# Galaxy
## SCIENCE FICTION

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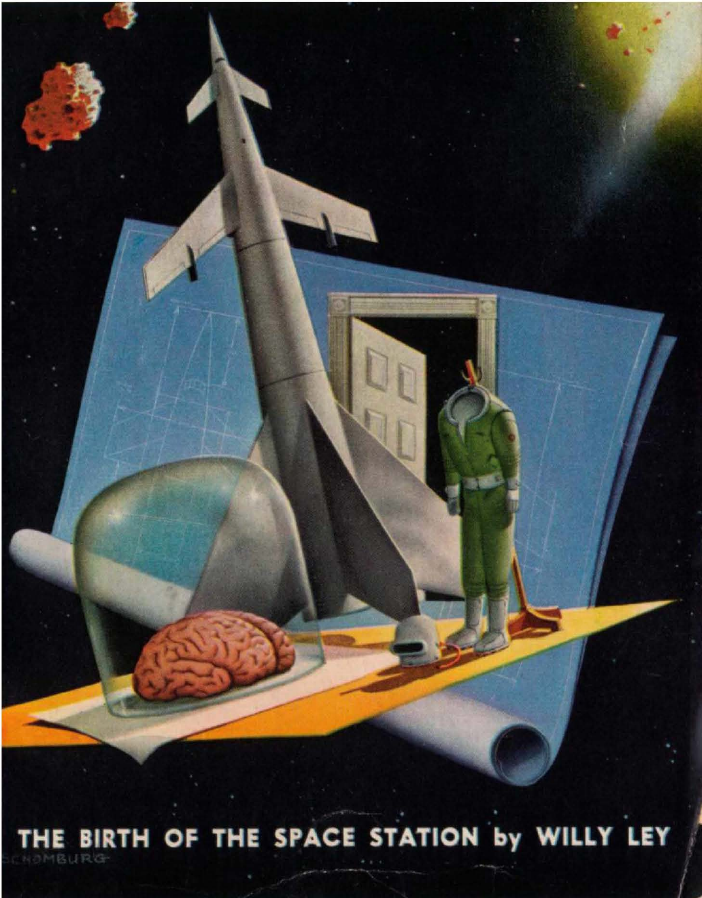
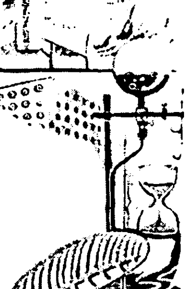
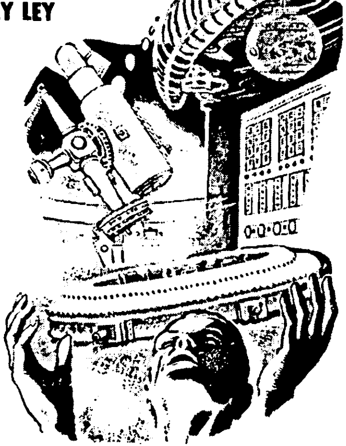






# For Your Information

By WILLY LEY





## THE BIRTH OF THE SPACE STATION

MOST ideas which finally took the shape of an invention have a long and usually complicated history. Talk about the submarine and you can, without straining, find dozens of examples of early thinking or dreaming about underwater travel.

The amount of early material on flying is almost overwhelming.

Even such a relatively simple machine as the typewriter can boast a lot of background—I remember the amazement with which I read a publication of the Society of German Engineers (VDI) some twenty years ago, for which a diligent researcher had collected dozens of century-old typewriters. Not just reports, but pictures of them and even a number of originals. Moreover, he had covered only the German-speaking countries of Europe.

Small wonder that nobody ever succeeded in writing a complete and reliable *History of All Inventions,* although there are at least a dozen books which bear some such title.

However, there are exceptions. The "idea" of photography, prior to the first picture actually taken, seems to have been only a few years old. As for earlier prophecy, there is just one old French science fiction novel in which something resembling photography was forecast.

