Galaxy

SCIENCE FICTION

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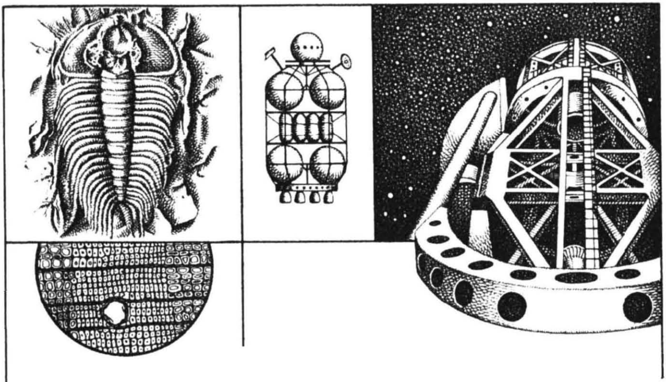
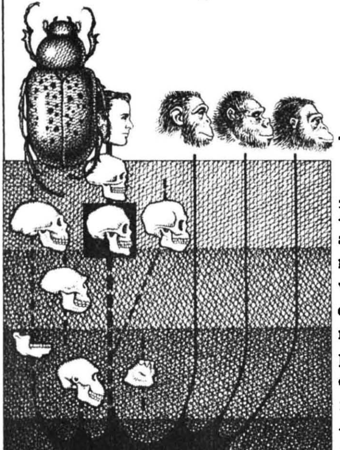
THE TIES OF EARTH by James H. Schmitz

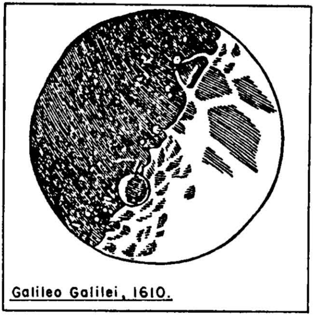


for your information

By **WILLY LEY**



IT WAS DURING the year 1609 that Galileo Galilei of Pisa, then Professor of Mathematics at Padua, learned about the invention of a Dutchman involving optical lenses, which enabled its user to see distant things as if they were nearby. A small amount of experimentation sufficed to reproduce the instrument which had not yet been named "telescope" — Galilei himself referred to it as the *occhiale* when writing Italian and the *perspicillum* when



One of the earliest drawings of the moon.

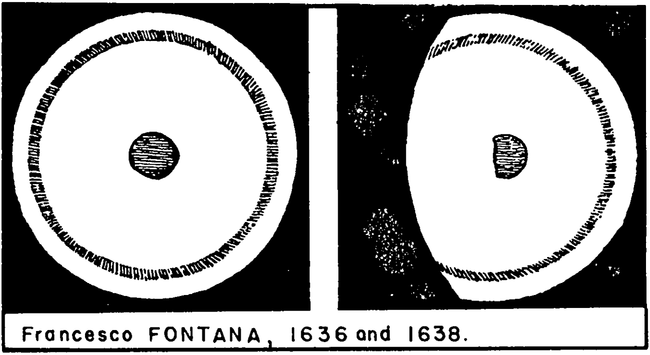
writing Latin.

Within a few months, he had made quite a number of revolutionary astronomical discoveries. He saw mountains on the Moon. He observed that Venus shows phases, just as the Moon does. He "resolved" the Milky Way into countless stars. He saw dark spots on the Sun. He discovered the four largest moons of Jupiter. He noticed that there was something strange about the shape of Saturn. And he wrote it all down in his *Sidereal Messenger,* which appeared in 1610.

Everything Galilei saw with his new instrument can be seen with a reasonably good pair of binoculars or with a pocket telescope. In fact, my own 10-power pocket telescope — actually a target 'scope from a tank gun — is superior in many respects to Galilei's *occhiale,* even discounting its much smaller size. The interesting point is that so many of the astronomical facts discovered by Galilei are almost, but only *almost,* visible with the naked eye.

I don't know whether it is true that a very few people are able to see the four large satellites of Jupiter without any optical aid, as Jules Verne stated in one of his stories. But it is true that some of the major lunar features can be recognized *after* you have studied a good large photograph of the Moon. You could never draw them from naked eye observation, but once you have "learned" them, you can look for them with some success. Likewise the phases of Venus are very close to naked-eye visibility, but only close. To really see them needs a few magnifications.

Lunar map by J. Keill, first published in 1718.



