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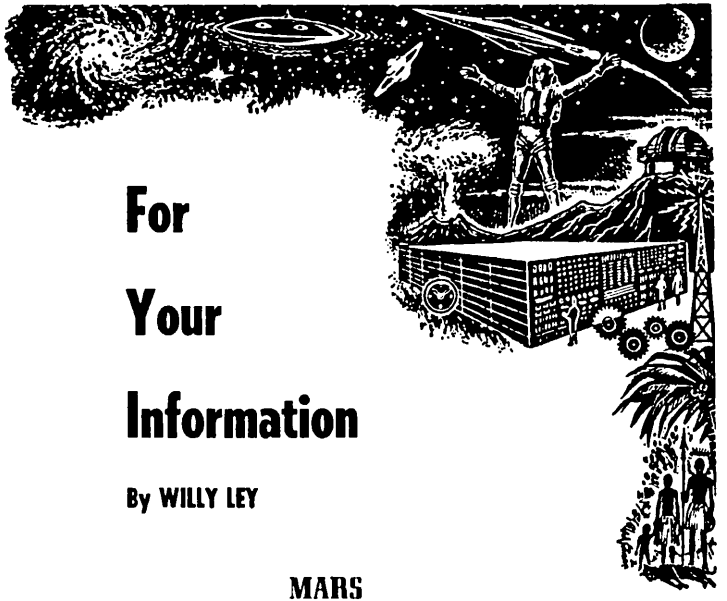
THE MARTIAN WAY

By ISSAAC ASIMOV



For Your Information

By WILLY LEY

MARS

EVERY couple of years I see to it that I am where there is a reasonably large telescope, because every two years and two months Earth and Mars are on the same side of their orbits around the Sun. Since the orbit of Mars has a rather pronounced ellipticity, not all of these approaches are uniformly good. The closest Mars came to us in 1952 (on May 8th) was 51,860,000 miles. The next approach in 1954 will be some-

what better, and the one after that, in 1956, will be almost the minimum possible, which is 35 million miles.

As you can easily guess from the first sentence, I make sure that I have a look at Mars on those occasions. And since I know what to expect, I was disappointed only the first time, quite a number of years ago.

The man who goes to an astronomical observatory on visitor's night usually has read a few books on astronomical subjects and has seen some pictures. Now he is going to check the pictures with reality and in general he sees what he expects to see. There is bright-glowing Venus, showing phases like the Moon's. There are the mountains and craters and dark *maria* of the Moon, just as described in the books. There is Saturn with its rings, incredible but sharp and clear in the dark sky. And there is Jupiter with its stripes and several of its large moons almost militarily lined up. But when it comes to Mars, the visitor is almost always disappointed. He expected to see—well, reddish deserts and gray-green areas of vegetation. He was hoping for one of the famous "oases," preferably *Lacus solis*, and maybe a canal or two.

What he actually sees, even with a hundred magnifications, is something slightly smaller than the Moon appears to the naked eye. Mars looks like a brightly illuminated orange about a block away. When there is a polar cap, you can make it out quite easily. And if you are lucky, you can also see the main marking, the dark triangle of *Syrtis major*. After having a look at Mars yourself, at close approach and with a fairly large instrument, you no longer wonder why astronomers cannot answer so many of the layman's questions. On the contrary, the wonder is how they managed to learn as much as they have.

LET'S run quickly through the facts agreed upon by everybody. The dark areas called "seas" are not seas, but sections covered with vegetation which shows very pronounced seasonal changes in coloring. Most astronomers say that this vegetation probably corresponds to terrestrial lichens, but this statement mostly means that terrestrial lichens could probably survive on Mars. What shape the Martian plants took via a hundred million years of local evolution is something we'll have to see in order to be certain.

Another point on which there is general agreement now is the nature of the polar caps. They are true ice (not "dry ice" as was suspected by a few for some

time) and very thin, probably just a few inches on the average. It is also agreed that the canals do exist, although nobody knows what they are. Dr. Clyde Tombaugh, the discoverer of Pluto, advanced the guess that the so-called "oases" are large impact craters, caused by arrivals from the Asteroid Belt, and that the "canals" are cracks formed by those impacts.

