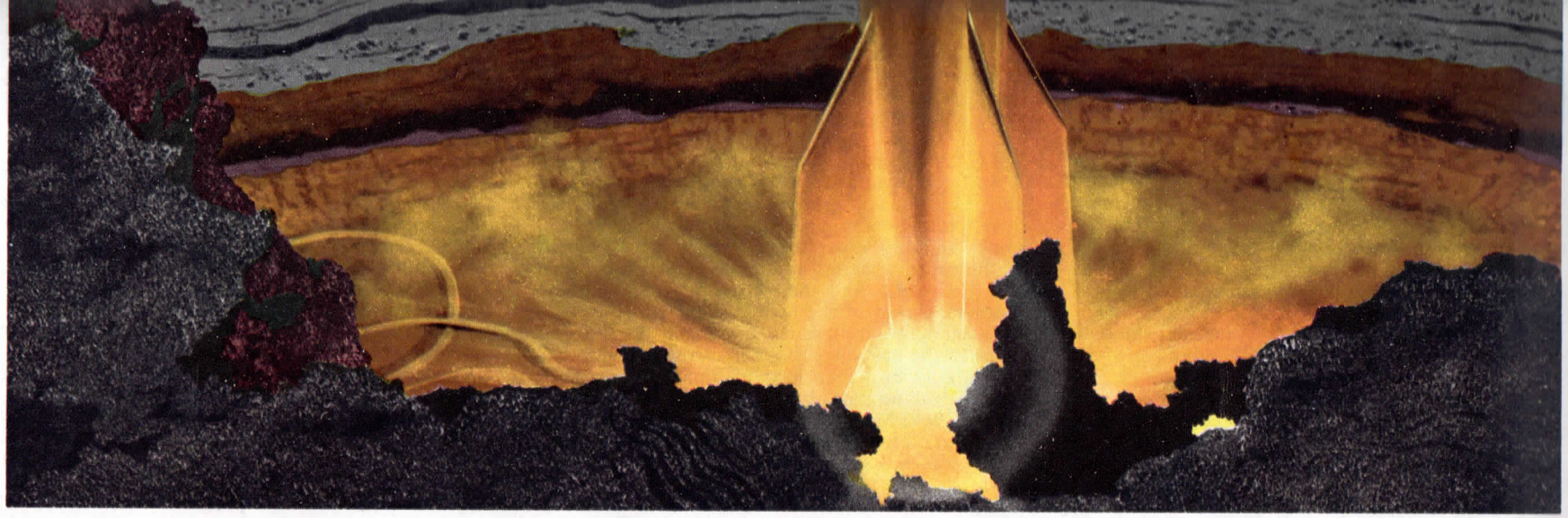

The rocket base on the moon as it might appear at the time of the attack on New York City. The rocket in the foreground is just starting its leap through space. Following the vertical take-off it will be guided toward the target by an automatic pilot. Within our stratosphere, controls operated on the earth will take over

Rocket Blitz From The Moon

By ROBERT S. RICHARDSON

When the interstellar rocket comes of age someone will fly to the moon. Who will be first? Will the return trip be an attack on the United States? A scientist describes how possible that may be

THE idea that someday we will find a way to bridge the gulf between the earth and the planets has fascinated men for centuries. The moon in particular, since it is much the nearest, has been the object of innumerable fictional expeditions into space. Most of them have been incredible romances but a few have that semblance to scientific basis in fact.

Of all the contrivances devised for leaving the surface of the earth there is only one that holds real promise for space flight—the rocket. The balloon and airplane must depend upon the atmos-

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The beginning of the end for New York. One rocket has exploded between the Empire State Building and the Battery, another in Queens. Others, launched earlier, may have missed. The slightest error by attackers on the moon would cause projectiles to land thousands of miles from the big city—or even miss the earth

phere for flight but the natural medium for the rocket is a vacuum. Generally regarded as little more than toys before World War II, government research has developed rockets that have attained elevations of more than a hundred miles. Yet each fresh triumph seems merely a preliminary step toward the main goal. Nothing will ever satisfy us short of getting to the moon.