Another exception is the X-ray. It did not have any earlier "history" at all. Dr. Konrad Röntgen discovered X-rays almost accidentally, immediately realized their value for surgery—especially military and industrial surgery —and that was that. Later, some German doctor discovered an older book, dating back about a quarter-century prior to the actual discovery, in which the author writing under the heading of *Medical Fairy Tales* had said, "We'll make the patient as transparent as a jelly-fish," and this was duly noted as the only "prediction" of the X-ray.

THE concept of the space station is such an exception, too. While the idea of space travel has a two-thousand-year history, the idea of the space station has virtually none. It appeared for the first time in 1897 in Kurd Lasswitz' famous novel *On Two Planets,* and it was introduced as a technological concept in 1923 in Prof. Herman Oberth's first scientific work on space travel by means of liquid fuel rockets. There is nothing between these two dates which may be said to have contributed to the concept.

True, old Herman Ganswindt told me that he had thought of space stations around 1880, when he toyed with the idea of reaction-propelled ships. Even if he remembered his youthful ideas correctly after so many years, he had not influenced anybody. At any event, he could not show me any documentation to prove he had mentioned the idea in public.

Nor can I bring myself to consider a certain French science fiction novel—now half a century old—as a contribution to the idea, even though the theme consisted in putting something in an orbit around the Earth a few thousand miles away.

This novel, *Sélénś Cie,* was based upon the notion that people could save money ordinarily spent for the illumination of cities and roads if only the Moon were not 240,000 miles away, but circled the Earth at an altitude of 3000 or 4000 miles. (That it would spend a lot of time in the Earth's shadow when at such a short distance, which would eliminate it as a source of illumination, was nowhere mentioned.) The story relates that a mountain of pure iron is discovered in French Equatorial Africa which, wound with cables, makes an enormous and powerful magnet. Why this should pull the Moon closer is incomprehensible, but in the story it did. The outcome was less than satisfactory—the Moon wins and pulls the iron mountain clean out of the African soil.

The concept of the space station thus originated in just two places: first in a novel and then in a scientific book. It has to be mentioned, however, that Kurd Lasswitz, the author of the novel, was a scientist himself, specifically an astronomer and professor of mathematics. The space station he thought up for his novel is so unique that it has never been imitated by any other writer, simply because it would have been such an obvious imitation.

When Lasswitz wrote the book (during the years 1895-97), it was more or less generally accepted in astronomical circles that the planet Mars is inhabited by intelligent beings. Other theoretical reasoning had it that the planets were the older the farther they were from the Sun. Mars, as an older planet, had provided the proper conditions for the origin of life at an earlier date, so intelligent life had also appeared much earlier than here. Hence the intelligent Martians should be far ahead of us in every respect.

LASSWITZ drew from this the conclusion that, if space travel were possible at all, the Martians would come to us long before we could go to them. In order to explain the delay (for they might just as well have arrived during the reign of Nabopolassar of Babylon or of Augustus Caesar), Lasswitz made the problem of space travel appear much more difficult than it actually is. And he made the solution of the problem such that it could not be solved on Earth.

On Mars, he postulated, there is a substance which happens to be transparent as glass, but which has the far more important property that it can also be made "transparent" to gravity. Lasswitz got around a few important theoretical difficulties by saying that the energy of gravity did not appear as gravity in treated material, but "in other forms of energy."

He also was careful to point out that just as glass cannot be made *completely* transparent to light, this substance could not be made completely transparent to gravity, but only to a point where the still remaining weight did not matter any more. And finally he made it clear that the substance retained its inertia.

A takeoff from the planet, under these conditions, would then proceed as follows:

The ship, spherical in shape for structural reasons, would be made virtually gravity-free. Instead of following its planet around the Sun, it would continue in a straight line, a tangent to the orbit. After waiting long enough, the planet would have receded far enough so that its gravitational field hardly influenced the ship, even if susceptibility to gravity were restored. But the Sun would then influence the ship and, by diligent and precalculated maneuvering in the gravitational fields, the ship could go from one planet to another, in a tedious and dangerous voyage. (You can see where H. G. Wells got his idea for *cavorite* for his story *The First Men in the Moon*.) But then reaction propulsion is added to the ships and the safety of trips and the duration are improved enormously.

