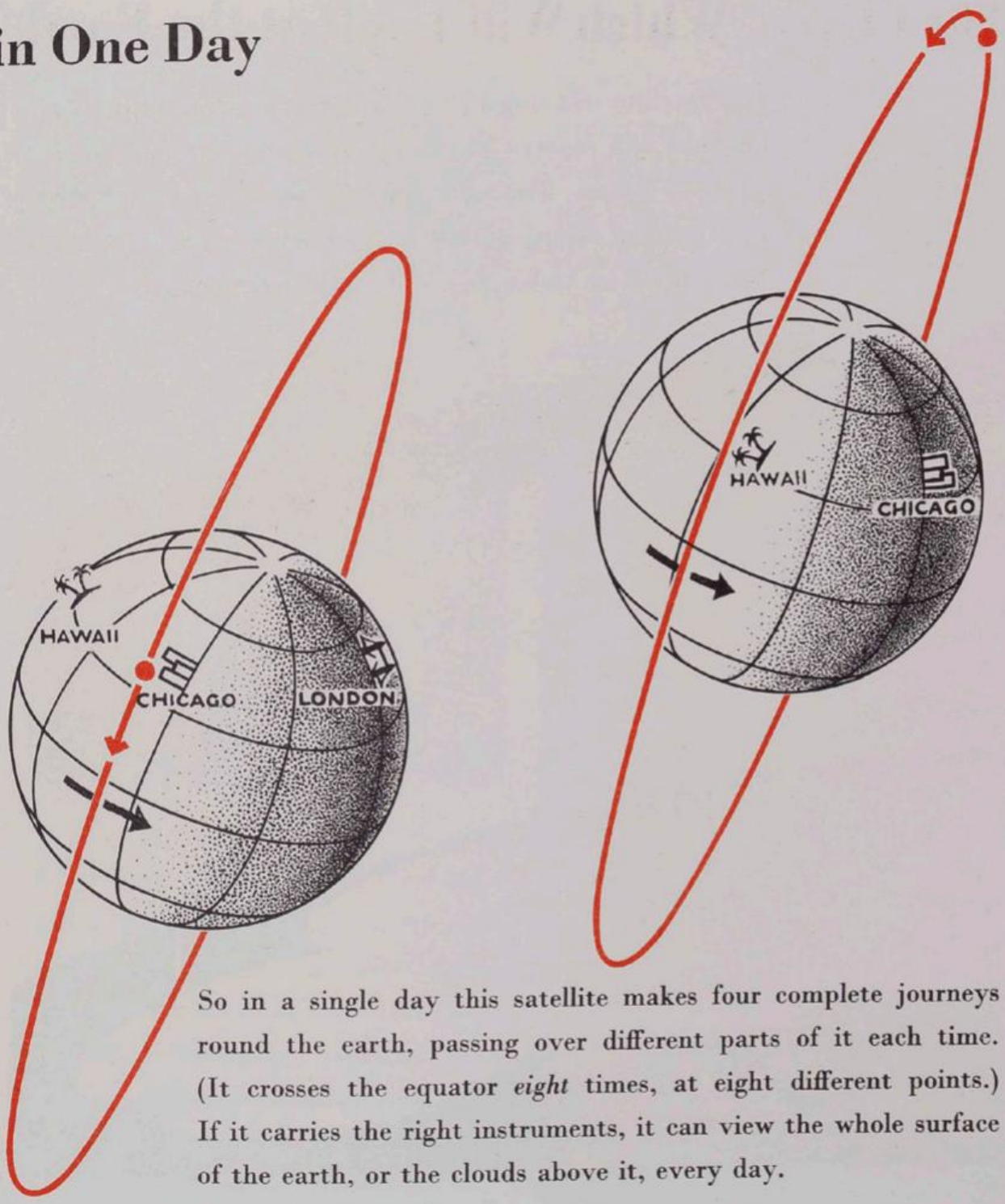

MARS
EARTH

Viewing the Whole Earth



The red line is the track of a satellite which is 6,000 miles above the earth's surface, circling from north to south and back. On page 16 we found that it goes round once every six hours. But during that time the earth below makes exactly a quarter of its daily spin from west to east.

in One Day

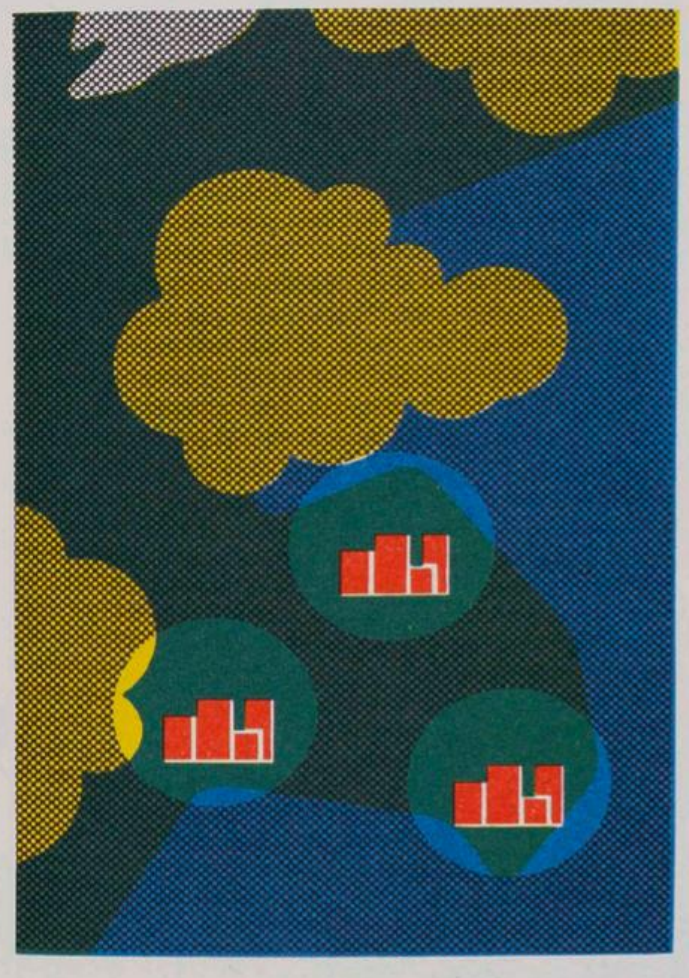


So in a single day this satellite makes four complete journeys round the earth, passing over different parts of it each time. (It crosses the equator *eight* times, at eight different points.) If it carries the right instruments, it can view the whole surface of the earth, or the clouds above it, every day.

The "Eyes" Which Will Look at the Earth

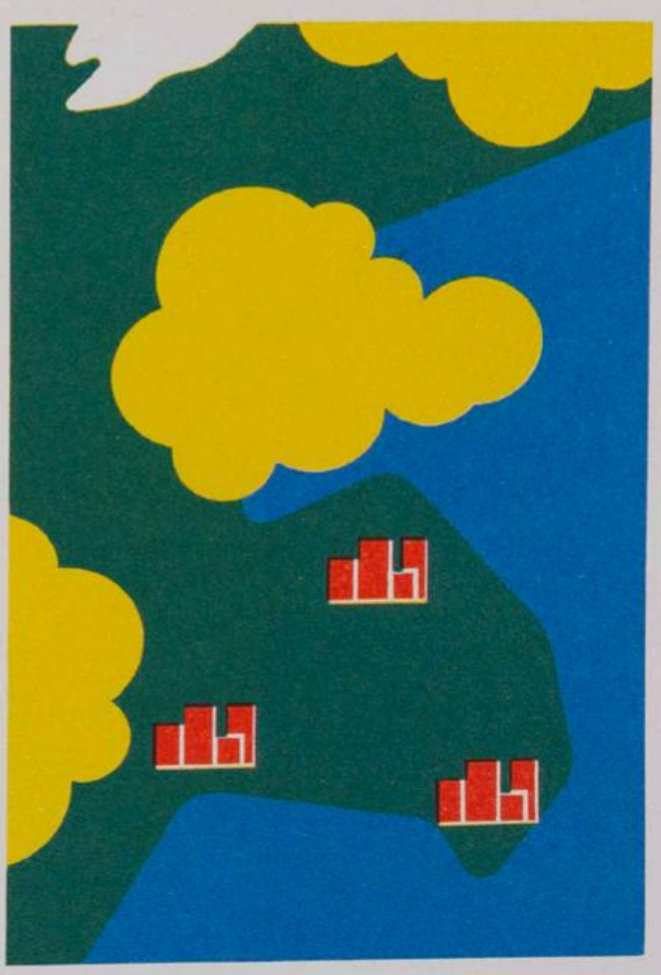


This satellite will spin round, so that its two window "eyes" together will receive heat rays from *all* the surface over which it passes. The rays will fall on electric cells, strong rays causing strong currents, weak rays weak ones. These will tell us, by radio, where the rays are strong.