Now a new, more advanced sort of interplanetary project is being proposed, one that might be described as a moon rocket working in reverse. It is to begin where the moon rocket will leave off; in it *a rocket aimed at the earth will leave the moon.* Admitting that the idea sounds fantastic, we must also admit that the atomic bomb and radar contact with the moon would have sounded equally fantastic twenty years ago. Perhaps we should at least take the trouble to see what lies behind this idea of a "moon-to-earth rocket."

Once you start thinking about the moon realistically, as if it were a subdivision over in the next county, it will soon begin to dawn on you that this could be the world's ideal military base. Certainly, when space travel comes into being, the first nation to gain control of the moon will be able to control the earth; for it will have a powerful ally in the force of gravitation.

The mass of the moon is so small in proportion to its size that gravity upon its surface is only one sixth of what it is on the earth. In other words, objects on the moon weigh only one sixth as much as they weigh here. They would feel one sixth as heavy to us. A sack of cement guaranteed to tip the scales at 60 pounds in Chicago would register barely ten pounds in the crater Plato. A man transported to the moon would feel like Hercules, easily able to toss about huge rocks he could barely lift back home in Vermont.

Similarly, explosives and propellants would have far more power on the moon, owing to the sixfold decrease in gravity. In an artillery duel between planets the advantage would be all on the side having the lower surface gravity to cope with. Shooting at the earth from the moon would be like throwing rocks downhill.

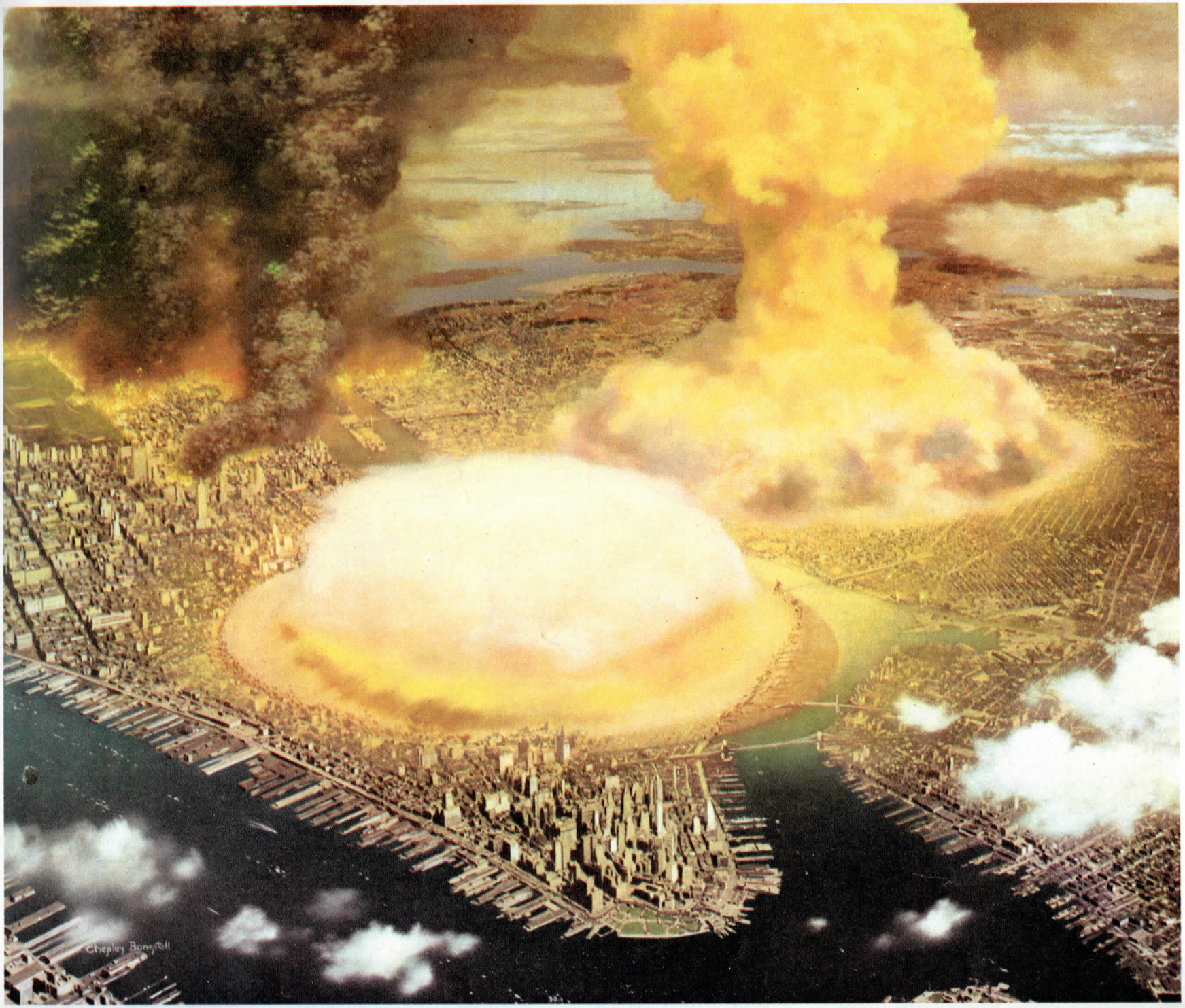
Assume that a nation hostile to the United States secretly launches upon an all-out program of rocket research. Eventually it gains technical knowledge far surpassing others in this field. (This is what happened in Germany about 1935 when the Nazis began experimenting with a rocket similar to the V-2. When the first V-2s struck England in September, 1944, the Allies were incapable of retaliating.) Soon it is busy producing rockets capable of sustained flights at altitudes of hundreds and thousands of miles.