As for the deserts, Prof. Henry Norris Russell suggested a number of years ago that they are red because they are iron oxides, which would also explain the lack of oxygen in the Martian atmosphere. Dr. Tombaugh did not agree with this view and thought that the sands of the Martian deserts were red because they had been pulverized from normally red rocks. But most recent observations by French astronomers agree with Prof. Russell—the Martian deserts polarize light in the same manner as limonite. Limonite is the name of a terrestrial iron ore, chemically almost the same as rust.

As regards the atmosphere of Mars, some conclusions were published recently by Gerard de Vaucouleurs, who is at present working in Australia. Nobody can say that de Vaucouleurs is very optimistic about Mars, which he calls: "A desert, moved to the arctic and lifted to stratospheric heights." The composition of that thin atmosphere, according to de Vaucouleurs, is 98.5 per cent nitrogen and about 1.3 per cent argon, which leaves only very little room for oxygen and other gases.

That this should be the last word on the Martian atmosphere is at least doubtful. It certainly cannot be the composition near the ground.

In the first place, the areas now generally accepted as vegetation must produce *some* oxygen. I have to mention at this point that it is assumed that the Martian vegetation does not require liquid water, but can utilize water vapor in the atmosphere. This assumption is quite reasonable, for some terrestrial plants can do it, too. A few years ago, the Russian astronomer Tikhov reported the discovery of a tree with that characteristic from the highlands of Inner Asia; in fact, Tikhov referred to it as *Marsianka* ("little Martian"). Quite recently it was discovered that we have a similar tree on the West Coast.

But if we assume occasional water vapor in the Martian atmosphere (for the sake of the plants), then something discovered in our own atmosphere must also take place on Mars. Dr. Joseph Kaplan has offered the

theory that solar radiation takes water vapor apart, splitting it into oxygen and hydrogen. The hydrogen escapes, but the oxygen remains in the form of separate atoms, as long as the Sun is shining. After sunset, the atoms of oxygen combine into oxygen molecules with some release of energy, which accounts for the sky glow. In our atmosphere, this takes place at a considerable height, around 60 miles. In the Martian atmosphere, the same process should take place nearer the ground.

Well, we'll indubitably find out one day, but not by making our observations from Earth.

THE BUMBLEBEE BUGLER

THE bumblebee, *Bombus terrestris*—everything that follows is also true of the related *Bombus ruderatus*—builds its nest on and often even in the ground. Neither the architectural arrangement nor the workmanship compares with that of the honeybee, but the general idea is the same. Nor are there as many inhabitants in a bumblebee nest; the maximum number seems to be about 450.

But in spite of lesser numbers and poorer housing, the bumblebee seemed to be able to boast something that the honeybee did not have. An otherwise long forgotten naturalist by the name of Goedard told the story for the first time in 1685.

Old Goedard, who either suffered from insomnia or had the reprehensible habit of getting up at 3 A.M., reported that he came across a bumblebee nest at that early hour, when the sky was already bright, but all of Nature that he could see was still asleep, including the bumblebees.

As he watched, an especially fat bumblebee climbed out of the nest. It took its position near the hole from which it had emerged and began to beat its wings. But to Goedard's surprise, instead of taking off, it just sat there, humming loud and furiously. This went on for ten minutes, fifteen minutes. Other bumblebees crawled sleepily out of the nest and reluctantly began the day's work. But the first one kept humming for another fifteen minutes until the whole family was awake. Then it disappeared.

The bumblebees, Goedard announced, have a bugler like a military garrison—an individual with the duty of waking up the others so that they will not oversleep and waste some of the new day the Lord hath made.

Others read this and accepted it as one more example of the miraculous organization of tiny insects. A little later some authors became cautious about it

and, still later, the story was repeated with an amused and somewhat superior smile, as a typical fairy tale from the early days of natural history.

But then, almost 200 years after Goedard, came Professor Hoffer of Graz in Austria and said: "Yes, its true, the bumblebees do have a bugler." He had seen it himself because in his garden there was a nest of *Bombus ruderatus*.

The day of the year when he noticed it first was the 7th of July. The bugler began making noise at 3:30 A.M. and kept it up until about 4:15 A.M. This went on every day—Prof. Hoffer called the members of his family, colleagues and even the local policeman as witnesses—until the 25th of July. On that day Hoffer caught the bugler to see whether it differed in any way from any of the others. Next day a new bugler was on duty.