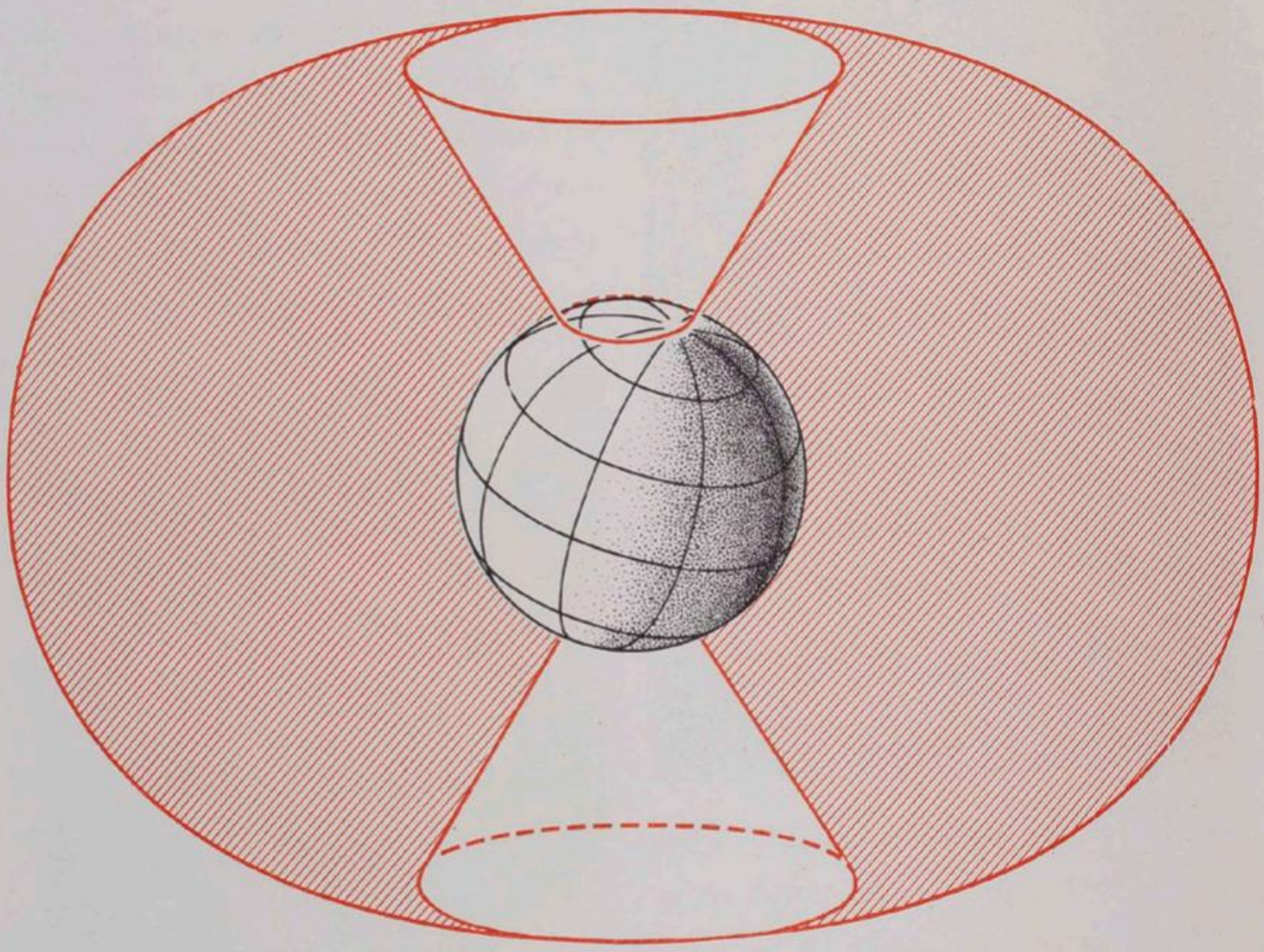


At present we only know fully what the weather is like near weather ships and weather stations (shown by clear circles above). So we can only be sure what the weather will be near these and for a short time ahead. If we knew conditions everywhere, we could forecast the weather anywhere, and for a longer time in advance.

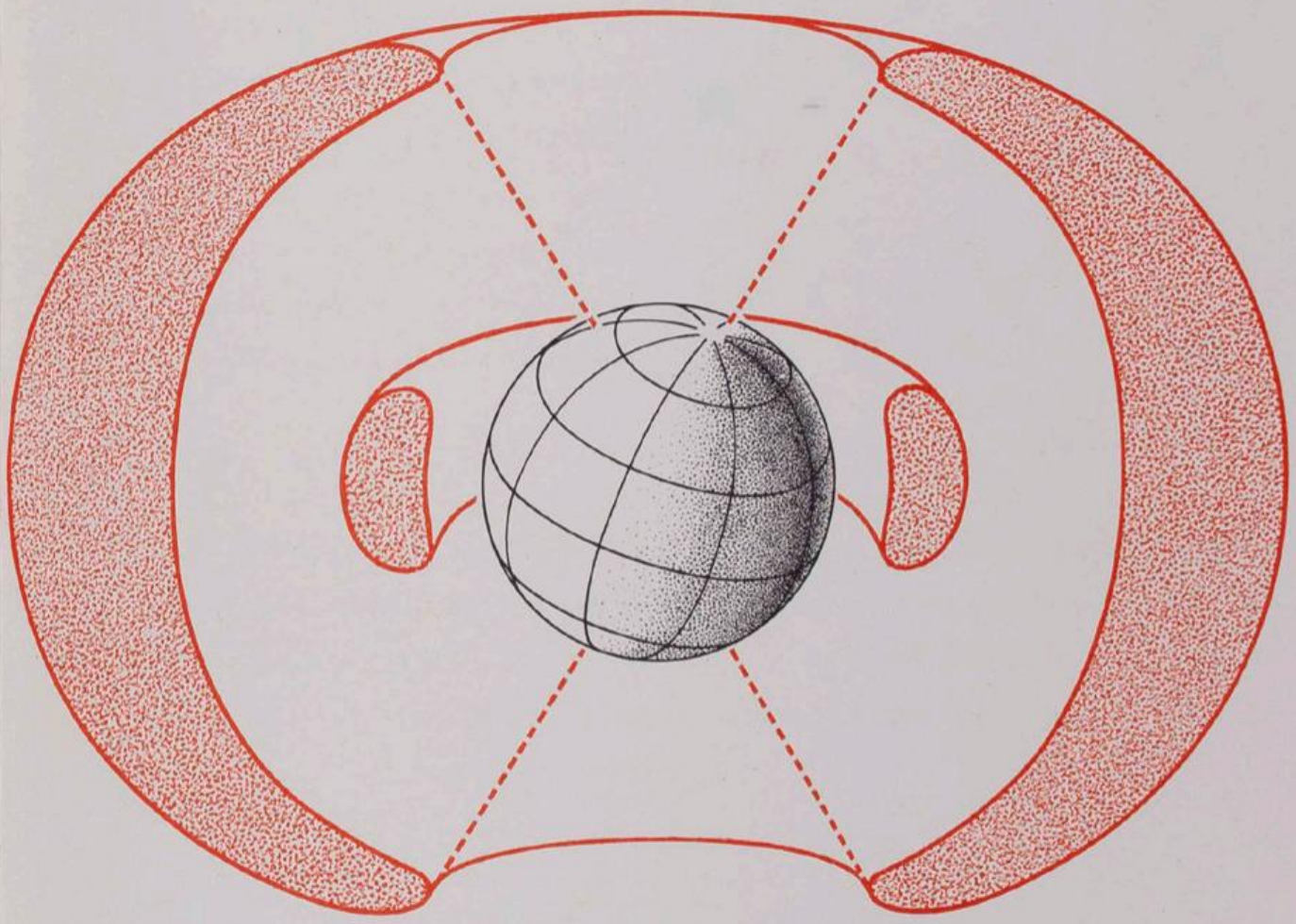
When the strips which the satellite "sees" are pieced together, they will form a map *every day* showing rays reflected from all over the earth. Experts will know that strongest rays mean snow, next strongest cloud, and weakest earth or sea. So they can watch the clouds and storms everywhere, and how they are moving from day to day.