Finally after many failures comes the supreme achievement. Some experts take a rocket all the way to the moon, effect a landing, and live to make the return trip to earth. Now military work goes ahead with a rush. In an incredibly short time a base is established upon the moon, with its own power plant, fully equipped to manufacture all the weapons needed for the conquest of the earth.

Whether such a daring project is ten or ten thousand years in the future, there is today nothing, from the purely scientific standpoint, to prevent our launching a rocket at the earth from the moon. The formulas expressing the laws of flight through space are no military secret. Positions of the earth and the moon are calculated a year in advance by the U.S. Naval Observatory and published in the American Ephemeris and Nautical Almanac. Anyone who desires can begin laying his plans on paper immediately for the rocket conquest of the earth, just as if a base upon the moon were already in existence.

Suppose we try to anticipate the future by making such plans ourselves. No one would dare attempt to foretell the course of discovery in electronic or nuclear physics, but there is no corresponding uncertainty about the motions of bodies in space. The position of the moon a thousand years hence can be determined *(Continued on page 44)*

ILLUSTRATED BY CHESLEY BONESTELL



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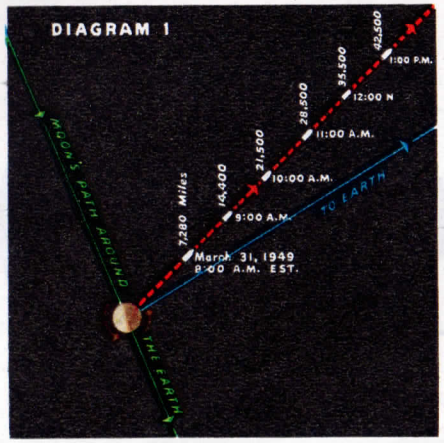
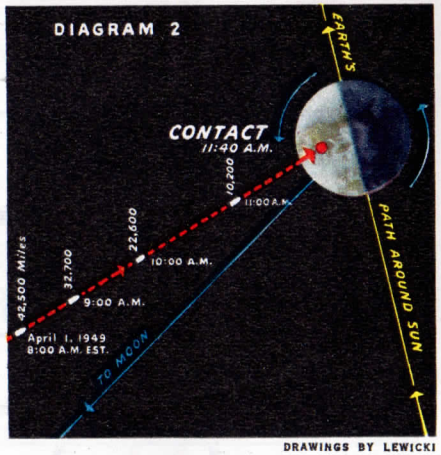


Diagram 1



DRAWINGS BY LEWICKI

Diagram 2

ROCKET BLITZ FROM THE MOON

Continued from page 25

today with a margin of error that would seem trifling to anyone except an astronomer.

Let's say that the calculations necessary to launch a body from the moon so as to strike a selected point upon the earth have been carried through rigorously by an enemy. For this purpose, New York City has been chosen as the first target.