Still, a takeoff has to be made from the poles of the planet, where there is no rotation to interfere. It is still better not to take off from the surface at all, but from a space station. For Earth, this is an absolute necessity because the marvelous substance of the Martians happens to deteriorate in the presence of water vapor.

Hence the Martians first equip their planet and then the Earth with two space stations each, placed vertically over the poles; in each case, one planet-radius from the surface. Travelers come from a polar installation on the ground to the space stations by way of a specialized conveyance built for just this purpose, and then transfer to the true spaceships.

In appearance, the space stations resemble the planet Saturn sliced in half in the plane of its rings. There is a hemispherical main dome which has eight cutouts for the ships to berth in, with ring-shaped galleries around. The whole can be rotated around its vertical axis so that the station can be turned in such a manner that no part of its structure will interfere with a departing or an incoming ship.

Of course, nothing that is not made of this substance from Mars could be made to stay in place without moving over one of the poles. But aside from this, you might have noticed the first appearance of a number of very "modern" ideas; for example, the need for a specialized vehicle, capable of penetrating the atmosphere, for the trip from the ground to the station, while the spaceships proper never enter an atmosphere and are, in fact, incapable of doing it.

NOW for the appearance of the space station concept in science. As has been mentioned, the idea was introduced by Professor Hermann Oberth in 1923 in the first edition of his book *Die Rakete zu den Planetenräumen* ("A Rocket into Interplanetary Space"). Even there it cropped up very much as an afterthought, on pages 86-88, which are the last pages of the last chapter.

In that last chapter, Prof. Oberth, after having investigated mathematically the characteristics of liquid fuel rockets and discussed possible design features, spoke about likely applications of large-size liquid fuel rockets. He had only two in mind at the time, one a high altitude research rocket — virtually what we now actually have with the rocket *Aerobee* — and one a man-carrying rocket ship for flights into space in the vicinity of Earth. Then he threw out a few estimates to indicate the general order of size which such rockets would have.

He estimated, for example, that a rocket ship for flights up to about 1000 miles with a pilot only would have a takeoff weight of 300 metric tons and that the rocket ship built for two men would need a takeoff weight of at least 400 metric tons. After that he started a new paragraph, writing (I am now translating from the original book):

"If we force such large-size rockets to circle the Earth, the rocket will behave like a small moon. Such rockets do not even have to be designed for landing. Contact between them and the Earth can be maintained by means of smaller rockets so that the large ones (let's call them observing stations) can be rebuilt in the orbit the better to suit their real purpose. If the continuing state of apparent weightlessness should have undesirable consequences, which, however, I doubt, one could connect two such rockets by wire ropes a few kilometers long and make them rotate around each other."

Here you have the whole concept in a few sentences: The rocket which stays in space and which is gradually changed around to such an extent that it cannot even land anymore; the smaller transport rockets; the idea of substituting centrifugal acceleration for gravity, if needed. Then he went on to outline a few possible uses:

"With their powerful instruments, they would be able to see fine detail on Earth and could communicate by means of mirrors reflecting sunlight. [Remember that this was written about 1921, when radio was very much in its infancy.—W.L.] This might be useful for communication with places on the ground which have no cable connections and which cannot be reached by electric waves. Since they, provided the sky is clear, could see a candle at night and the reflection from a hand mirror by day, provided only that they know where and when to look, they could maintain communications between expeditions and their homeland, colonies and their motherland, ships at sea, etc. . . .

"The strategic value is obvious especially in the case of war in areas of low population density; they might either belong to one of the two countries at war or sell their services at high rates to one of the combatants . . . The station [at this point the term "station" is used for the first time] would notice every iceberg and warn ships . . . the catastrophe of the *Titanic* in 1912 would have been avoided by such means."

AND then Oberth added another completely new idea which had not been voiced before anywhere.

