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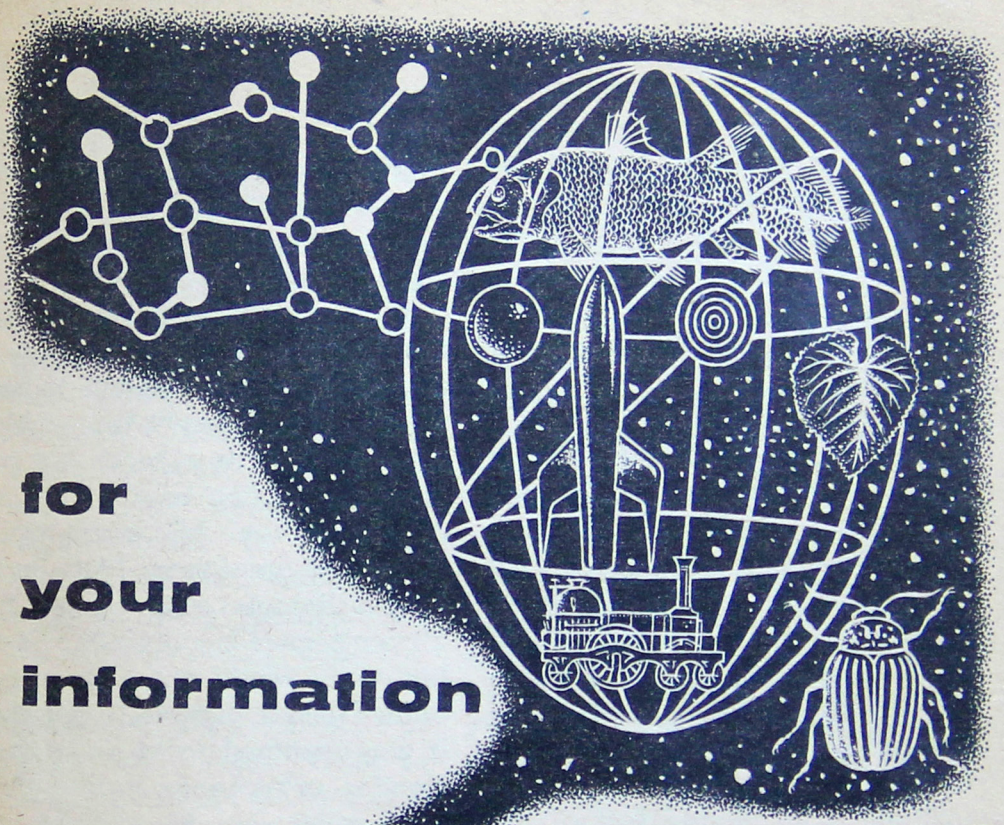
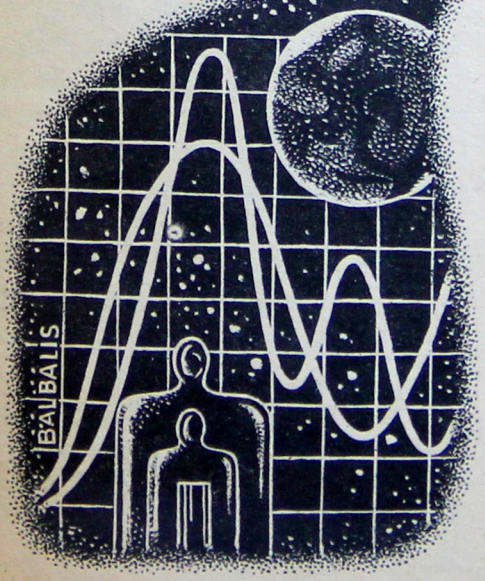




BY WILLY LEY

EARTH'S EXTRA SATELLITES

WE all know, of course, that the year 1961 will go down in history as the year during which a manned spacecraft orbited the Earth for the first time. But it is also the year during which earth's additional natural satellites were finally discovered.

That our Earth might have another satellite in addition to the moon was suspected for more than a century. Now Dr. K. Kordylewski of Kraków Observatory could

announce that he had discovered it. But rarely have expectation and reality differed so much from each other. The expectation had been that it would be a small but massive moonlet, and that it would be much nearer the Earth than the moon. The reality is the opposite of both these expectations—but let's tell the story from the beginning.