We will begin detailing the evening's attack problem by briefing the reader quickly regarding conditions under which a lunar military base would be operated. The essential facts upon which astronomers are well agreed can be summarized in a few words.

The surface of the moon is exceedingly rough and broken, crossed by several steep mountain ranges and studded with thousands of craters. As a friend of mine from the Middle West once remarked, it would make mighty poor farming land. Although the craters resemble volcanoes in certain respects their origin is still a matter of speculation. If they were once volcanoes it is certain that they are quite extinct now, for there is no accepted record of one ever having been seen in eruption.

Data on Lunar Conditions

The most delicate tests have failed to reveal any trace of lunar atmosphere. Therefore, it seems work on the moon fixed in the sky only shifting back and forth very slightly during the course of a month.

Trying to work under such abnormal conditions would be a severe handicap. Living quarters and other installations would have to be in airtight chambers underground. To venture outside without wearing a space suit inflated to atmospheric pressure would be instantly fatal. A man would burst like a deep-sea fish brought up from the depths of the ocean. As there is no air on the moon to carry sound, communication out of doors would have to be by portable radio or sign language.

Is the moon inhabited? This is a question that no one can answer definitely but it is hard to see how life could survive under such unfavorable conditions. It is safe to say that the moon is a desolate world utterly devoid of life.

Returning now to what we shall call

This article isn't the product of an imaginative man's flight of fancy. Its author is an astronomer who for 18 years has been on the staff of the star-watching Mount Wilson observatory.

For two and a half months,

Operation Knickerbocker, the general approach to the problem of hitting the earth from the moon is not so different in principle from that of a man who is preparing to shoot at a jack rabbit from a moving automobile. After making allowance for his own motion, the hunter aims at where he estimates the rabbit and the bullet meet.

In some ways the astronomer's problem is simpler than the hunter's; in others, it is much more complex.

Rabbits are unreliable animals prone to changing course suddenly, without warning. Even if a rabbit obligingly ran with uniform velocity in a straight line the hunter might have his aim spoiled by a bump in the road. But we can rely upon the earth and moon to keep moving smoothly around the sun year after year in docile obedience to the law of gravitation.

On the other hand, gravitation is a complicating factor in launching a rocket into space. It would be disastrous to neglect the gravitational attraction of the earth and moon, for they never cease to influence the rocket over every inch of its path. It is somewhat as if the hunter and rabbit were able to exert an influence on the course of a bullet after it leaves the gun. Nor are the earth and moon the only bodies that would act upon a rocket. Although 93,000,000 miles away from the rocket's path, the sun is so massive that during most of the flight it would outpull the earth and moon combined.

We are now confronted by one of the most famous problems in the history of science: the problem of what would happen if three or more bodies were turned loose in space with nothing but the law of gravitation to guide them. The greatest mathematicians have never been able to find a practical general solution to the interstellar problem, although plenty of them have tried. Any particular case, however, can be solved by a slow and tedious process called numerical integration, whereby the answer is obtained a little bit at a time, like a detective gathering clues which, added together, enable him to reconstruct the crime.

We will suppose that the message containing the last-minute instructions to the enemy chief of staff has been received and that all arrangements have been completed for launching his Diana I, the first rocket ever to be fired at the earth. The base is situated upon a comparatively level expanse about a hundred miles northwest of the great crater Eratosthenes on the southern edge of the Imbrium Mare, or Sea of Showers, as it was named by the old astronomers.

The zero hour is set at 7:00 A.M. Eastern standard time, of March 31, 1949, which corresponds to slightly past midnight by local lunar reckoning. The lunar landscape is brightly illuminated by the earth overhead. Africa and Europe can be readily discerned near the center of the disk, with eastern Asia just visible near the twilight zone.

Seconds of Tension

In the underground control room technicians are seated before the mechanism that will send the rocket into space. A clock synchronized with the quartz crystal oscillator at the U.S. Naval Observatory in Washington indicates the seconds till 700 hours—fifty-eight—fifty-nine—zero!