The First Discovery the Satellites Made

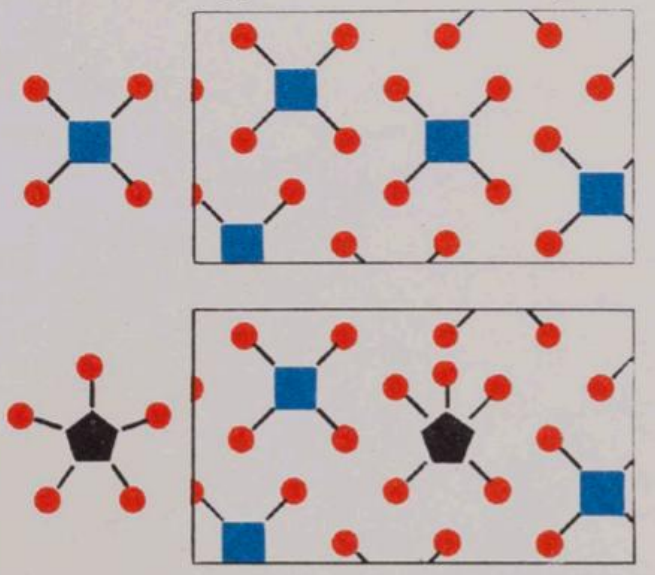


Around the north pole and the south pole there are often brilliant displays of light in the night sky, caused by showers of particles coming from the sun. For many years, scientists thought they were pulled mainly towards the poles (into the areas shown as white cones) by the earth's magnetism. What happened to the particles elsewhere (in the shaded areas) was not known.



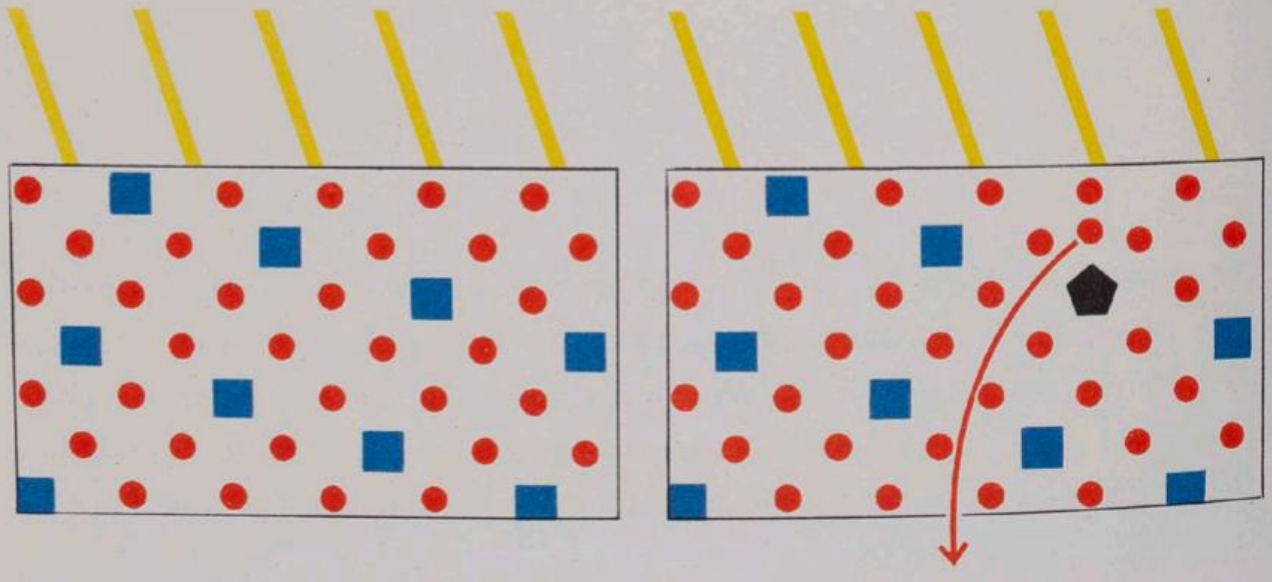
The signals sent back by the satellites now make us think that the earth's magnetism collects the particles into two belts, going all round except at the poles. Within these belts the particles fly from end to end at great speed. They will be dangerous to spacemen passing through. If particles crowd into the belts, some may overspill towards the poles, causing the lights in the sky.

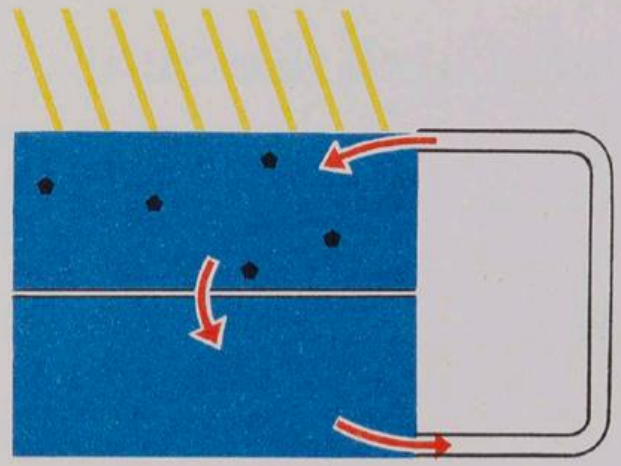
Making Electricity from the Sun



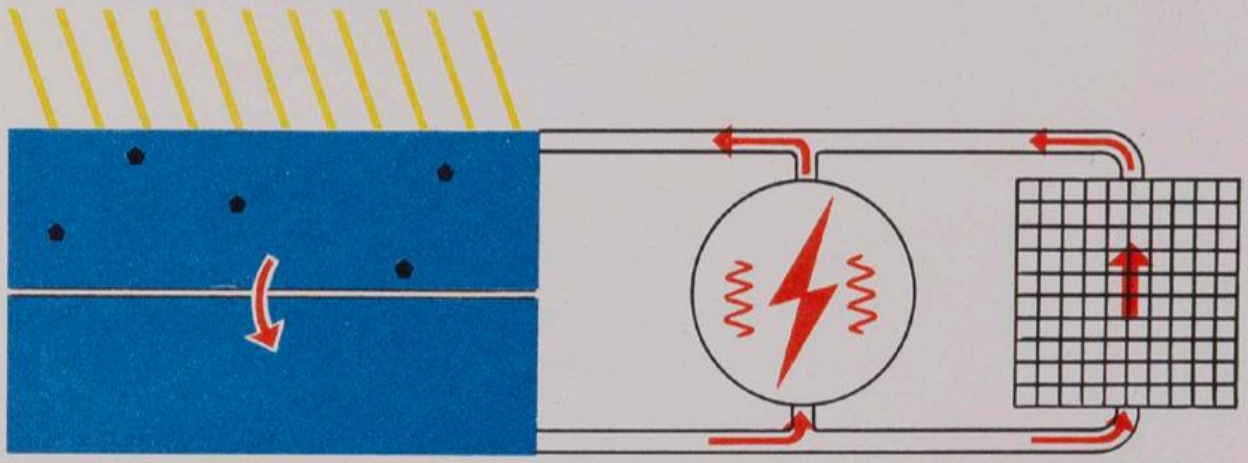
In a crystal of pure silicon the electrons are arranged in a regular pattern, four outer electrons to each atom. But if the crystal contains small quantities of an impurity with five electrons, a few atoms will be different from the pattern.

When sunlight strikes a crystal of pure silicon some electrons are knocked out of place. But they simply change places with electrons from other atoms. In an impure crystal, extra electrons are moving about, but the extra spaces are not so easy to find. Some reach the edge of the crystal before they can settle again.

