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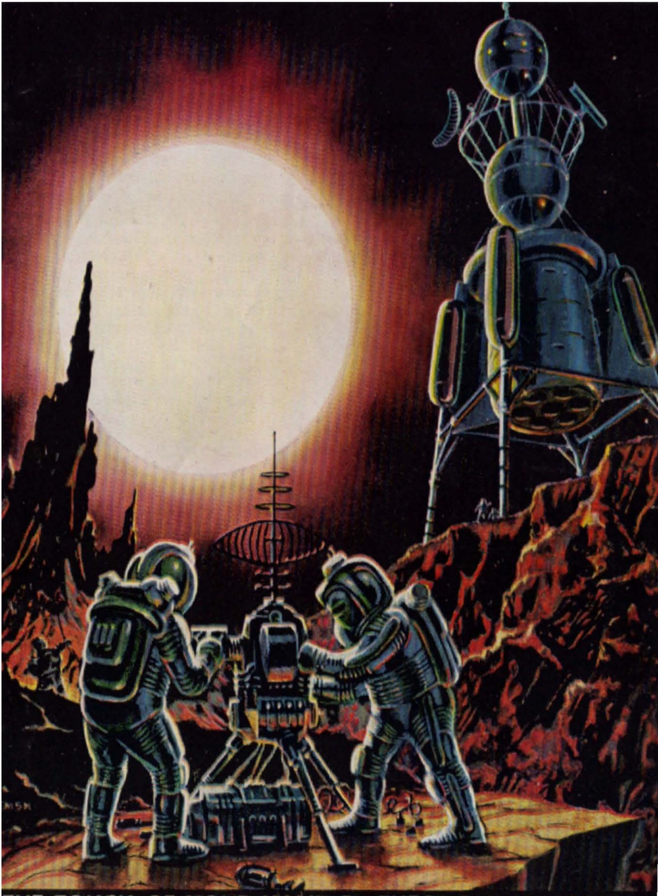
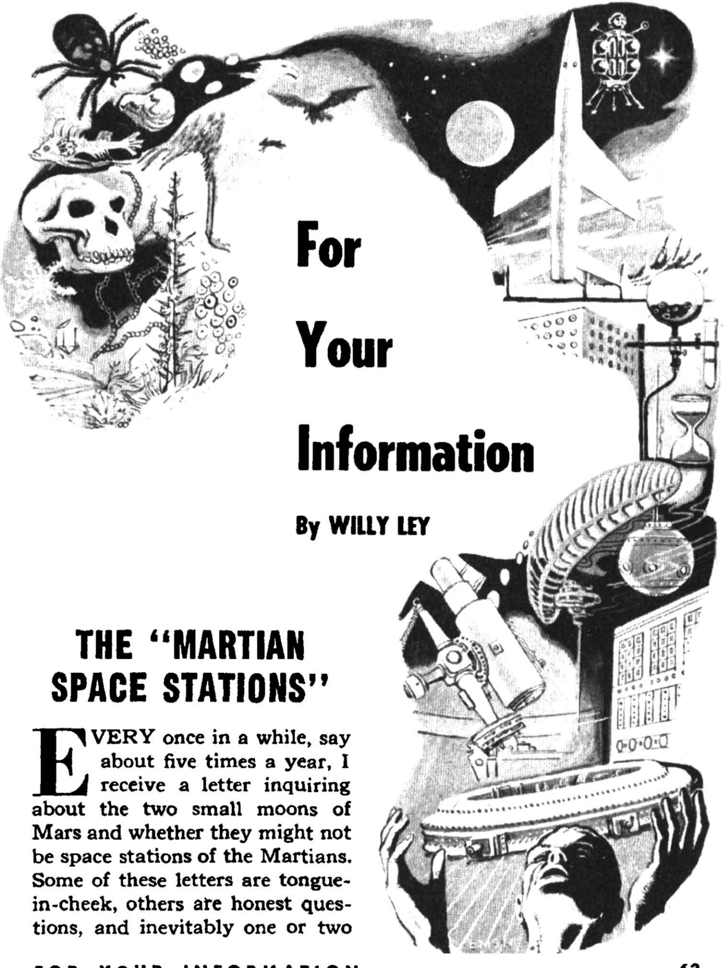


THE TOUCH OF YOUR HAND By THEODORE STURGEON



For Your Information

By WILLY LEY

THE "MARTIAN SPACE STATIONS"

EVERY once in a while, say about five times a year, I receive a letter inquiring about the two small moons of Mars and whether they might not be space stations of the Martians. Some of these letters are tongue-in-cheek, others are honest questions, and inevitably one or two simply take the artificial nature of the moons for granted and wonder whether a careful photographic watch for "operations" is being kept by the Earth's observatories.