There is no sound as the rocket rises vertically from the launching cradle, a column of flame streaming from its exhaust. The ground crew watches anxiously as the Diana I rapidly gains altitude. But with not a breath of air to disturb its motion the take-off is perfect. Soon the automatic pilot begins to incline the missile gracefully toward the east.

An astronomer notes that it is heading in the direction of the star Alpha in the constellation of Libra the Balance. He nods with satisfaction—exactly on course.

When the flame from the exhaust suddenly dies, the watchers know the rocket

first target.

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Data on Lunar Conditions

The most delicate tests have failed to reveal any trace of lunar atmosphere. Therefore, it seems work on the moon would have to be done in a hard vacuum, as physicists call it. The first expeditions would be compelled to carry their own supply of oxygen and water, but eventually it should be possible to produce those necessities chemically from mineral deposits. We should expect to find the same elements on the moon that occur on the earth, although not necessarily in the same abundance.

Without an atmospheric blanket to shield the surface from the rays of the sun by day, or prevent the escape of heat into space at night, the range in temperature on the moon is far more extreme than it is upon the earth. During the lunar day, which lasts for two of our weeks, the bare rocks become hotter than boiling water; while during the equally long lunar night their temperature falls far below that of dry ice. Yet probably a few feet below ground enough warmth remains from the sun's rays to keep the temperature above the freezing point.

Instead of appearing light blue as it does on earth the sky is uniformly black because there is no air to diffuse sunlight. The stars are always visible as sharp unwinking points of light even when the sun is shining among them. On the equator the earth looms overhead as a bluish-tinted globe with white polar caps, four times as big as the moon appears to us. The earth hangs almost

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For two and a half months, Mr. Richardson spent his spare time on the extremely complicated mathematical calculations needed for the moon-to-earth rocket flight he describes here. Checking his first figures, he found that rocket people using them would miss this planet by more than 50,000 miles.

"I revised my figures," he says, "and again missed the earth, theoretically, by 10,000 miles. I had to make ten calculations to get the right answer. The last and correct calculations filled enough foolscap to form a stack five inches high."

Chesley Bonestell, the artist who made the illustrations on pp. 24, 25, makes a specialty of scientific subjects.

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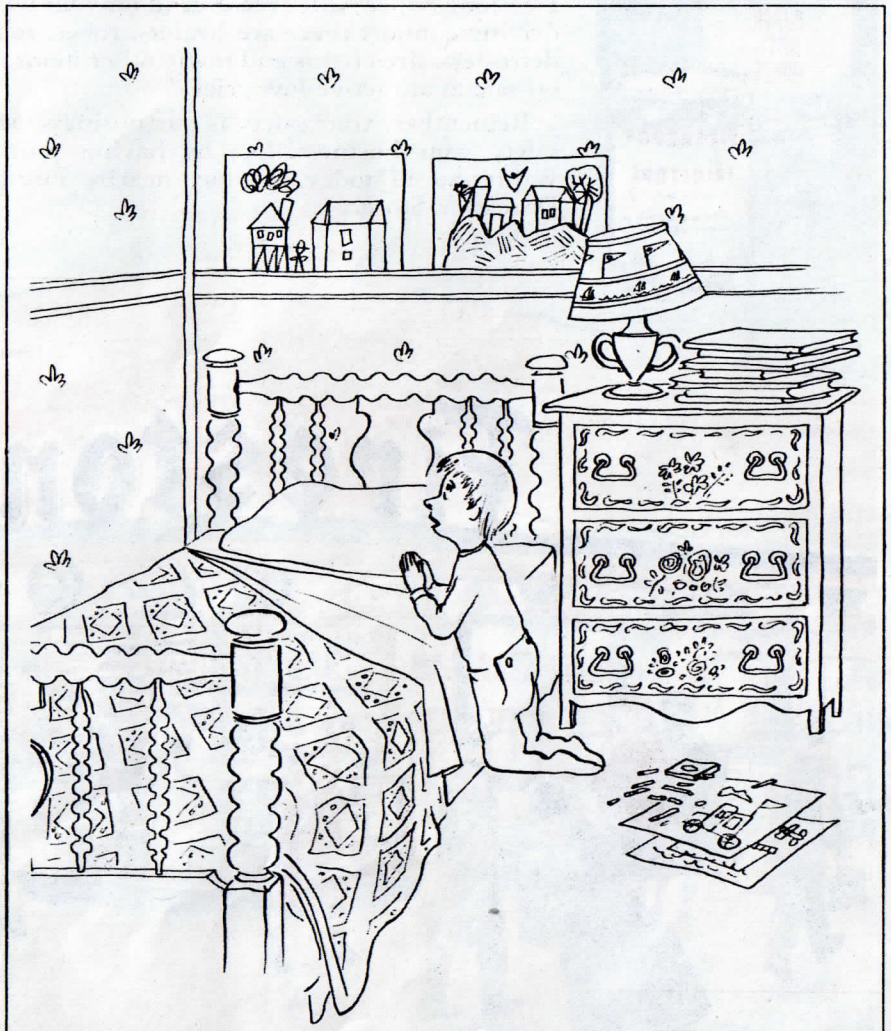