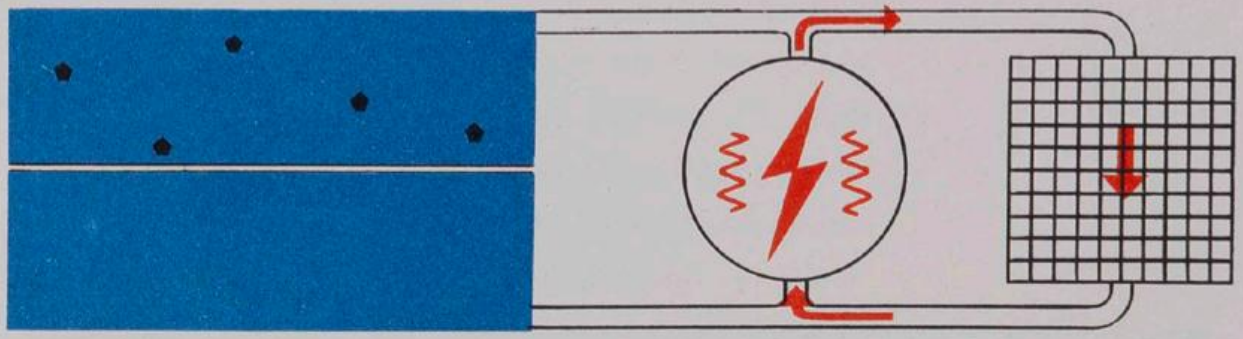




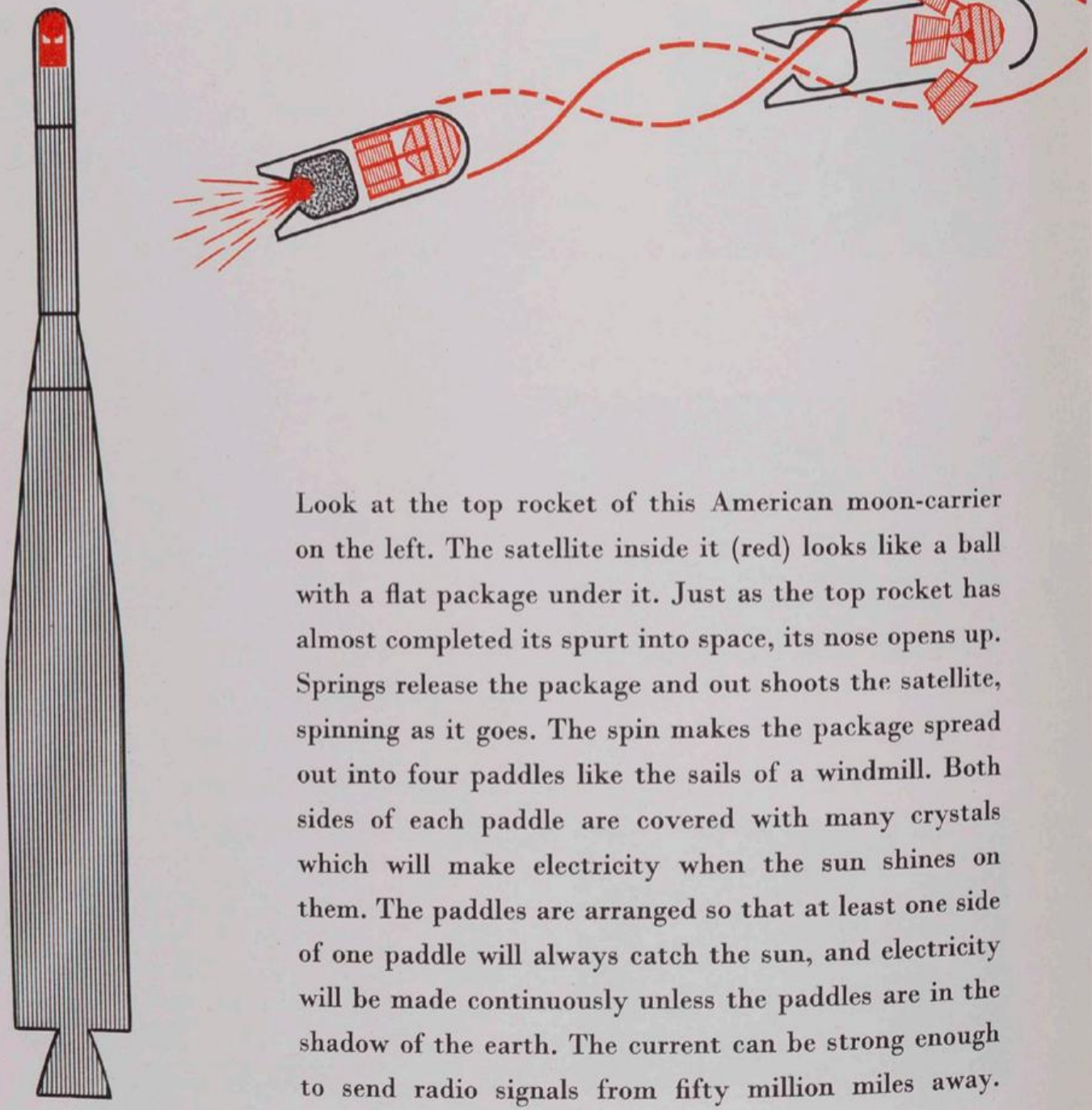
If a barrier at the edge of the crystal lets these electrons through *but will not let them back*, a pure silicon crystal beyond the barrier collects extra electrons. These will flow through a wire connecting the two crystals, making an electric current.



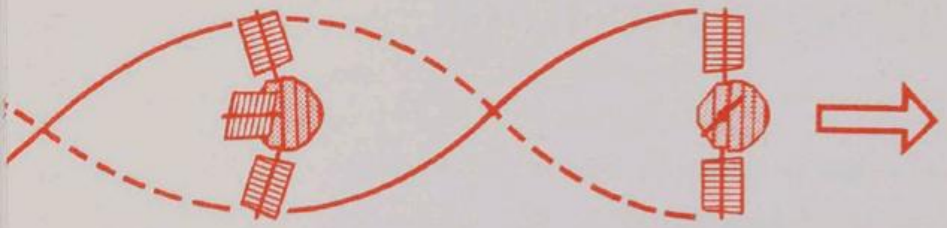
While the sun shines, many crystals arranged in this way will make a current strong enough to send radio signals and also to charge a battery. In darkness, when the crystals make no current, the battery will keep the signals going.