The originator of the idea of a second moon of Earth was a French astronomer, Monsieur Petit of Marseilles, in about 1850. He invented the second moon for the purpose of explaining certain small discrepancies in the motion of our big moon. Our big moon did not always seem to be in the point of its orbit where, according to calculation, it should be at that moment. The simple fact of life was that the methods of calculation then used were not quite good enough for the purpose; but at that time it was just as logical to assume that an unknown body in orbit around the earth was the cause of the discrepancies.

To the best of my knowledge no astronomical observatory ever instituted a full-fledged search program. But single amateur astronomers, and groups of them, did try to find it. The reason for the continued interest was that a French novelist by the name of Jules Verne had read an abstract of Petit's work and had incorporated the second moon of Earth into one of his earliest novels. Since *From the Earth to the Moon* became a world success, with translations into literally dozens of languages and steady reprints in all of them, the idea was kept alive.

It is always easy to be wise after the event but it can now be stated that nobody seems to have sat back and thought the problem through in all its aspects. A moonlet large enough to influence the motions of our big moon would have to be quite large. But a moon with a diameter even of, say, just 10 per cent of the diameter of the big moon would not have stayed undiscovered, especially not since it was assumed to be in a much smaller orbit, only a few thousand miles out. Everybody who has seen *Echo I* in orbit (about 100 feet in diameter and about 1,000 miles out) will understand this. Even if the second moon appeared only as a luminous dot to the naked eye it would have been noticed because of its fast movement. Moreover it would have risen in the West and set in the East. It might have been a tiny naked-eye object, but it would have been a conspicuous one.

This, of course, still left the possibility that the moonlet was too small to be a naked-eye object, something only a foot or so in diameter.

Nobody was much interested in this possibility. A moonlet or even several of that size would not influence the orbital motion of our big moon; moreover that orbital motion had been fully explained in the meantime without need for additional bodies in orbit. Interest in moonlets too small to be seen emerged for the first time when artificial satellites came under consideration. *Then* it became important to know about their existence. The situation was somewhat similar to the one which produced the famous first catalogue of what we now call gaseous nebulae and extragalactic spiral nebulae.

Monsieur Charles Messier in Paris—he lived from 1730 to 1817—had decided that he would become famous if he discovered a comet. Now the first suspicious sign of a comet, before it has grown its tail, is a fuzzy appearance. Messier found to his dismay that there were objects in the sky which always looked fuzzy. One could not tell what they were but they were decidedly not comets. In order to avoid disappointments Messier went ahead and made himself a list of those permanently indistinct-looking bodies. After he had settled that he did go ahead comet-hunting.

A reference book will tell you that Charles Messier discovered 21 comets . . . but what he is famous for is the first catalogue of the nebulae which he compiled.

BY 1955, when the first artificial satellites were decidedly in the near future, it was necessary to catalogue the orbits (if any) of small natural satellites (if any) of about the same order of magnitude as the coming artificial bodies. Professor Clyde Tombaugh went ahead, under Army contract, to find small natural moons. Soon after he had started his search several newspapers printed a story to the effect that he had found at least one 400 miles out and another one 600 miles out. It simply was not true (moreover the story was printed before he had even searched these areas) and the overall outcome of Tombaugh's search was negative.

This seemed to end the quest started by Petit once and for all. The earth did not have more than one moon, of any size and at any reasonable distance.

Only one faint possibility was left.

There are a number of asteroids in the same orbit as the planet Jupiter. They are usually called the "Trojans" because all the asteroids in Jupiter's orbit bear the names of heroes of the Trojan war, straight out of the *Iliad*. The theoretical groundwork had been laid back in 1772 when

Joseph Louis Lagrange had published a mathematical essay on "Three Bodies." He had been looking for a possibility of a stable system formed by three bodies. Two bodies was easy: if one was much smaller than the other, the smaller one would orbit the bigger one. If they were of nearly equal size they would both go around their common center of gravity. But what would three bodies do? Could they form a stable system like two bodies?