"—and please, try very hard to make me a good boy"

COLLIER'S CHARLES E. MARTIN

is finally on its way. No more fuel is needed to keep it moving now—it is a free body in space. Were it not aimed for collision with the earth, the Diana I would revolve around the sun indefinitely, a tiny man-made planet among the myriad natural inhabitants of the solar system.

Diagram 1 on page 44 shows the rocket's progress for the first six hours. It moves away from the moon in a nearly straight line, slowing down a trifle at first but soon going at a pretty steady rate of about 8,000 miles an hour toward its rendezvous with New York.

When Diana I crosses the halfway mark, at 120,000 miles, the sun is rising at New York on the morning of Friday, April 1, 1949. In New York, then, people are awakening, scanning the headlines over their coffee, and beginning to make plans for the day, never dreaming of the death that is rushing at them from outer space.

By 8 o'clock the speed of the rocket is quickening under the mounting attraction of the earth. At 11 o'clock it is 10,200 miles from New York and moving at a 15,700-mile-an-hour clip. Forty minutes later its mission is ended. Diagram 2 (page 44) shows its approach to the earth during the final minutes.

Easy to Miss the Target

It is doubtful if the first rocket would be launched with such precision that it would speed unerringly to the target as we have described. An error of a tenth of a mile per second at the start could throw the rocket several thousand miles off course by the time it had covered the distance between the moon and the earth.

In actual practice the first rocket might, instead of hitting New York, land far to the west in the Aleutian Islands or even miss the earth entirely. But as soon as ballistic experts on the moon were able to determine how far off their first shot was, they would correct their aim for the second.

Suppose they are luckier than they deserve on the third and fourth shots, which land on Manhattan and Queens, and the fifth and sixth which drop less than 50 miles away. There would be no respite even when the United States is turned away from the moon. Methodically the men on the moon could proceed with their work of destruction. Secure from reprisal they would be in no hurry to press the attack.

In modern warfare the psychological effect of a new weapon is often almost as important as its capacity to destroy. From this standpoint a rocket attack from the moon should be eminently successful. Attempts to trace the source of the attack would be practically hopeless. Rockets would seem to be arriving from all directions out of nowhere. There would be a terrible frustration at being unable to fight back. The nation that secretly initiated the attack could loudly protest its innocence, pretending to be as bewildered and mystified as ourselves. It might even arrange to have a few rockets fall in its own territory to make this story sound convincing.

We have attempted to describe war as it might come in the future. Is there any possibility that manned rockets will reach the moon during our lifetime?

There are many who scoff at the mere mention of such a notion. Others feel we are just as good as on the moon right now. (Several inquiries have been received by the government land office regarding title to land acquired on the moon.) The truth of the matter is that most people are simply guessing or indulging in wishful thinking. But one amateur rocket society, whose members design and test real rockets and so should be thoroughly aware of the difficulties to be overcome, went on record in June, 1946, as believing that manned rockets will complete the round trip to the moon within approximately two decades.

The trouble with trying to get reliable information is that the only individuals who really know how much progress has been made toward space travel are scientists working for the government, and their knowledge is a profound military secret. The government has been releasing very little information on rockets lately.

So who can say how close we are to making a lunar hop?

THIS FASCINATING WORLD

LOCALE	FASCINATING OCCURRENCE