For almost half a century, the bumblebee bugler was back in good graces (and in natural history textbooks) until Dr. von Buttel - Reepen re-opened the case. He did not say that it wasn't so. The facts were clear and, moreover, von Buttel-Reepen had observed it himself many a time. What he doubted was the explanation, in spite of all analogies with alarm clocks, military procedure and crowing roosters.

The bumblebee nest, he said, is in the ground, or close to it. It is moist. The insects themselves have collected their version of honey which thickens by evaporating surplus water. In short, the air must be awful in the morning and even if bumblebees don't mind bad smells, the moisture content must be too high for their purposes.

Now the same thing happens in bee hives where much larger quantities of honey are thickening. The bees have found out that they can do something about it: They form long chains from the entrance to the honeycombs and sit there, fanning the air with their wings, getting the moisture out of their hive. Since the bumblebee colony is so much smaller, a single individual can do it.

Simple tests showed that the solitary bugler actually causes a ventilating wind. The new inter-

pretation was accepted by other entomologists without delay. It had been one of those cases where the by-product is mistaken for the purpose. Some electric fans make a lot of noise, but only incidentally.

HOT WATER ICE CUBES

MY casual mention about the latent heat of water and the inadvisability of overworking your refrigerator with hot water in the trays has caused some "hot" mail plus a heated phone conversation. Mrs. Carr of the National Fantasy Fan Federation in Seattle, Washington, wrote some harsh words: "An excellent example of a certain type of so-called 'scientific' thinking which brands as 'superstition' any fact it cannot explain in its own pompous and shortsighted terms."

Now let's all calm down and review what I said. I did not claim that I had made the experiment, or even checked it. I stated that somebody in the Bureau of Standards had done so and told me about it. I also said that cold water has less heat for the refrigerator to carry away. Well, it has! As for the discussion itself, I'll quote from a letter by Mr. Paul D. Hobson of 220 Research Road in Ottawa, Ontario, Canada. He wrote me:

"Some time ago I was asked the same question and carried out experiments. I found that a dry clean ice tray on a dry clean shelf gave the expected result, as found by the Bureau of Standards. If, however, the shelf was covered with a layer of frost, as is usually the case with a domestic refrigerator, a tray containing initially warm water would freeze appreciably more quickly than a tray of cold water. The reason seems to be that the warm tray melts the frost and settles into contact with the metal of the freezer shelf before the moisture freezes up again, so that there is an improved conductive heat flow between the tray and the freezer unit.

"If the freezer is badly in need of defrosting, the saving in time can be as much as five minutes. Further experiments have shown that even faster freezing can be obtained by using cold water in a clean tray and freezer shelf, free of all frost, and wetting the outside of the freezer tray so that it is 'glued' to the shelf by a thin film of ice. This last result is confirmed by statements in some refrigerator manufacturers' handbooks."

And that, I hope, is that. You can't expect the Bureau of Standards, or anybody else, to enter poor maintenance as a factor in its research.

—WILLY LEY

ANY QUESTIONS?

I have heard of a device that is supposed to reproduce long-dead sound vibrations from the atmosphere. It is said to work on the principle that sound never dies, but continues to agitate the air molecules.

Willard C. Reed,
R.F.D. No. 4
Camden, Tenn.

The inventor of this device was an author in a story in which the Sermon on the Mount was reproduced, leading not to clarication, but to endless discussions about the precise meaning of this or that Aramaic word. Actually, such a device is impossible because sound does die and very quickly too.

Supposing you yell, "boom!" This means that you expend a certain amount of energy causing spherical waves traveling outward from your mouth and expanding. As they expand, their surfaces increase rapidly, but there is only the original energy you put in. Therefore a given amount of energy is spread over a larger and larger surface. After a very short time, the energy per air molecule in that expanding sphere becomes less than that of the random motion of the air molecules.

At that instant, the sound is dead and its reassembly is as impossible as the reassembly of the ashes of a cremated body sprinkled over the ocean twenty years ago.

Explain the words positron and proton and give the difference, if any.

Dick Clarkson,
410 Kensington Rd.
Baltimore 29, Md.