In general the answer was "no," but Lagrange found two exceptions to that "no." One of the two exceptions was when the three bodies formed an equilateral triangle. If they formed such a triangle and revolved around one of the three (obviously the biggest one) they would maintain their relative positions. If the orbit was rather elliptical the equilateral triangle would change its size during the course of completing one orbit. But it would not change its shape. Many years later, in February, 1908, an asteroid (No. 588, Achilles) was discovered which demonstrated that this actually happened in nature. Achilles was in Jupiter's orbit; it formed an equilateral triangle with Jupiter and the sun and kept steadily ahead of Jupiter. Later in the same year asteroid 617—Patroclus was discovered. It also had an equilateral position with Jupiter and the sun, but trailed Jupiter in its orbit. Now a dozen are known. Half of them lead Jupiter, the other half trail.

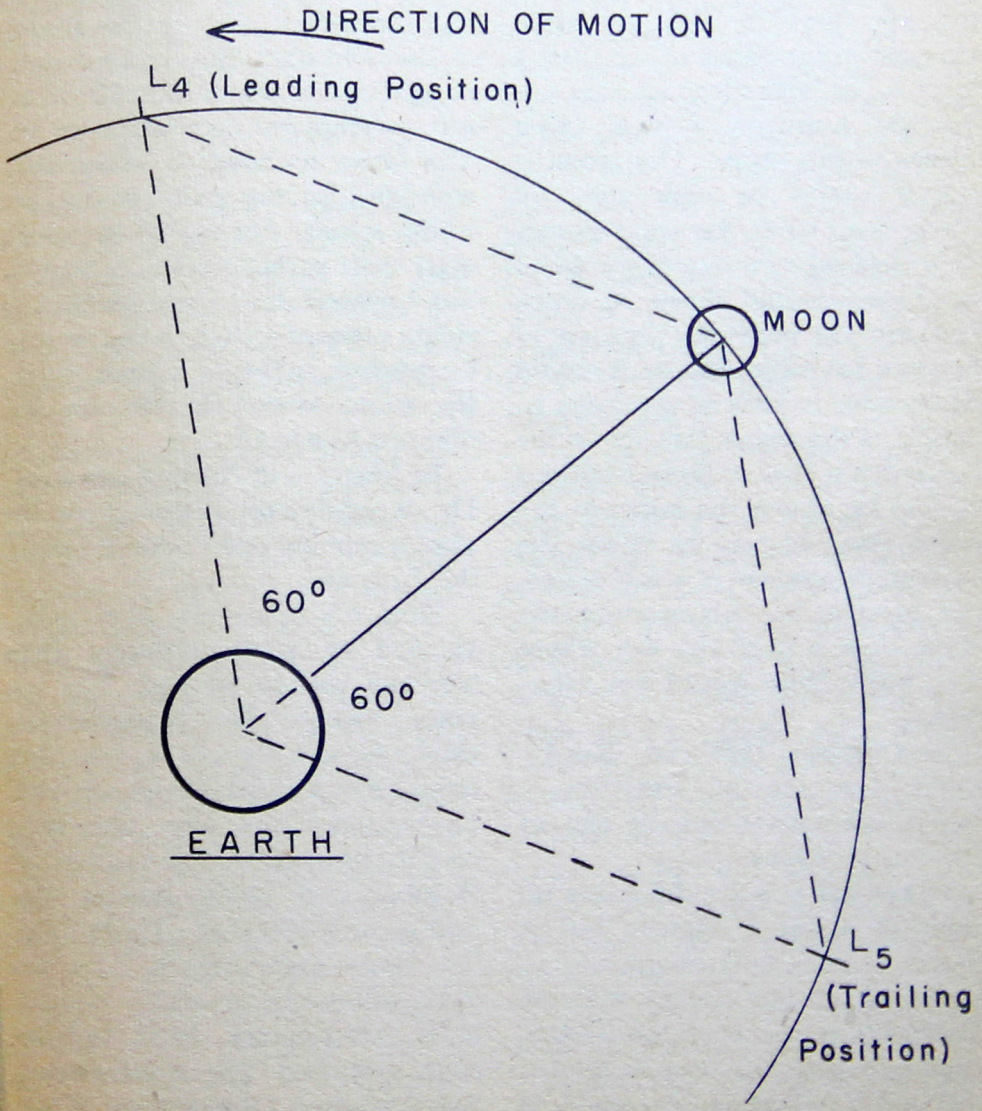
When I wrote my book *Conquest of Space* in 1949 I had to explain this to my readers. At that time I began to wonder whether the "Trojans" of Jupiter's orbit are really the only case and I wrote on page 150: "We don't know whether there are 'Trojans' forming an 'Earth Equilateral,' a 'Venus Equilateral' or even a 'Moon Equilateral.' So far nobody has looked for them, though it might be an interesting job for a gifted amateur with a reasonably large telescope."