My answer, of course, is always the same—namely that Phobos and Deimos are actually moons and not artificial structures, even though the Martians—if there were any—could make good use of them as space stations.

Sometimes I get a letter back, asking for proof: "Are our telescopes good enough to see detail, so that we *know* they are natural moons?"

Well, no. They are too far away (some 35 million miles when close) and too tiny (their diameters are estimated at 10 and 5 miles, respectively) for telescopic examination of their surfaces to be possible. But that scarcely makes them artificial structures—and even if we knew that Mars was inhabited by intelligent beings, the idea would still have to be rejected.

To understand the problem, let's look at the principles which will apply when we ourselves get around to putting a space station into an orbit around the Earth.

THE first consideration will be to have the space station out far enough so that its movement would not be slowed by residual air resistance. In the case of the Earth, 200 miles above sea level would do nicely, and the same figure could be used for Mars.

The next consideration is the expense of putting the station into space, and the expense of maintaining steady supply and contact. To lift a pound 20 miles costs so-and-so much fuel, and it doesn't matter whether you lift a pound of oxygen or a pound of stainless steel. To lift it 300 miles costs still more fuel. In short, it is more expensive to maintain the farther away it is (although the first 200 miles cost more by far than the next 800 miles); so the closer you can have the station the better, as far as fuel economy is concerned.

But the problem isn't that simple.

For when it comes to the inherent uses of the space station, a longer distance is preferable. The station wants to see the ground, and, for many purposes, it wants to be seen. If it is farther away, naturally it can see more area at any given moment and can be seen from a larger area. However, if you place it too far out, you lose detail; the home planet should appear large, filling a little better than 130° of the sky — which means that you would want the space station closer than ¼ planet diameter. The diameter of the Earth being

7900 miles, we would place our own space station or stations higher than 200 but lower than 2000 miles.

The precise height within these two limits will be decided by still another consideration: Since a very close check will be kept on the movements of the space station, it is convenient to place it at a distance where its natural period of revolution around the planet is an *even fraction* of the planet's rotation. That's the reason why von Braun wants his station at 1075 miles, for that distance produces one revolution in 120 minutes. It is also the reason why I advocated the distance of 350 miles for an unmanned orbital instrument carrier, because that distance produces a period of 96 minutes.

Of course, there is the 24-hour orbit at 22,300 miles, where the period of revolution is equal to the Earth's rotation; but such a high orbit is of little use, except for planet-wide radio and television coverage, in which case you need three relay stations, spaced 120° apart, in the same orbit.

Now that we have refreshed our memory, let's check what the Martian "engineers" have done.

Their space station should not be farther out than 1050 miles at the most, this being ¼ planet diameter, and it should be no closer than 150 miles. One useful distance for Mars would be about 500 miles from the planet's surface—moving at a little less than 2 miles per second, the station would need 1/10th of a Martian day for one complete revolution.

The Martian "engineers," then, have done a pretty sloppy job.

The Martian day is 24 hours, 37 minutes and 23 seconds, or, forgetting about those 23 seconds, 1477 minutes long—and the moon Phobos moves around the planet 5800 miles from the center (or 3700 miles from the surface) once in 7 hours and 39 minutes, or once in 459 minutes. This is not only too far out on general principles; it is also a time relationship which is about as awkward as you can make it. As for the moon Deimos, it is even beyond the distance which, in the case of Mars, would result in a one-day orbit. The actual distance is 12,500 miles from the surface, and the period is 30 hours and 18 minutes or 1818 minutes.

Sorry, gentlemen, don't bother looking for "operations." The moons of Mars are just moons, probably asteroids captured from the nearby belt.

CALIFORNIA INCIDENTAL INTELLIGENCE

THERE is one club for "People Who," which, if it existed, would be very exclusive by its very nature, small in numbers of membership, but spread over large portions of the world, excluding the iron curtain district, Africa and South America. Its name would be "The Society of People Who Have Handled a Live Tuatara," and I would be a member.