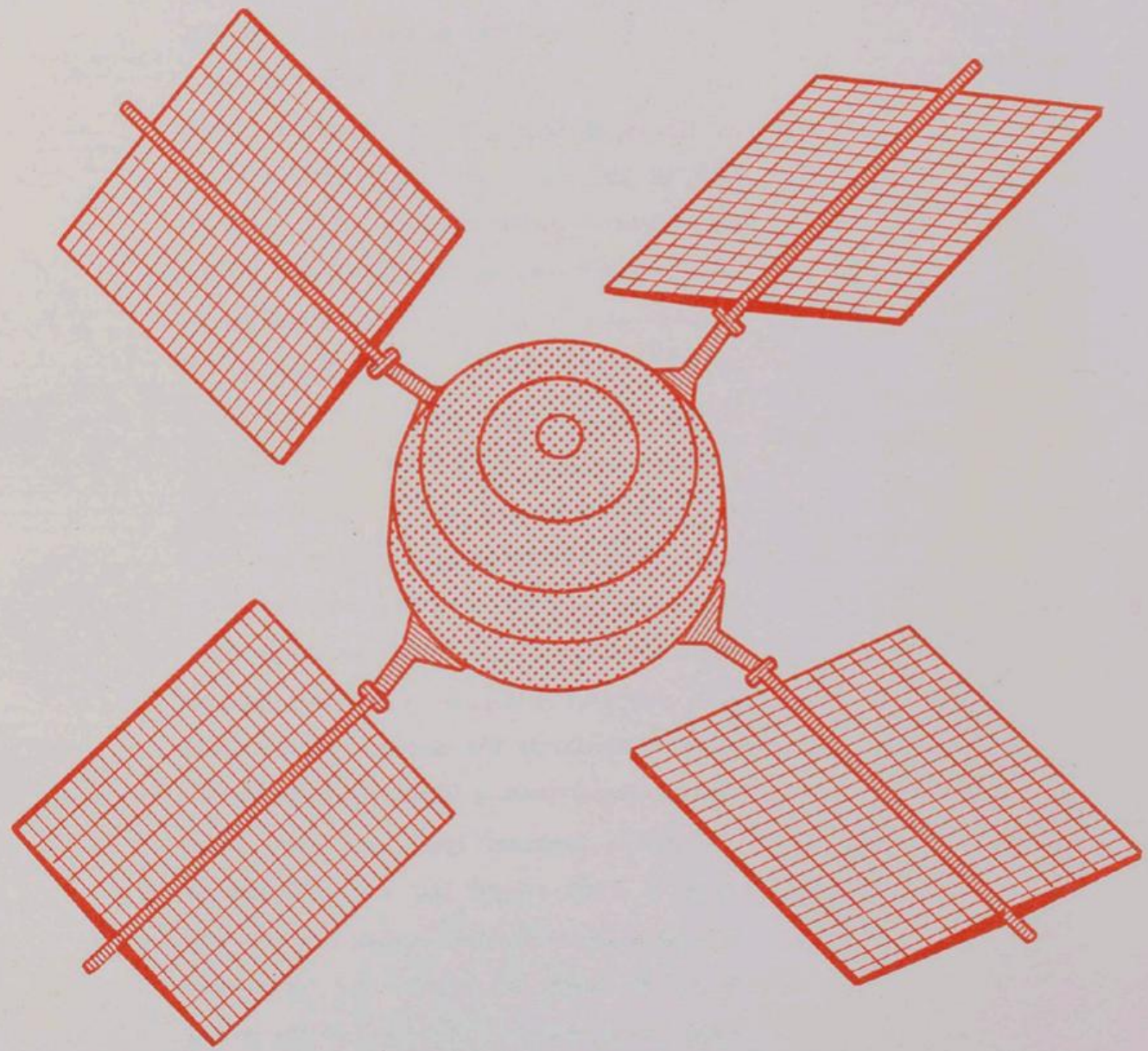


Spinning Paddles Which Catch the Sun



Look at the top rocket of this American moon-carrier on the left. The satellite inside it (red) looks like a ball with a flat package under it. Just as the top rocket has almost completed its spurt into space, its nose opens up. Springs release the package and out shoots the satellite, spinning as it goes. The spin makes the package spread out into four paddles like the sails of a windmill. Both sides of each paddle are covered with many crystals which will make electricity when the sun shines on them. The paddles are arranged so that at least one side of one paddle will always catch the sun, and electricity will be made continuously unless the paddles are in the shadow of the earth. The current can be strong enough to send radio signals from fifty million miles away.





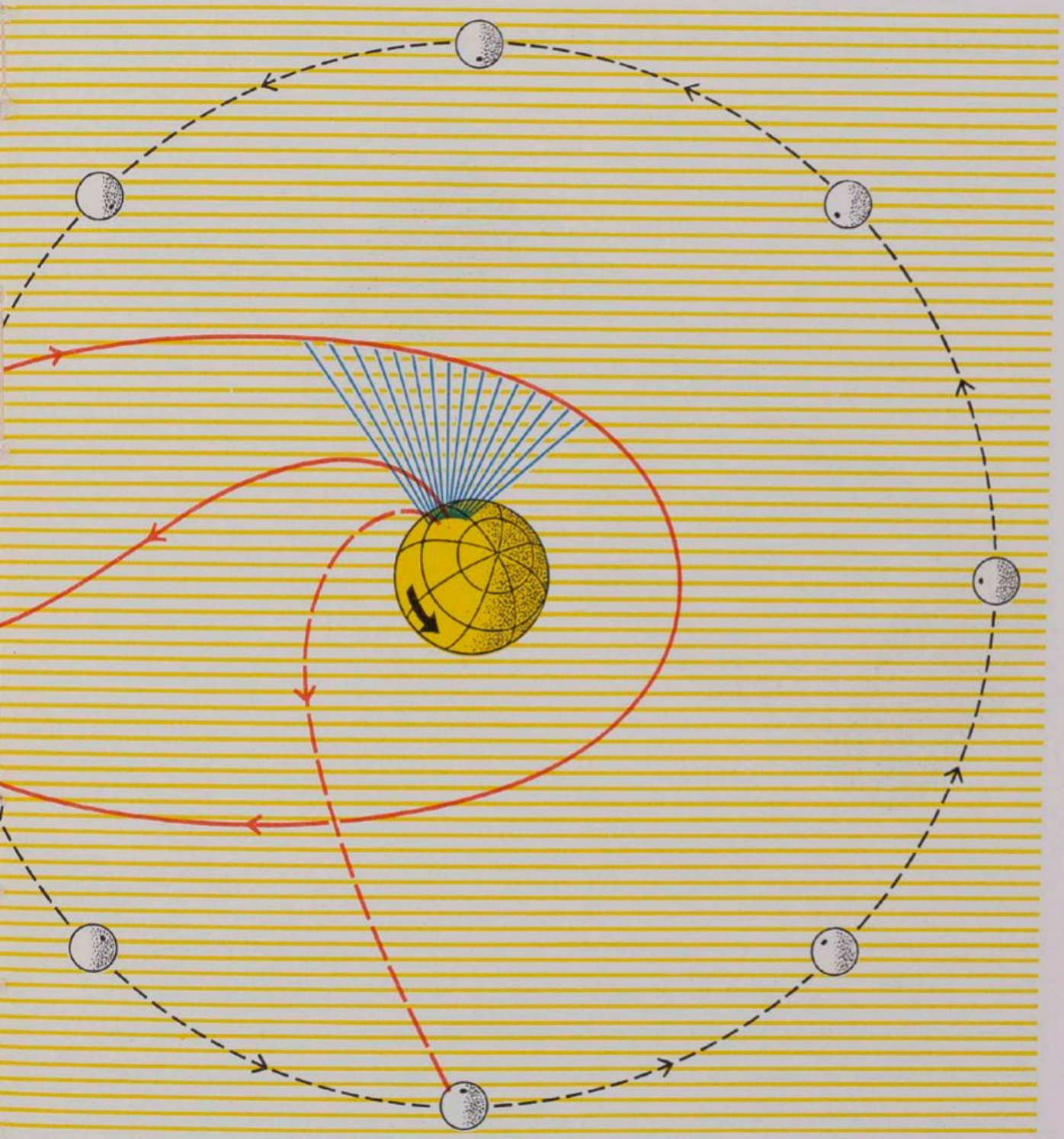
Hitting and Rounding the Moon

The earth is spinning like a top and the moon is circling round it. The moon will move round while a rocket is flying towards it. So only if the rocket is fired at the right moment, at the right speed and in the right direction will it cross the moon's path so that they collide. The rocket's path (dotted line) is curved.