"All this," he wrote, "amounts to practical advantages. But an even greater advantage could be gained in the following manner: one could spread a large circular wire net simply by rotating it around its center. Small plane metal mirrors could be fitted into the spaces between the wires and their position relative to the wire net could be controlled electrically from the station. The mirror as a whole should rotate around the Earth in a plane which forms a right angle with the plane of the Earth's orbit. The wire net would be inclined to the direction of the Sun's rays by 45°. By proper adjustment of the positions of the single facets, one could either concentrate the reflected sunlight on specific points of the ground or could diffuse it over large areas, or, if not needed, make the whole beam miss the Earth.

If, for example, the mirror is 1000 kilometers (600 miles) distant, the image of the Sun from each facet would have a diameter of 10 kilometers; if they are made to coincide, the energy would be concentrated in an area of 78 square kilometers. Since the mirror can have any size desired, it could have colossal effects. It would be possible, for example, to keep the shipping lane to Spitsbergen and the North Siberian ports ice-free by such concentrated sunlight.

If the diameter of the mirror is 100 kilometers, it could make large areas in the North habitable by means of diffused sunlight. In the middle latitudes, it could prevent sudden drops in temperature in Spring and Fall and save the fruit and vegetable crops of whole countries. It is especially important that the mirror is not stationary over any one point of Earth and is therefore capable of rendering all these services . . ."

After a discussion of the most suitable material for the mirror (Oberth believed sodium metal would be best), and the estimated costs (far too low), he continued:

"The observing station could also be a refueling station. If the hydrogen and oxygen [the fuels Oberth had in mind] are shielded against solar radiation, they'll keep for any length of time in the solid state. A rocket which is refueled at the station is no longer hampered by air resistance and not much by the Earth's gravitation . . . Furthermore, it no longer needs a high velocity of its own. In the first place, the potential of the Earth is lower at the distance of the station. In the second place, the rocket only needs to make up the difference between the required final velocity and the velocity of the station which is, in round figures, six kilometers per second.

If we now connect a large sphere of sodium metal which was assembled and filled with fuel in the station's orbit with a small solidly constructed rocket which pushes the "fuel sphere" ahead and draws its fuel from the sphere, we get a highly efficient apparatus which should be capable of flying to other planets."

Oberth's first book stopped at that point.

Then the concept of the station in space was adopted by others who added their own ideas. How the evolution of the space station progressed will be discussed here next month.

—WILLY LEY

## ANY QUESTIONS?

*I know of binaries and I know that there are triple systems of stars, two stars moving around each other and one of them a binary itself. Are there systems of more stars than three and, if so, are they stable?*

*Gloria Quinn*

*2122 Miller St.*
*(city missing)*

**If you had mentioned your city, you would have had your answer weeks ago. The answer is yes.**

**One of the examples which are easily found in the sky is the star *Zeta Ursae Majoris*, the middle star in the "handle" of the Big Dipper. It is, as you can easily see, a naked-eye binary. The Arabic name of the brighter star is *Mizar* and that of the faint companion is *Alkor*; the latter word is said to mean "little rider". It was Sir William Herschel who found that the larger of this pair was a binary, the two components of which are now known to swing around one another with a period of 1.83 years. Later it was found that the fainter star is a binary too, with a period of only four days. And the smaller binary moves around the common center of gravity with the bigger one in sixty years.**

**The most amazing collection of multiples of binaries can be found in the constellation which the ancients called *Gemini*, the Twins, because of the two bright stars Castor and Pollux. Both are not merely binaries but multiple systems. Seen with the naked eye, Castor looks like a single bright star but even a comparatively small telescope shows that it is a binary, the two components about 80 times farther away from each other than the earth is from the sun. Then it turned out that each one of these two white stars is a binary itself and a faint reddish star, not far away, was found to be a binary, too. So Castor consists of two white twins, with periods of three and nine days, respectively. The two pairs swing around their common center of gravity in 340 years. The faint red star, is, as mentioned, a twin too, with a period of about 19 hours. And the red twins move slowly around the system of the two bright twins. They haven't been under observation long enough to establish their period but it must be many thousands of years. —As to your second question: to the best of our knowledge these systems are stable.**