A few months ago I reported on Tuatara in this column and on the fact that, for the first time in many decades, the New Zealand government had permitted the export of a few live specimens. There is one in the New York Zoological Park, and one should assume, since I live in New York City, that that's the one I met socially. But things don't work that simply; I still haven't even seen the New York specimen. Instead, I made the acquaintance of the one in the San Diego Zoo, and so did Chesley Bonestell. Both our thanks to its keeper, Mr. Shaw, who generously pulled the somewhat reluctant survivor from the Mesozoic Age out of its heated cage for close inspection.

An almost full-grown specimen, it measured 23 inches upon arrival in America, and has grown by about an inch since then. Because it is mature, the pineal or "third" eye has virtually disappeared. The third eye is reasonably conspicuous in a very young specimen, but tends to disappear with increasing age, and eventually it can be located only by a few tiny scales in a *rosette*-like arrangement. All of which proved to me in retrospect that the only other specimen I'd ever held, a dried one from the collection of the Natural History Museum in Berlin, was quite young.

Handling the living specimen, I learned a few things about Tuatara that you don't find in books—at least, I don't remember reading them. Those "spines" on the back of the head and on top of the body do not only look like the empty shells of sunflower seeds, they also feel that way—dry and fairly soft. And the spines on top of the tail are pointed and hard. The loose skin around the neck is just as loose, or even more so, as it looks on photographs—it feels like fine, dry, old silk. As for the color, it is best described as "rock color"—neither a pronounced gray nor a pronounced brown—overlaid by a sheen of quite brilliant moss green.

Tuatara has exceptionally large eyes, and the San Diego specimen is in the habit of sitting for hours with one eye closed. What is probably the strangest aspect, in view of the background and age of the type, is that they like to be handled — after a while you wouldn't be surprised if they purred . . .

PRIOR to that side trip to San Diego, Dr. Robert S. Richardson had taken me up to Mt. Wilson Observatory. (To be precise, it was Chesley Bonestell who took me up the mountain, for he was driving, but Dr. Richardson acted as guide when we reached the top.) The visit included a look at the 60-inch telescope, a close look at the 100-inch (which Arthur C. Clarke called a "Victorian instrument") and an even closer look at the 150-foot solar tower. Dr. Richardson even took us up. You ride in an open steel box which rises outside the tower. Then you step across some 18 inches of nothing into the dome. And when the dome opens, you discover that there is no railing.

Because I did not find the 100-inch especially "Victorian" myself—the Flushing IRT subway is much more so in my opinion—arrangements were made to show me the 200-inch on Palomar Mountain. Of the 200-inch I can only say that it is colossal, breathtaking and awe-inspiring. This extends to the control mechanism—everything is enormous. What is normally a reflection inside a prism goes here across an entire room. Where you ordinarily turn a screw elsewhere, you have here a few handwheels.

Even more modern looking and streamlined than the 200-inch is Palomar's 48-inch Schmidt telescope, housed in a separate dome. If it were mounted in the open, every visitor would take it to be a heavy siege howitzer, complete with two recoil absorbers. These, when you look closer, turn out to be "finders"—small (by comparison) telescopes used for aiming the camera. There are two of them because the Schmidt can work from horizon to horizon, and in many of its positions one finder is most awkwardly placed; then you use the other, for the more finder A is out of reach, the easier finder B can be approached. The Schmidt bears the name of its originator—or inventor, if you prefer—Bernhard Schmidt of the observatory of Bergedorf, near Hamburg, Germany.

The Schmidt is based on two ideas. Normally, when you build a telescope of the reflecting type, you begin by making a spherical mirror, which is comparatively easy. Then you *parabolize* the spherical mirror, which is tough and tedious. The difference between the spherical surface and the parabolic surface is small, but it is an important difference—for one surface can be used and the other is useless. Useless, that is, until Bernhard Schmidt had the first of his two ideas that went into his invention.

Why correct the mirror physically, he thought. Why not leave the spherical surface alone and correct its useless image optically?

This required a correcting lens —something very hard to make, mostly because no such lens had ever been made before. In fact, the correcting lens is so unlike other lenses, and differs so little from a piece of plate glass, that many astronomers call it the correcting "plate" rather than the correcting "lens."

One thing I did not know until told: The designation of a Schmidt is based on the size of the correcting plate. Palomar's 48-inch has a correcting plate of that size, while the diameter of the spherical mirror is 72 inches. (Of course, there are some instruments in which both units have the same diameter, but it is the correcting plate that counts.)