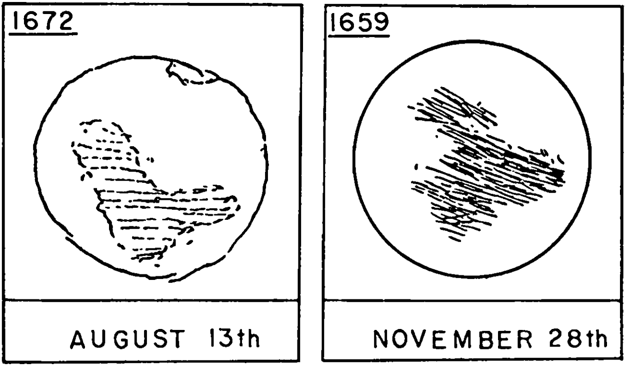
The first drawings of Mars by Fontana.

WELL, AS soon as there was a telescope, however primitive it may appear in retrospect, it was possible to see and to draw those things, and the planets sat for their first portraits, beginning with the Moon. Figure 1 shows a drawing of the Moon by Galilei himself. It may not be the very first telescopic drawing of the Moon made — Galilei probably made several and published only the best — but it certainly is one of the earliest.

The round object visible directly on the terminator is indubitably the *Mare serenitatis*, while the white spot with the two white lines going to (or from) it is certainly the crater we now call Tycho. The roughly triangular shadow on the bright half near Tycho is probably meant to be the *Mare humorum* and the irregularities below the *Mare serenitatis* may be the *Mare frigoris*, dimly seen.

Compared to Galilei's sketch, the lunar map drawn by the Scotsman John Keill just a century later looks virtually modern (Fig. 2). It was printed in Oxford in 1718 in a book entitled *Introductio ad veram Astronomiam;* all the *Mare* plains are recognizably drawn and many of the more conspicuous craters are entered, even with indications of their systems of "rays."

Moving on to the planets, Fig. 3 shows the first drawings of Mars made by Francesco Fontana in 1636 and 1638. Since Mars moves around the Sun out-



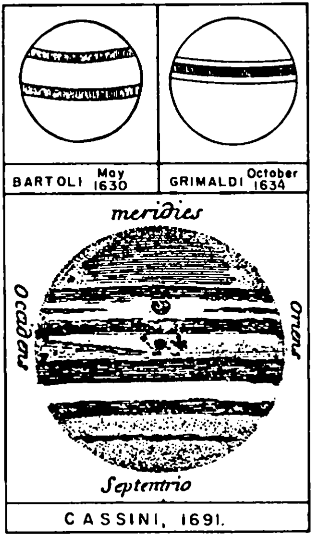
Two drawings of Mars by Christian Huyghens.

side the orbit of Earth, it can never show phases like Venus. Only a small portion of the night side of Mars could be seen from Earth when the relative positions are favorable. Since there is nothing luminous on the portion of the Martian globe that happens to have night, it simply disappears from view. Fontana, in one of his drawings, caught this maximum phase that Mars can show.

But the dark portion in the center and the dark rim near the edge of the disk does not correspond to anything known, indicating that Fontana's telescope must have been rather imperfect. The two drawings of Mars made by Christian Huyghens only a few decades later are much better. The darkish triangular area is probably meant to be the one now called *Syrtis major* and one of the two drawings shows a rather clear indication of the south polar cap of Mars (Fig. 4).

But Mars is a difficult object even now, just because most of its markings are so faint. Moreover, Mars can be seen well only when it comes close to Earth, roughly every two years and two months. Giant Jupiter is a far better object.

It is bigger, to begin with, and it is so far distant from the Earth at any time that it does not make too much difference whether both planets are in neighboring sectors of their orbits as seen from the Sun. Even the earliest drawings

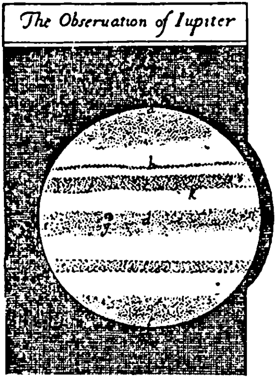


Three typical drawings of Jupiter made by various observers of the 17th century.

of Jupiter by Bartoli, Grimaldi, Cassini and Hooke (Fig. 5 and 6) can be recognized at a glance for what they are supposed to be.

JEAN DOMINIQUE Cassini's drawing is not only one of the early drawings of Jupiter; it is also the first to show the feature which later became famous as the Red Spot. That Red Spot — it isn't always red incidently; it has been seen as orange, yellow, lavender and plain gray — was greeted as a great novelty when it became faintly visible in 1872. Eight years later, in 1880, it was most pronounced and of a particularly vivid color.