Both are particles composing atoms. As you know, there are essentially two kinds of subatomic particles, light ones and heavy ones, the heavy ones having about 1840 times the mass of the light ones. The heavy ones are the *proton* (which carries a positive electric charge) and the *neutron* (about the same mass as the proton, but without electric charge). A third heavy one, the *negatron* (same mass as the proton, though carrying a negative electric charge) is assumed by some, but so far has not been discovered. The light ones are the *electron* (with one negative charge), the *positron* (with one positive charge) and the *neutrino*, assumed to have the same mass as the electron, but no charge.

The neutrino is, by definition undetectable and has, therefore, not been actually detected; it has been found

necessary to assume its existence to balance equations.

In between the light and the heavy sub-atomic particles, there is a whole slew of *mesons* of different weights (up to 800 electron masses) and exceedingly short lifetimes. One explanation of the mesons is that they are temporary swirls of a bunch of electrons; in ten years or so, we may know more about them.

Since the nucleus of the normal hydrogen atom is a single proton, protons are often referred to as "hydrogen nuclei." Heavy hydrogen has a nucleus composed of one proton and one neutron, the nucleus as a whole being called a *deuteron.*

The nucleus of the very rare form of hydrogen which consists of one proton and two neutrons is called a *triton,* since that isotope of hydrogen is called tritium. The nucleus of helium of mass 3 (same mass as a triton) consists of two protons and one neutron and, since the He-3 isotope is called tralphium, is a tralpha particle. The reason why this form was chosen—one could have called it "tralphon"—is that the nucleus of the abundant helium isotope He-4, consisting of two protons and two neutrons, has been known for many years under the name of "alpha particle."

If I stopped here, I would get letters asking why an alpha particle is called an alpha particle, so I might as well add that now. The most frequent phenomenon in natural radioactivity is the release of a helium nucleus, accompanied by radiation. In order to give a graphic example of what happens, one of the early researchers (I believe it was the late Lord Rutherford of Nelson) compared it with the firing of a gun. Most important is the heavy projectile, the alpha particle. Then there is some smoke, tenuous but still material, the beta radiation (electrons), and then there is the flash, not material, the gamma radiation.

There are two theories regarding the red shift of extragalactic nebulae: one being that the red end of the spectrum is displaced because of the Galaxy's radial velocity, and the other that the light has actually become tired on its journey through space. In your opinion, which one of these two theories is more logical and why?

Gary Motley,
24 Crane Avenue,
West Caldwell, N. J.

Before I state my personal

opinion, it might be useful to explain what this question is about to those not too conversant with the term "red shift."

Everybody knows that visible light comes in an assortment of wave-lengths. Violet rays have the shortest wave-length that still makes an impression on our eyes. Then comes blue, then green and, through yellow and orange, we arrive at red, which has the longest wave-length that we can still see.

In that spectrum, from violet to red, there are lines which can be used as reference points. If they appear shifted toward the red end of the spectrum, it means that the body which emits the light is moving away from us. If the body were moving toward us, the lines would be displaced in the direction of the violet end.

There are thousands of "extragalactic nebulae" (other galaxies) that we can see, and they all display a pronounced red shift. When the amount of red shift was measured, it turned out that it was larger as the separating distance grew longer. In other words, the ones which are farthest away are also running from us most rapidly. The ones nearer us are also running away, but not so fast.

The whole picture is what would result if the Universe as a whole were expanding and it has, indeed, led to that concept.

But if we make the assumption that light waves, after traveling thousands of years, gradually "tire" and "stretch," a red shift would be the result, too, and it would also be proportional to the distance.

Now, some of the other galaxies which are quite near, as galactic distance go, show movements other than recession from us. Some are even approaching. This is explained by Gamow and others as a random motion which, for these objects, happens to be directed against the motion that would result from universal expansion. But you may also say that these galaxies are close enough to permit us to measure their true movements, since their light has not traveled long enough to become "tired."

Nobody can say at this point which explanation is true. But I was brought up on the advice that, if you have two alternate explanations for the same set of observed facts, the simpler one is likely to be correct. Personally, I find it far easier to believe that light waves are not indestructible and that the red shift is the result of distance traveled rather than of movements proportional to distance.