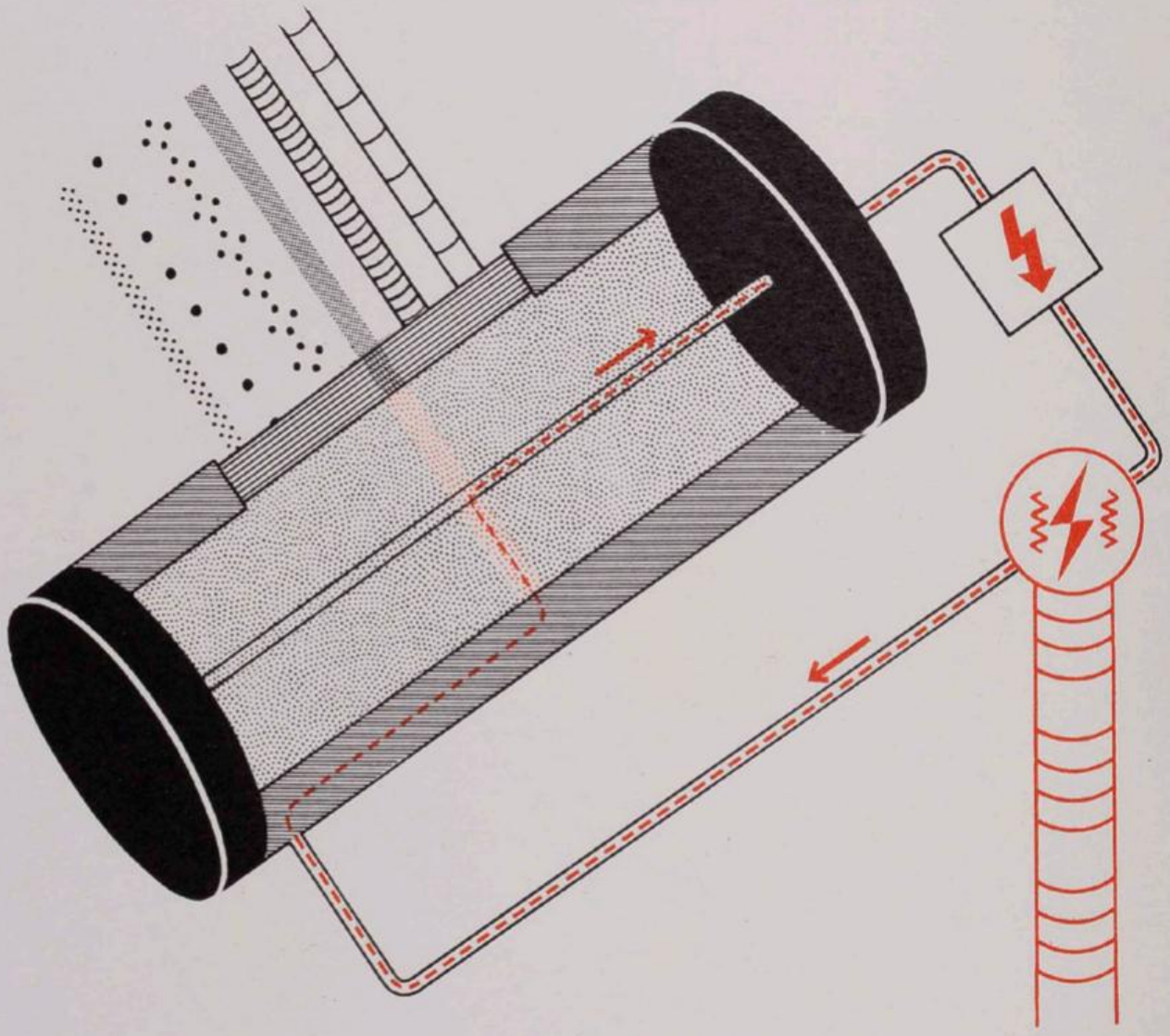
To send a rocket flying round the moon is still more difficult; for it must be flying just fast enough to pass and come back round the earth. The third Russian moon-rocket passed only a few thousand miles from the moon, and just at the time when the back of the moon was lit up by the sun. At a signal from the earth, gas-jets stopped Lunik's spin, its cameras pointed towards the moon, opened their shutters and took a film of the surface.

Lunik's journey (full red line) then took it back round the earth. When it was nearest, at another signal, the film was televised back to earth—the first view man has ever had of the back of the moon.



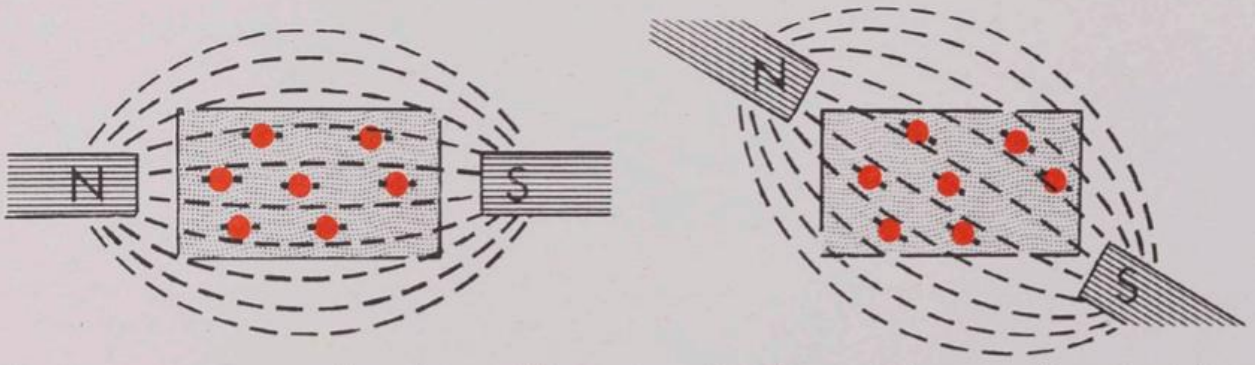


Measuring the Swift Rays of Space

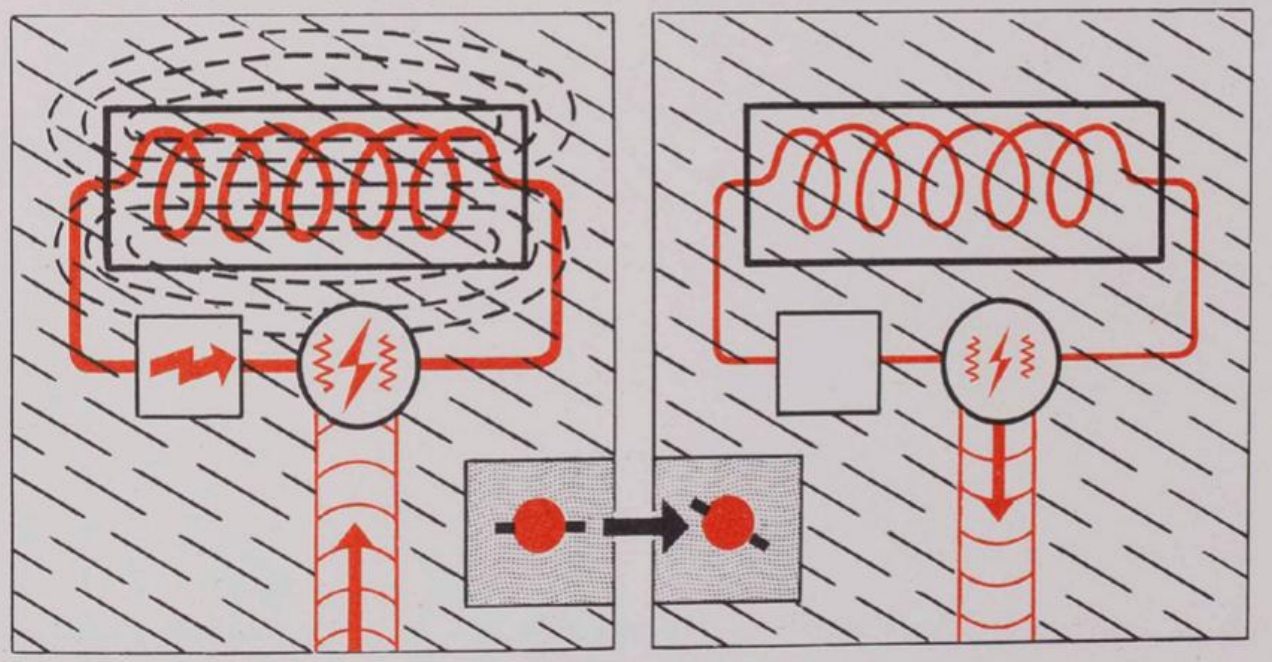


Rays of various kinds, waves and particles, fly swiftly through space. To measure them, satellites carry tubes with windows which let only one kind in. When a ray strikes through, it knocks electrons out of the atoms of a thin gas in the tube. The electrons make a bridge between wires from a battery. A current flows ; its strength, signalled to earth, tells us the strength of the ray.