Speculation ran high then. Some astronomers thought they were lucky enough to actually observe the birth of still another moon of Jupiter. Remember that in 1880 it was still generally believed that the satellites of the planets had been produced by their primaries by flinging portions of their own masses into space. Maybe here was a lucky chance to observe this very process.

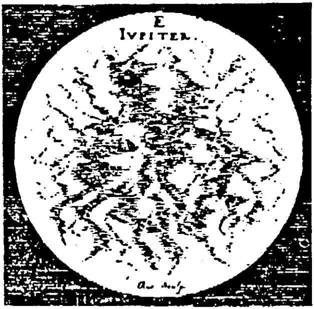


Jupiter as drawn by Hook on June 26, 1666.

Other astronomers believed, however, that they were seeing just the opposite — not the birth of a new moon, but the funeral of an old moon or at least a potential moon. They thought that one of the asteroids, pulled out of its belt by Jupiter's gravitational might, had crashed and that the Red Spot was the reflection of enormous lava flows caused by the impact.

In the middle of the spirited debate, somebody discovered an older drawing of Jupiter which showed the Spot, although it was very faint and not labeled "red." And then, knowing what to look for, it was traced farther back, the trail ending with Cassini's picture. In short, the Spot has been there for centuries, being sometimes well defined and sometimes not — and we still don't know what it is.

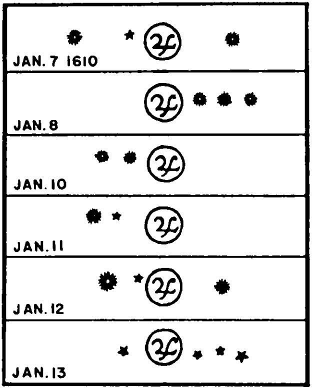
A strange case, to my mind, is presented by Fig. 7. The drawing was made by Johannes Hevelius (real name : Hewelcke) of Danzig who built himself an observatory in 1641 and who is usually mentioned with much praise for his observations of the Moon and his improved star catalogue. The lunar maps of Hevelius constituted progress, but his drawing of Jupiter is practically meaningless. If it did not have the name of the planet engraved on it, one might think it an early attempt at



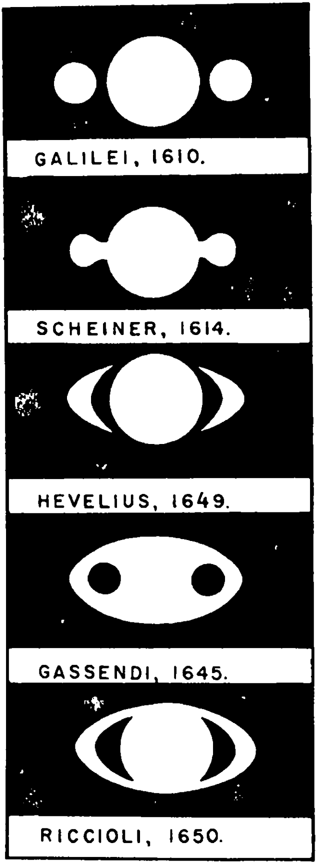
Hevelius' drawing of Jupiter.

drawing the faint markings of the daylight side of Mercury or perhaps the disk of Venus.

By the time Hevelius built his observatory, it was known to



Galileo Galilei's observations of Jupiter in January 1610, proving the existence of the four large moons.



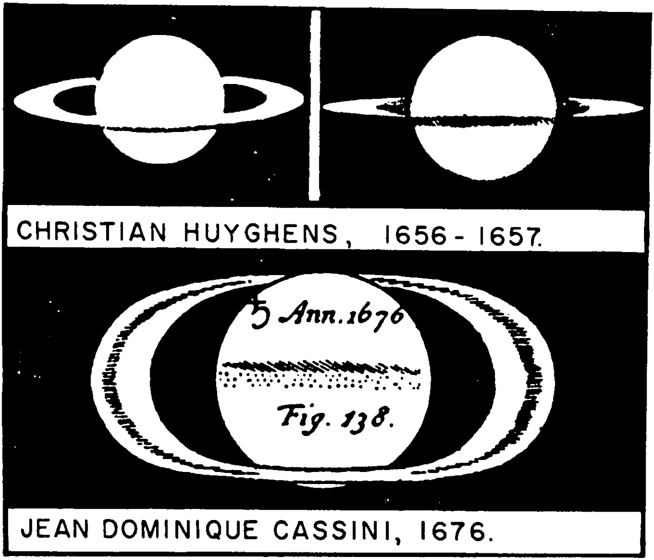
Five drawings of Saturn from 1610-1650.

everybody interested in astronomy that Jupiter had four large moons. They are so easily visible with any telescope of any kind that Galilei must have seen them the very first time he pointed his *occhiale* at Jupiter. But at first he may have thought that he just saw a few stars which happened to lie in the direction of Jupiter.