Even with all this, however, you still don't get your image on a flat plane; the image remains curved. And this is where Bernhard Schmidt's second idea came in. One could either use such a small portion of the focal image that the curvature didn't matter too much; or one could sit down and try to figure out how to flatten it optically; or one could simply curve the photographic plate.

For the 48-inch Schmidt they use square plates of thin glass (14 by 14 inches, if I remember correctly) which flex enough to fit into a plate holder that forces them into shape. Of course, when they are taken out they flatten again, and you have your photograph — no optical refinements or fancy tricks needed. Except one:

In the basement of the dome, there is a plate holder, with *double* the curvature of the one in the camera. The plate holder is mounted over a metal drawer, and there is a metal basket nearby. Each plate is thus tested before use—it's so much easier to dispose of a drawerful of glass splinters than it is to fish them out of a large but delicate cannon-shaped camera!

MEA CULPA

HAVE you ever, at a party, for example, called one person persistently by the name of somebody else, either because of an accidental resemblance or because the correct name sets up some association of ideas? Well, I do this occasionally, and did it recently in GALAXY *Science Fiction* in a reply to a letter. And, of course, I was promptly caught—in this instance by Dr. Lincoln LaPaz, the Director of the Institute of Meteoritics of the University of New Mexico.

My mistake, committed in the May issue, was to say that the

Pretoria Salt Pan has a diameter "on the order of 20 miles." Dr. LaPaz gave the correct figure in his letter, which is 3330-3450 feet, and continued: "No doubt you had in mind the remarkable Vredefort Ring structure in South Africa which by many is regarded as of meteoritic impact origin; and which, could we remove the sediments now covering much of the Ring, would be seen to have a diameter of at least 20 and, possibly, of as much as 30 miles."

Yes, this is the one I had in mind, and this is about the fifth time that I have called the Vredefort Ring the Pretoria Salt Pan. But it is the first time that it's happened to me in print, and maybe this will cure me. My thanks to Dr. Lincoln LaPaz for catching it.

—WILLY LEY

ANY QUESTIONS?

I have two questions; one is: would a space station of Dr. von Braun's design be visible to the unaided eye from Earth? Another is: how much difference in "seeing" is expected by astronomers as they contemplate the possibility of work outside our atmosphere?

C. W. Olney
356 Acacia
Sierra Madre, Calif.

Yes, von Braun's space station would not only be visible from the ground, it would be a fairly conspicuous slow-moving star. It would be easiest to see if the observer on the ground had the station overhead either just before sunrise or soon after sunset. In daylight, he might be able to pick it out if he knew where to look. In fact, the naked eye visibility of the space station may have some propaganda value: at least one expert on the Far East has gone on record as saying that the existence of the "American star" would greatly impress the Asiatic peoples.

As for the improvement of "seeing," no simple answer can be given. Our atmosphere absorbs radiation of different wavelengths to different degrees. It is almost transparent to what we call visible light and to the very short electrical waves used in television, and almost opaque to other wavelengths which normally never reach the ground. To say that astronomical instruments above the atmosphere would receive a total of three times as much radiation as they do on the ground is probably a conservative statement. It will be at least that much, and it may be more.

I would like to know whether it is a recognized fact that a *planet's age is the higher the farther it is from the Sun.*

L. Comunale
25-54, 38*th St.*
Long Island City 3, *N. Y.*

The idea that a planet is older the farther it is from the Sun was based on the so-called Kant-Laplace hypothesis of the formation of the Solar System. In that hypothesis, it was assumed that the matter which later condensed into planets had been thrown out from a rapidly spinning sun in successive rings. Under this assumption it seemed obvious to have the age of a planet inversely proportional to the distance from the Sun, and some people even went ahead and calculated the respective ages. This was especially reckless in view of the fact that they didn't even know the age of the Earth.

Current theories assume that all the planets were formed at about the same time, because they condensed from dust and gas which never was a part of the finished Sun.

Is it true that if one of the planets were destroyed or moved from its orbit the balance of the whole Solar System would be destroyed?

Philip Officer
402 *Ave. La Resolana*
Albuquerque, New Mexico.

The mass of all the planets taken together is only a fraction of one per cent of the Sun's mass. For this reason, the destruction or removal of one planet would not change the overall picture at all. There would only be very minor changes in the orbits of the planets nearest the missing one.