*I recently read in a local paper that a German clergyman had found a city in the sea off the German coast. He is said to have expressed his belief that he has found Plato's Atlantis. Do you have any opinion about this?*

*(Name withheld)*
*Lansing, Minn.*

**I haven't read this report even though I receive several German scientific periodicals. But I am quite certain that the**

sunken city which the German clergyman found is *not* Plato's Atlantis—a remark which may have been added by the newspaperman who wrote the story. The mention of Atlantis, no matter who made it, is probably just a hangover from those days when every sunken city, or suspicion of a sunken city, was linked with the Platonic dialogues. It can be considered pretty well established by now that the "model" for Plato's Atlantis was the city of Tartessos, the Biblical Tarshish, in western Spain; the same city which served as the model for Homer's Scheria in the *Odyssey.*

On the other hand I feel reasonably sure that the German clergyman found something. Along the northern coast of Germany there are a number of remains of what looks like old roads which seem to lead straight into the sea. And there are also quite a number of local legends of remains of old cities and towns at the bottom of the sea, but generally close enough to present day land so that the land is still clearly in sight from the alleged locations of the old cities. The legends have a tendency to exaggerate, but most of them seem to be founded on some fact. Often these former cities—or better, townships—are generally referred to as "vinetas," which is supposed to be the name of the most famous of them.

Detail is awfully hard to ascertain. It seems that about a thousand years ago a number of old townships were abandoned because they had been established too close to the shore line. It is even possible that the sea level rose somewhat as a late result of the melting of Ice Age glaciers. At any event the finding of a sunken settlement off the German coast is not at all unlikely.

I may add a few words about the "city" of Vineta, the supposed name of which is sometimes used as a generic name. The former existence of that city is historically well-established; it existed during the tenth and eleventh centuries and had been built by a Slavonic people, the Venden or Wenden. But the original name of the city was Jumne, the version Vineta originated by way of Latinization on the part of later chroniclers. They first transliterated JUMNE as IVMNETA which soon came to be written VIMNETA and finally VINETA. Although nobody doubted its former existence, and historians were agreed that the sea finally conquered merely an abandoned city destroyed by war, there was no agreement about where it originally stood. It was known that its inhabitants could reach it from the hinterland by travelling downstream on the Oder River, but that still left a comparatively large area where it could have been. Only a quarter century ago did historians succeed in finding a place which was in full agreement with all the sources. It happened to be quite near a small seashore resort which later became famous. Name of Peenemünde.

*If there is a layer of hydrogen in the upper atmosphere, is there not danger that one day a rocket will be fired high enough to enter and explode this hydrogen layer?*

*Raymond Wilkes*
*Box* 114
*Greenfield, Missouri*

**The answer to that one is "no" and this answer can be backed up with a number of good reasons. In the first place the idea that there is a layer of pure hydrogen in the upper atmosphere (proposed originally by Svante Arrhenius) has been dropped. In the second place even if there were such a layer it would be enormously attenuated and should properly be called "a vacuum with occasional hydrogen atoms in it." But even if there were a layer of pure hydrogen (which there isn't) and even if it had a density comparable to that at sea level (which is impossible) it would still not be ignited by a rocket's exhaust blast. Igniting hydrogen means to start combustion which requires oxygen. Without oxygen the hydrogen could not explode and in a pure hydrogen layer there would, of course, be no oxygen. Finally, if there were such a layer and if enough oxygen were present too, the whole would have been ignited by meteorites millions of years ago.**

*When the distance from one planet to another is mentioned, do they measure from the center of one to center of the other or do they start measuring from the edge?*

*Loren Shaw*
12605 *S.E. Division*
*Portland* 66, *Oregon*

**All astronomical distances are center-to-center distances, not surface-to-surface distances. This is a fundamental rule but most of the time it would not matter much if surface-to-surface distance were used by somebody by mistake. In the case of Earth and Moon, the difference between center-to-center distance and surface-to-surface distance is just about 5000 miles. But the center-to-center distance varies itself,**

from a minimum of 221,460 miles to a maximum of 252,-700 miles. In the case of Mars and Earth the difference becomes negligible, the difference between surface-to-surface and center-to-center distances is on the order of 6000 miles while the closest possible distance is 35 *million* miles.