To be sure they were satellites, one had to establish that they move around the planet and in January, 1610, Galilei watched for this particular phenomenon. The drawings reproduced as Fig. 8 were the result. Of course Galilei just marked their positions, but even so, they are the first drawing of satellites of another planet.

WHEN IT came to Saturn, something new entered the picture. Every schoolboy — and quite a number of the fathers of schoolboys — knows nowadays that Saturn has rings. And knowing that Saturn has rings and having seen drawings of the rings of Saturn, everybody can "see" them at once when given access to a telescope. But the early telescopes were small and weak. In addition, nobody had ever even guessed that a planet may have rings.

There was nothing else in nature which compared with what



Saturn as drawn by Huyghens and Cassini, the latter being the first to show Cassini's Division."

the telescope showed, wavering because of the constant movement of the atmosphere and with beautiful-looking but annoying rainbow fringes. To add to these difficulties, the planet itself appeared much smaller than Jupiter. We now know that it actually is somewhat smaller than Jupiter, but the main reason for the apparent smallness was simply its greater distance, for the orbit of Saturn is 400 million miles beyond Jupiter's.

Galilei's impression of this difficult planet was that it might be a triple planet (see Fig. 9, top drawing) while, to Christopher Scheiner, it looked as if the two smaller spheres were attached to the main body. To Pierre Gassendi, it appeared rather as having the general shape of a football with two large dark holes in it.

Johannes Hevelius saw and drew the appearance fairly correctly, but was at a loss to explain what he saw.

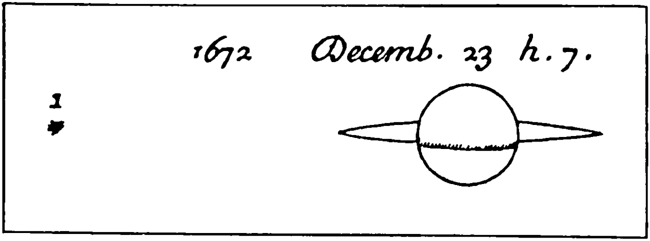
The drawing made by Giovanni Battista Riccioli (Fig. 9, bottom drawing) also looks quite correct to us, though it seems that Riccioli believed that the two "handles" were somehow attached to the planet's body.

It is somewhat strange that none of these early astronomers who strained their eyes to understand the mysterious shape of Saturn noticed Saturn's satellite, Titan. Though pretty far away, it is, after all, not only Saturn's largest satellite, but by far the largest one in the whole Solar System, surpassing Mercury, the smallest of the planets, by more than 500 miles in diameter. Mercury's diameter is almost exactly 3000 miles, while that of Titan is around 3550 miles.

The man who finally did discover Titan also solved the problem of the "appendages" of Saturn. He was the Dutchman Christian Huyghens, who lived at The Hague and who built himself a telescope which could magnify up to 100 times. It was not a large telescope, for it had an aperture of only 2-1/3 inches, with a focal length of 23 feet.

HUYGHENS discovered Titan in 1655 and, during the following year, he realized that the appendages were actually a flat ring around the planet, not touching it at any point (Fig. 10, top). Knowing that it was a flat and unattached ring did not reveal anything about its nature, of course, but just then the time approached that was favorable for discovering a little more detail.

The ring always maintains the



Cassini's drawing marking the discovery of Saturn's moon Rhea on December 23rd 1672.

same "attitude" in space, and as Saturn and Earth are moving around the Sun, we see the ring more or less "open" depending on the mutual positions. It can and does happen that we see the ring edge on. Since it is quite thin, it simply disappears from view in that position, except for observers with very powerful telescopes.

The other possible extreme is that we can see even the farther rim of the ring raised a bit above the rim of the sphere of the planet itself — Riccioli caught this position in his drawing. When Huyghens made his discovery, the ring presented itself in an intermediate aspect, but in the following years it "opened up" some more.