The Earth's Magnetic Pull in Space

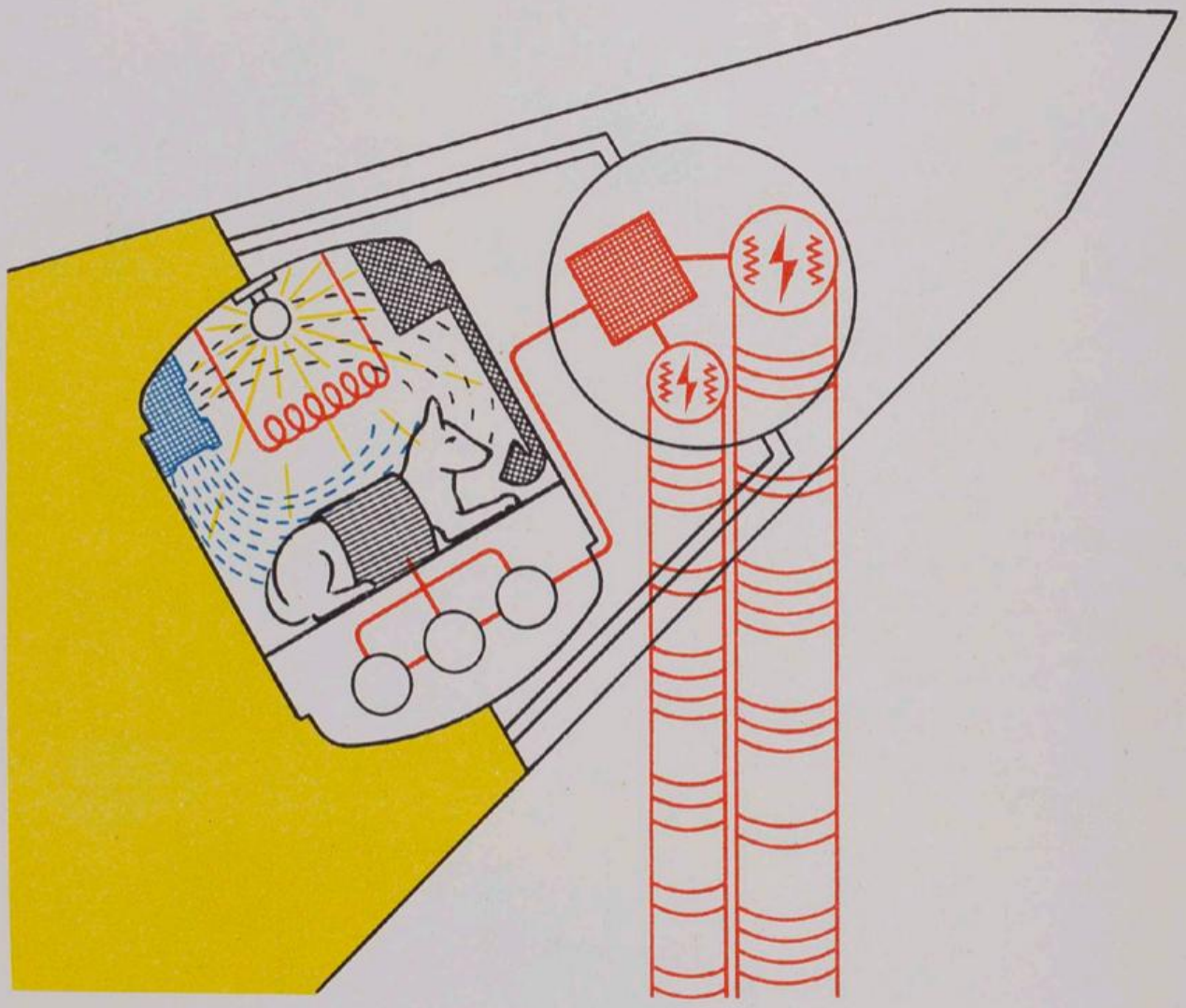


How can we measure how far, and how strongly, the earth's magnetism stretches into space? If we put water between the poles of a magnet, the cores of atoms in it line up like tiny magnets. If we turn the poles, the cores turn.

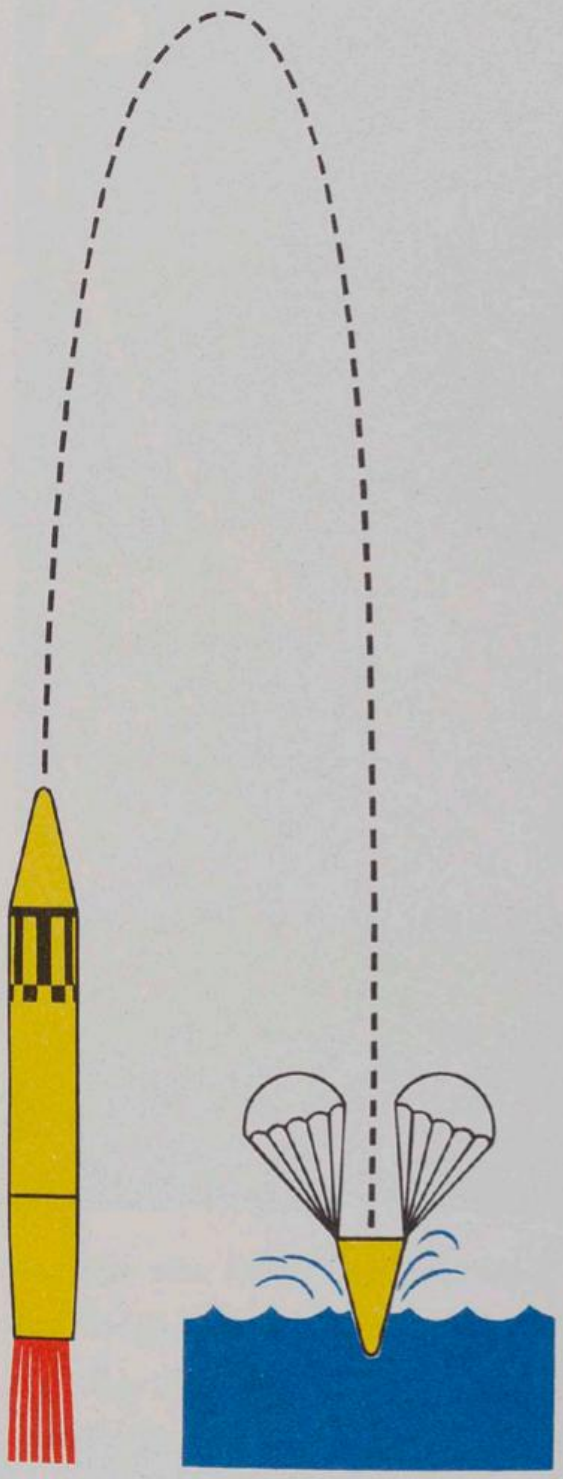


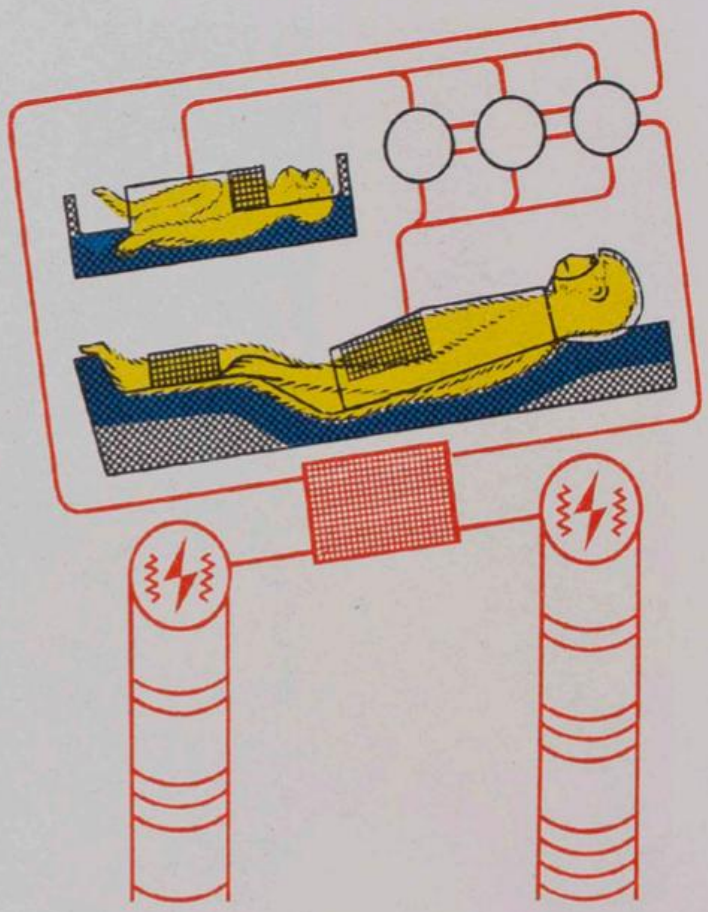
A signal to the satellite starts a current through a coil in water. This lines up the atom cores along the coil. When the current stops, the cores turn to the earth's magnetism. As they turn, they make a weak current in the coil; its strength, signalled to the earth, tells us the strength of the earth's magnetism.