Well, I was right in one point only. The additional moons of earth are in a "Moon Equilateral" position. But they were discovered by a professional—and a telescope is no help!

DR. K. Kodylewski reported in Spring 1961 that he had found two faint cloud-like objects in position L_5, which is the trailing equilateral in the moon's orbit. At a later date, in letters written to the Smithsonian Astrophysical Observatory at Cambridge, Massachusetts, and to the journal *Sky and Telescope* he told the story of his discovery.

In 1951 he began to examine both position L_4 and position L_5 with a telescope, hoping that fair-

ly large meteoroids might be orbiting the Earth in the moon's orbit. The search was unsuccessful and Dr. Kordylewski was probably ready to give up. But in 1956 his compatriot and colleague professor J. Witkowski suggested that there might be meteoroids in these positions, but too small even to show up in a good telescope. However, if you had a whole cloud of dust particles, or not much larger than dust, they might be visible, though *not* with a tele-



scope. Such a cloud might be luminous enough to be seen with the naked eye on a dark night. Using a telescope would "magnify it out of existence" . . . the same case as the famous *Gegenschein* I discussed a few issues back.

Dr. Kordylewski was willing to try. He went to high mountain stations in Czechoslovakia. Just a dark night with clear air was not enough, however. A few other things were needed. The moon—which would be near the full phase itself when the so far purely hypothetical dust clouds would be brightest—would throw so much light into the night sky they would become invisible. Hence it would do no good to look at positions L_4 and L_5 if the moon was above the horizon too. One of these positions had to be above the horizon; the moon itself had to be below the horizon. Moreover, if you checked, say, position L_5, this position had to be in a part of the sky where the Milky Way would not interfere.

In October, 1956, Dr. Kordylewski saw, for the first time, a fairly luminous patch in one of the two positions.

It was not small, subtending an angle of about 2 degrees, but it was very faint, only about half as bright as the notoriously difficult *Gegenschein*. But even the *Gegenschein*, faint as it is, can be photographed if conditions are good, if you know precisely what you are up against and if you also have some luck. Dr. Kordylewski decided to try his luck with a camera. But first he checked with the Sonneberg Observatory in East Germany. At Sonneberg they have been taking thousands of pictures every year in the study of variable stars. Maybe they had caught one of the dustclouds without paying any attention to it. The latter sounded so likely; the smudging of the plate would be quite minor, besides they were after their variable stars. It turned out, however, that there was not a single plate of either the L_4 or the L_5 position taken at a time when the moon wasn't in the sky to obscure things too!

In March and April of this year Dr. Kordylewski did succeed in photographing two clouds near the L_5 point.

Now his discovery has to be verified by other observers. But patience will be needed. The L_4 point (where Dr. Kordylewski thinks he saw something with the naked eye but which he did not photograph) will offer the right conditions around the middle of October and again around the middle of November (1961) for a few days each month. The L_5 point will not be favorably located until mid-January, 1962. But on each occasion the Smithsonian Astrophysical Observatory plans

to go after it with the Baker-Nunn satellite-tracking cameras.

If this is successful we might try to obtain an idea of the density of these dust clouds by sending suitably instrumented rockets through them. At any event, our Earth does have extra satellites, even though they turned out to be entirely different from anything anybody ever predicted!

The Hidden Reptile

One might say that discoveries ran from A to Z in 1961, from astronomy to zoology, for the second discovery for which no date could possibly have been predicted was a zoological discovery.