The first observers to notice a detail on the ring were the brothers Ball in Minehead, England, who reported that they had seen, in the late evening of October 13, 1665, that the ring showed a black line. But apparently no conclusions were drawn and the statement itself was more or less forgotten.

In 1668, Jean Dominique Cassini, following an invitation by Louis XIV of France, gave up his professorship at Bologna and moved to Paris. And just ten years after the announcement of the black line by the brothers Ball, Cassini saw it very clearly himself and continued to watch for it to see whether it was a permanent marking. In 1676, he made a drawing which he published (Fig. 10, bottom) and the main gap has been referred to as "Cassini's Division" ever since, and the "ring" became "rings."

Because Cassini watched Saturn so carefully for the sake of the black line on or in the ring, it was very nearly inevitable that he should also discover some of the other moons of Saturn. Both Japetus and Rhea are large, with a diameter of around 1000 miles each, and Cassini discovered both of them: Japetus in 1671 and Rhea in 1672 (Fig. 11). In 1684, he found two more: Tethys and Dione.

We've come a long way since those first portraits of major discoveries in the Solar System — but we couldn't have done it without them and similar patient observations. Unlike old family pictures, they aren't a bit laughable.

The real miracle is that so much was learned with so little in the way of equipment.

ANY QUESTIONS?

Would you please tell me what the Doppler effect is?

Mike Davenport
8014 Broadleaf Avenue
Van Nuys, Calif.

The Doppler effect is named after Christian Johann Doppler, an Austrian physicist who died in 1853. He did not "discover" it in the customary sense of the word; he reasoned that it had to exist. Experimental proof was later established by others.

To understand the principle, imagine that you have a gadget which sends out 1000 separate impulses per second, such as 1000 very short bursts of radio waves. If you move rapidly away from this gadget, you will receive less than 1000 impulses per second. If you approach it rapidly, you'll receive more than 1000 impulses per second.

A sound is actually a succession of such impulses, the sound waves. If you approach the source of the sound rapidly, you'll "receive" more of them per second, which sounds like a higher note. Moving away from the sound source produces a lower note.

Experimentally, this can be shown quite easily by driving past an electric bell. At the instant you pass it, it 'seems to acquire a lower pitch. The whistle of a train passing the observer seems to undergo the same change.

Doppler predicted this effect in 1842 and it was proved experimentally for sound waves for the first time by Buys-Ballot in 1845. Proof that light waves produce the Doppler effect was first given by Fizeau in 1848.

The Doppler effect is very useful for establishing the velocities of bodies receding from or approaching the observer along the line of sight.

Recently I was told by a friend that there may be some giant sloths still living. What is the case for this?

Frank E. Goodwyn
9709 Lorain Avenue
Silver Springs, Md.

The somewhat paradoxical answer is that there is no case for living giant sloths right now, but that some zoologists once thought they had one.

It was during the early decades of the 19th century that the giant sloth became known — as a fossil, naturally. The great problem then was just when it had lived and, more specifically, whether primitive Man in America and the giant sloth had ever met. When evidence for contemporary existence of giant sloth and Man in South America was found, another discovery came to light.

Almost at the southern end of the South American continent, there is an inlet which was named Ultima Esperanza, and a retired German sea captain by the name of Eberhard built himself a ranch there. Somewhere on that ranch was the skin of a large animal and when a piece of the skin came into the hands of a professional zoologist, it turned out to be the skin of a giant sloth.

It was then that Professor Florentino Ameghino of Argentina announced that the giant sloth probably was not extinct, but had merely grown very rare. He quoted the experience of one Ramón Lista who told of having been startled by a large unknown animal one night while camping in the interior.

Since the genus of giant sloth Ameghino expected to be surviving was *Mylodon*, he coined the name of *Neomylodon listai* for the living species.

A search of early descriptions of South American animals also yielded several suspicious passages. Ameghino said that the native languages contained a name for an animal which could only be *Neomylodon*. The result of all this was that a British newspaper organized an expedition.

The expedition return empty-handed and some later newspaper accounts may not be entirely truthful.

With modern methods like radio-carbon dating, it would be possible to establish the true age of that skin, but I don't believe that this has been done. However, various remains of giant sloth from Texas have been so dated; the figures ran to ages of from 8,000 to 12,000 years. This confirms the other evidence that early American Man and giant sloth met.

That the interior of South America may still harbor survivors cannot be categorically denied. But there is no proof, either.

— WILLY LEY