The First Living Space Travellers



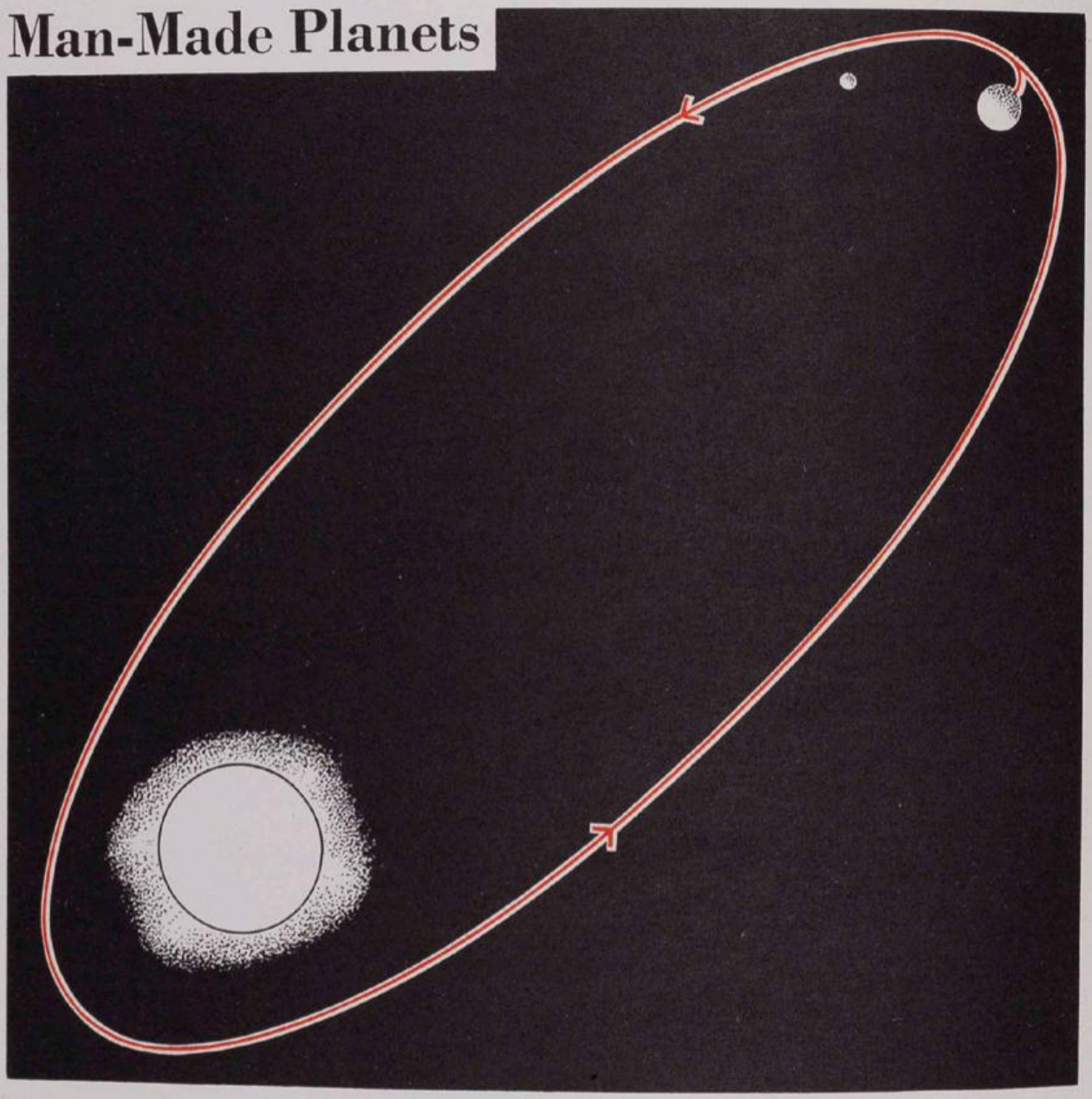
How would space travel affect men's health? To help find out, Sputnik 2 carried a live dog. Special instruments read its pulse, breathing rate and blood-pressure, and all the readings were radioed to earth. The dog lived in an air-conditioned chamber and an automatic machine gave it food and water at regular times. The dog was strapped down to avoid injuries while the carrier-rocket soared up.





Laika, in Sputnik 2, circled the earth many times but was never brought back. Later, American scientists sent two monkeys into space in the nose of a rocket. It was made to go up and then drop them into the sea on parachutes. Both monkeys were safe. First the instruments fixed to their bodies to take readings were removed, then they had a thorough medical examination.

Man-Made Planets



How strongly another heavenly body pulls a rocket depends on its own size and on how far away the rocket is. Once a rocket escapes the pull of the Earth, the small Moon pulls it only weakly. If it moves fast enough it escapes that pull too. Then, held by the giant Sun, it may circle round it. It is a man-made planet.

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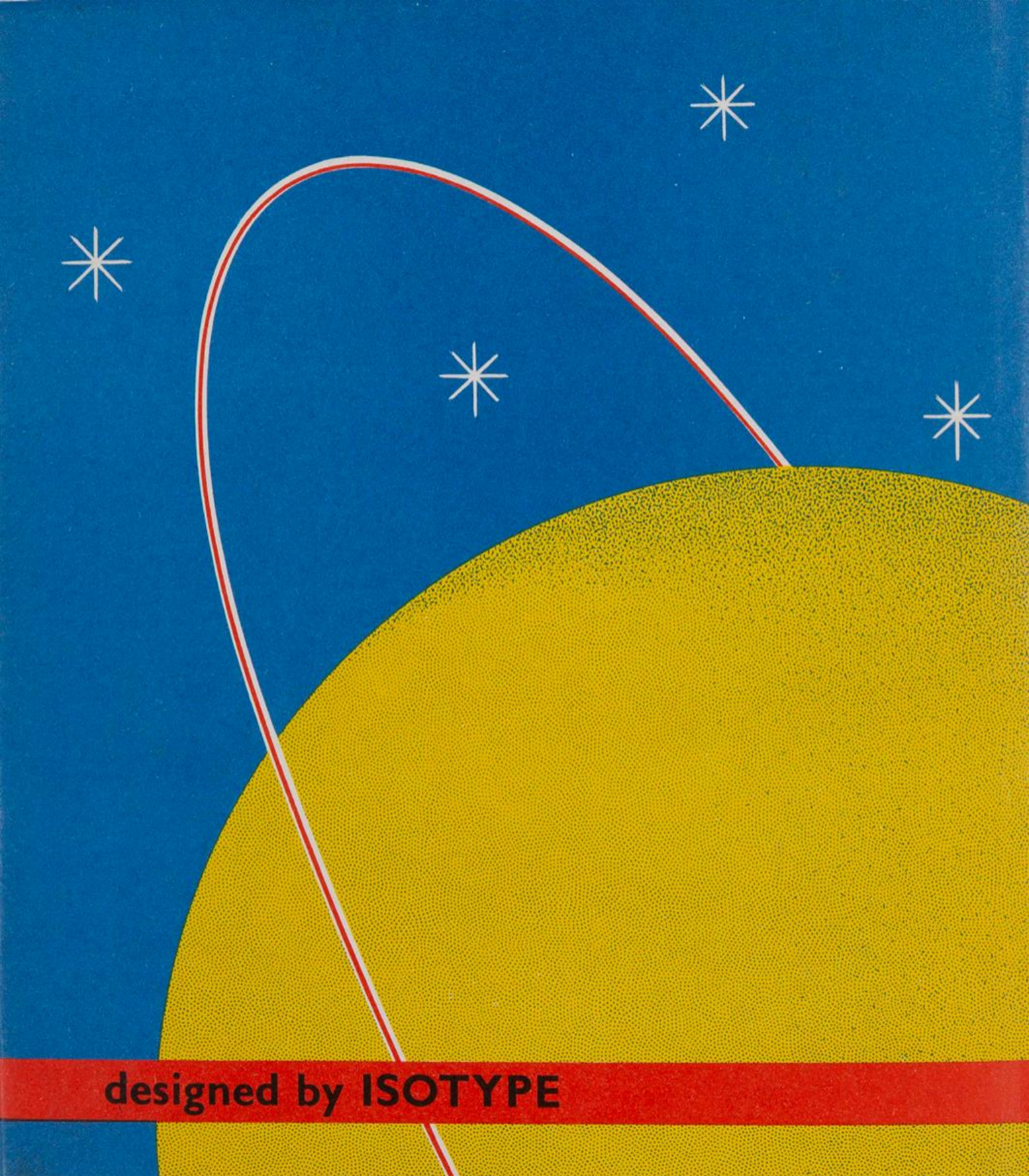
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