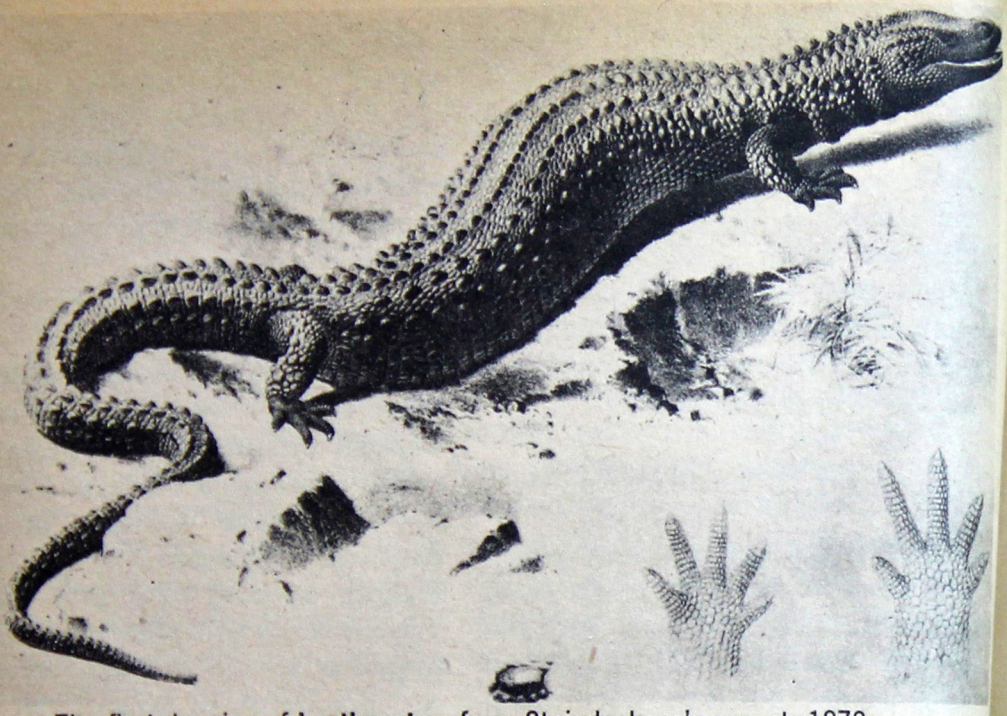
The name of the lizard-like reptile in question is *Lanthanotus borneensis*. The second word just refers to its habitat, namely Borneo; the first word of the scientific name is based on the Greek root *lanthano* which means "to escape notice" or "to be unseen." Rarely has a scientific name fitted the facts so well.

Lanthanotus is around thirteen inches in length, more or less dirt-colored and also more or less dirt-covered. It burrows but can also hide at the bottom of a pool for as long as thirty minutes. It is not very active in daytime. On top of all that, it is so rare that last year quite a number of zoologists would have said that it might be extinct. But since one was caught alive in January, 1961, this opinion had to be dropped. Otherwise it is *lanthano* in every shade of the meaning of this word, and has been for decades.

Some of the things stated in the preceding paragraph could not have been said a year ago because they simply were not known. Though the animal was listed in rather specialized works and even had a 140-page "Bulletin" of the American Museum of Natural History devoted to it (the title: *The Systematic Position of Lanthanotus and the Affinities of the Anguinomorphan Lizards*, N. Y. 1954) it simply had never been observed alive!

Its discoverer was the Austrian traveller Friedrich Steindachner, from whose report the picture is taken. But Steindachner did not observe it alive. The drawing itself was made from a mounted specimen. This was in 1878. Gradually a few more specimens became known; there were three (now four) in the Sarawak Museum at Kuching, Borneo, right in its own habitat. The museum in Singapore had one, and there is a total of four or five in British and American museums and scientific institutions. In most cases the "lizards" had been brought in dead by native collectors.

When the zoologists of the



The first drawing of **Lanthanotus,** from Steindachner's report, 1878.

Kuching Museum got their live specimen they did not even know what it might eat. Since there is a not very close relationship between Lanthanotus and the monitor lizards, which are known to like eggs, both bird eggs and reptile eggs, one of the researchers offered a selection of eggs to Lanthanotus. It took the eggs of *Chelonia mydas,* the green turtle of the area. At first it played dead whenever it felt threatened (which was often) but later it actually became quite tame.