During the last few months I have read several articles and books about climbing Mt. Everest. Most of the climbers said emphatically that they did not use oxygen in the past and would not use it in the future. Yet I understand the Air Force makes everybody put on masks at 14,000 *feet, only half the height those people climbed to. Why do they disdain oxygen, not sportsmanlike or something?*

Lucy Cores
15 *Hillside Rd.*
Larchmont, N. Y.

In the first place, they *do* think it is not sporting to use oxygen in the conquest of Mt. Everest. As one member of a former expedition expressed it to me: "If you want to conquer the mountain by mechanical means, you might as well use an airplane or a helicopter."

But in addition to this attitude, which you may or may not share, there is a very sound practical reason. The members

of these expeditions spend months at altitudes of 15,000 to 18,000 feet, where the air pressure is just about half what it is at sea level, in order to accustom themselves to low pressures before attacking the 29,000 foot summit. If they didn't do this, but instead relied on oxygen, and then something went wrong with the oxygen supply . . .

In such a case, an airplane pilot can simply put his plane into a steep dive and reach comfortable levels in a matter of minutes. But the mountain climbers could not get to comfortable levels and would perish.

Post Script, June 2, 1953: Everest climbed . . . with oxygen.

What is a "space warp" and how does it work?

Larry Givens
RFD No. 1
Wexford, Penna.

A "space warp" may simply be defined as a term in the science fiction fan's vocabulary. In stories it is used when the author has to get a spaceship over a distance of a few hundred light years in a hurry, and as usually stated to be a fourth-dimensional phenomenon.

One explanation read as follows: supposing you have a book, whose pages are inhabited by two-dimensional creatures. One of them is sitting in the center of a left-hand page and wants to go to the center of the right-hand page. For the two-dimensional creature, this would be a fairly long voyage; but a three-dimensional creature would simply step across the tiny gap separating the two pages of the (closed) book.

In this explanation, the space warp is a kind of shortcut through the fourth dimension. Other authors do not bother to explain it at all. Still others call it "hyperspace."

How cold is it in space?

Russell Chauvenet
721 Gist Avenue
Silver Spring, Md.

This is a question which requires two answers, the first being that space is neither hot nor cold; it simply does not have any temperature at all. Only material things can have a temperature. Space is not material, hence it cannot have a temperature.

But it is a different story if you ask about matter in space. A piece of matter will, of course, acquire a temperature: on one side, it will be illuminated and warmed by the Sun; on the other side, it will radiate some heat away. After a while, a balance of some sort will be reached, known technically as "thermal equilibrium."

The most important factor is, obviously, the distance from the Sun. A secondary factor is the nature of the body, especially its color—a dark body will absorb more heat than a light body. If you assume a color — black, for example — you can calculate what temperatures a body would acquire:

At the distance of Mercury (from the Sun) a black body would be 180° C (356° F); at the distance of Venus, 65° C (149° F); at the distance of Earth, 15° C (59° F), and at the distance of Mars —30° C (—22° F).

Beyond the orbit of Mars, the color of a body hardly matters any more; at the distance of Jupiter the temperature would be —145° C; at the distance of Saturn —180° C; at that of Uranus —210° C, and at that of Neptune —220° C. One light year from the Sun the body would be within about one degree of absolute zero: —272° C.

Is there a simple formula for the distance I can see if I am flying in an airplane?

Henry C. Backer
2232 *Rhode Island Ave. NE*
Washington, D. C.

Yes, there is, but you have to know how high you are, expressed in feet.

Take the square root of the height and multiply it by 1.317; the result will be the distance of the horizon in miles. The Smithsonian Institution says that this formula includes both the curvature of the Earth and refraction. Since 1.317 is fairly close to 1 1/3, you can simply take the square root of your height and add one third to it. The same formula for the metric system reads: Square root of height expressed in meters, multiplied by 3.839, gives horizon distance in kilometers.

I know that A.U. stands for "astronomical unit" and refers to the distance from the Sun to the Earth. But I also know that this distance is not always the same. Which figure is meant when astronomers say A.U.?

Gloria Kupp
6033 *Burdey Avenue*
Chicago, Ill.

The latest figure I have been able to find for the numerical value of an astronomical unit is that announced by Sir Harold Spencer Jones: 93,003,000 miles. But since A.U.s are normally used only for expressing general relationships, 93 million miles is good enough.