*How does the H-bomb work?*
*Frank Goodwyn, Jr.*
*9709 Lorain Avenue*
*Silver Spring, Md.*

This question is a somewhat large order,—not even counting the fact that the classifications which are probably stamped on each and every document pertaining to the H-bomb are terrifying themselves. But since this question will probably come in from numerous readers I'll try to answer it to the best of my ability. Let's begin with the "old fashioned" A-bomb. This is a "fission bomb," which means that the atoms of uranium-235 or of plutonium break apart, into two pieces of about equal mass, releasing energy in the process. The H-bomb is known to be a "fusion bomb" in which hydrogen atoms are fused together into heavier atoms, presumably helium, a process which also releases energy. This fusion of hydrogen atoms is the process which keeps the sun and most of the other stars visible in the sky going. In our sun the process takes place in six successive stages which fuse four hydrogen atoms into one helium atom; a carbon atom is involved in this process which has been called the Solar Phoenix Reaction because that hydrogen atom which initiates the first step re-appears unchanged at the end of the sixth step so that it can start all over again.

The fusion process in the H-bomb is in all probability quite different from the Solar Phoenix Reaction. But it has to be mentioned first that there are three kinds of hydrogen atoms, of three different weights and the rarer the heavier they are. The first is ordinary hydrogen, the second, of double the weight, is "heavy hydrogen" or Deuterium. The third, of thrice the weight of ordinary hydrogen is called Tritium. Ordinarily two "deuterons" would not fuse into one helium atom and no "triton" would consider fusing with a "proton," the nucleus of the ordinary hydrogen atom. The nuclei, having like electric charges, would repel one another if they came too close. Only if they move very fast can the energy of movement overcome the repulsion. It is easy to make small material particles move fast, all one has to do is to apply heat and thermal motion will be the result. All this is not precisely new knowledge, the main difficulty was to find a sufficiently intensive heat source so that the thermal motion would be violent enough to do what it was supposed to do. But the heat required was such that even an electric arc was icy cold by comparison. Not even the surface of our sun is hot enough for this purpose, one had to go into stellar interiors to find places with the requisite number of degrees of temperature. Until the A-bomb came along. The A-bomb does produce enough heat, even if only for a fraction of a second. It is for this reason that it has been said that the A-bomb is the "fuze" or "starter" for the H-bomb. The hydrogen in the H-bomb is probably not ordinary hydrogen; it would be asking too much to expect four atoms to have a head-on collision at precisely the right instant. But one can expect two deuterons to collide, or a triton to collide with a proton. Presumably, then, the hydrogen part of the H-bomb is a mixture of all three isotopes of hydrogen. Obviously there must be an optimum mixture. Obviously this optimum mixture is Top-Top Secret, for good and sufficient reasons.

All this, of course, is valid only with the proviso that the H-bomb is actually based on the reasoning given.

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## WHAT'S YOUR PROBLEM?

Science has become so complex and confusing, even to scientists, that there must be *some* question you'd like Willy Ley to explain clearly, authoritatively and in everyday English.

As you can see for yourself, he's an expert on clarification.

It should also be apparent that he is not a scientific snob—FOR YOUR INFORMATION is run for the benefit of laymen, not scientists—so there's no reason to be ashamed to ask *any* question in his field.

All we request is that you hold your questions down to one or two at a time (you can always send in more, later) and type or print legibly. Please add your name and address—we'll withhold them if you want us to—because there isn't room to answer all queries in the magazine and *every one of the others* is answered by mail.

Now . . . what was it you wanted to know?