There had been a certain amount of apprehension among the researchers for it was generally accepted that Lanthanotus had two living relatives in the Western Hemisphere, the "beaded lizard" of Mexico and our own Gila Monster (which bears the sinister scientific name of *Heloderma suspectum,* the suspected nail-skin), both of which are poisonous. But Lanthanotus apparently is not poisonous. At any event it never tried to bite. It turned out to be a good swimmer and a slow burrower—its front legs are both small and weak—and in general behaved like a nocturnal snake.

The first specimen of Lanthanotus which could be observed in action died on April 11, 1961—apparently for the reason that it

had to be transferred to another location where no turtle eggs were available. Chicken eggs did not seem to agree with it.

That an animal that had been known to science for eighty years could be observed for the first time is in itself an interesting story. It grows in interest if you know what could be deduced from the dead specimens which had been available all along.

In external shape Lanthanotus looks somewhat like a monitor lizard except for its small and weak legs. The real monitors have strong legs with powerful claws. Anatomists, going into fine detail about the shape and structure of teeth and bones, especially the bones of the skull, could write down a list of similarities. But they could also set down a list of dissimilarities, and when everything had been measured and compared you still had a great deal of free choice. Just in number of points the list of dissimilarities might be twice as long as the list of similarities. But which similarities (or dissimilarities) were important and which were not? One could not arrive at the conclusion that Lanthanotus was simply a smallish monitor with reduced legs, though a relationship of some kind indubitably existed.

One of the things which did not match was the tongue.

The tongue of Lanthanotus is most closely matched by that of the Gila Monster. Rather early, somebody had suggested that the Gila Monster of Arizona, the Mexican version of the Gila Monster and Lanthanotus belonged closely together. Again the list of dissimilarities was longer than that of similarities; and if zoologists until very recently mentioned the two species of Heloderma and Lanthanotus in one breath it was more for convenience than from conviction.

Then, in 1930, a new reptile became known from Kwangsi, southern China. It was named *Shinisaurus crocodilurus*—always remember that the Greek word *sauros* merely means "lizard"—and almost immediately the Baron von Nopcsa, one of the great paleontologists of our time, suggested looking into the relationship between the new Shinisaurus and the longer known Lanthanotus.

At first glance the similarities were strong. Both were of similar size; both have on their larger scales pustule-like organs which are believed to have a tactile function. Lanthanotus had, on occasion, been called an "earless monitor" because its scales go on without any interruption over the region of the ears. There is no external indication of where the ears are located. Shinisaurus

turned out to be earless in the same manner. But again, it all ended up by stating that a close relationship, if one existed, could not be proved.

Now, whenever you can't locate any living relatives it is only logical to look for common ancestors—which, in this case, means that a survey of extinct reptiles was conducted.

Remember that there had been similarities between Lanthanotus on the one hand and the monitors on the other. There had been a few between Lanthanotus and Heloderma. Was there a point in the past where they all came together?

Yes, there was one, the group of reptiles called Platynota. The two species of Heloderma (plus fossil relatives) are supposed to be an early offshoot of this group. The next offshoot along the line were the monitors, and the next one after that the aigialosaurs. Few people have ever heard of the aigialosaurs; in fact, they are rather poorly treated even in handbooks. There are two reasons for this. One is that they simply are not well known. The other is that the aigialosaurs gave rise to another group of extinct reptiles which are much better known and also much more spectacular: the enormous mosasaurs, the famous "sea serpents" of the oceans of the Cretaceous period.

Where does Lanthanotus fit into this scheme?

The largest number of similarities is with the aigialosaurs. One might say that Lanthanotus is simply a still living (and, of course, somewhat modified) aigialosaurian. It therefore takes its place in the ranks of "living fossils."

To return to the present: at long last one could be observed alive for a few months. Of course the experts at the Sarawak Museum are loudly calling for another one, several if possible. And of both sexes. Up to August, 1961, collectors have not been able to oblige. Lanthanotus lives up to its name and is easily overlooked. Besides, it *is* rare.

Henri Moissan's Synthetic Diamonds

When I sit down to write an article I do so after having checked all the facts; when I answer a letter I sometimes just trust my memory. And that is how the remark about Henri Moissan's synthetic diamonds got into the August issue. Not less than three readers quoted a sentence from Isaac Asimov's *The Intelligent Man's Guide to Science* reading: "All this proved that Moissan and his contemporaries could no more have produced diamonds than the alchemists could have produced gold." The

words "all this" in this quotation refer to a calculation about the necessary pressures and temperatures, e. g. 1500° Centigrade, with a pressure of 30,000 atmospheres.

Jim Blish also wrote me about that point, saying: "This is an example of fakery—though Moissan himself was not responsible: his assistant got tired of making these repeated messes with molten iron and cold water, and introduced a little diamond dust into the next mess . . . Moissan died believing he had succeeded, but in point of fact carbon is wholly soluble in molten iron, so it would diffuse too rapidly to make crystals — otherwise you would find them in tool steel."

Well, I take the implied advice. From now on every statement will be checked at least twice — but will I get the column out on time when I do that?

ANY QUESTIONS?

In an article on supersonic flight I just read the author kept talking about the motions of the air molecules. Is there such a thing as an "air" molecule?

Theo. J. Weise
Berkeley, Calif.

No, there is no such thing as an "air" molecule. The molecules in the air are nitrogen and oxygen molecules, with an occasional water or carbon dioxide molecule thrown in for variety. Speaking of "air" molecules, as if the air were a chemical compound, is quite sloppy but I must admit that I have done it myself on occasion; it is awkward to repeat terms like "the molecules composing our atmosphere."

Any book on astronomy contains the information that meteorites are either stones or iron with a high percentage of nickel. Is it possible that there are meteorites that are neither? Specifically, is it possible that some meteorites may be just ice?

Clarence Reilly
Washington, D. C.

A third type of meteorites has been established for quite a number of decades now: the "tektites," which are glass meteorites, consisting of a type of glass which resembles obsidian. It is partly because of this resemblance that a number of pieces are in doubt. Some experts consider them true tektites, while others think they might just be volcanic obsidian. But while there may be doubts about a specific find, the existence of glass-like meteorites is not doubted by anybody any more.

Whether ice meteorites exist is a question which has been debated since about 1920, if not

longer. Theoretically they are possible, if large enough, but there is no actual proof. Hailstones weighing eight or nine pounds have been cited in this connection, since it was declared impossible for a hailstone of such size to form in the atmosphere. That statement is perfectly correct. They don't form in the atmosphere. They form on the ground, after hailstones of a more normal size have partly melted and then frozen together.

Then there is another possibility. A few years ago in West Germany somebody phoned a scientific institution, saying that a 16-pound hailstone or ice meteorite had landed in his backyard and that he had put it in his refrigerator. Well, it took the scientist some time to get there, and the man's refrigerator was not particularly cold, so that the hailstone had shrunk to a little over one pound when examined, but it was resting in a big pail of its own melting water. The very first thing the investigator noticed was that this water had a strong and unmistakable odor. It smelled of toilet soap. The origin of this hailstone had been the used water discharge valve of an airliner. Normally such water would vaporize before it had fallen very far, but in this case it must have collected somewhere on the outside of the plane, frozen into a big lump and finally broken off.

— WILLY LEY

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FORECAST

One of the greatest names in science fiction has never before appeared in the page of *Galaxy*. As a matter of fact, he hasn't appeared anywhere recently, to the detriment of the field; so it is with a double joy that *Galaxy* welcomes in its next issue the author of *The Humanoids, Darker Than You Think, The Legion of Space* and a score of other science-fiction and fantasy classics. His name is, of course, Jack Williamson. The story is a novella called *A Planet for Plundering*. The planet in question is Earth; and the story is right off the top of a great talent.

There's more, of course. The cover story is another Jack Sharkey novella, *Big Baby;* there will also be another novelette or two, and the usual array of shorts. Avram Davidson's *The Tail-Tied Kings* is in the lineup. Back too is Arthur C. Clark with *Moondog*. Willy Ley will surely be with us — and as much more as we can crowd into what (we keep reminding you) is the biggest science-fiction magazine in the world.

We recommend the April issue. . .