Galaxy
SCIENCE FICTION

SEPTEMBER 1952

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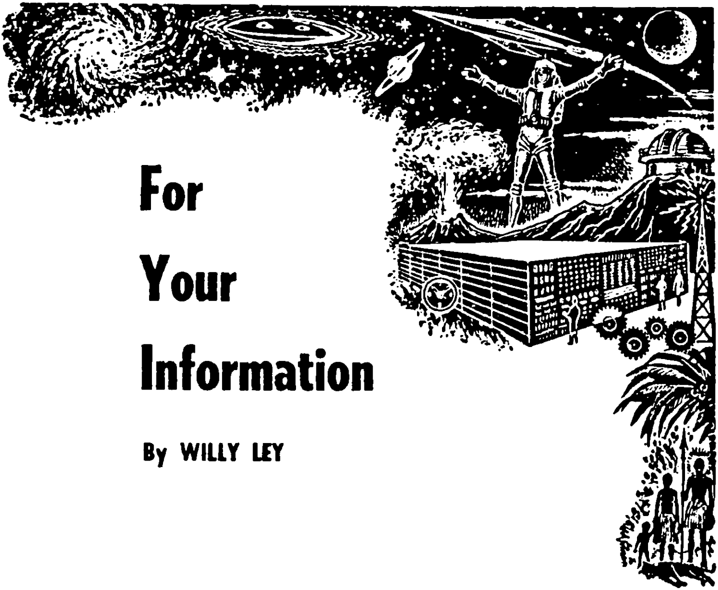

For Your Information

By WILLY LEY

SPACE TRAVEL BY 1960?

THIS issue's cover is something of "instant recognition" to science fiction readers—it shows a spaceship takeoff. Science fiction readers would have recognized such a picture even twenty years ago. Now, however, the same picture might be on the cover of *any* magazine and the majority of the readers of that magazine would know what it is supposed

to show. That is vast progress.

Fortunately, that is not the only kind of progress that has been made during the last two decades. In 1932, one could only prophesy that rocket research would eventually be taken up on a large scale, that it would be a long and difficult task, but that the goal of the manned spaceship would be at the end of the road. Now large-scale rocket research is going on, formerly "incredible feats" have been accomplished, and the goal of the spaceship appears so near that it will need only one concerted and serious effort to reach it.

After all, even though nobody has yet built a manned spaceship, space has already been pierced. During lectures I often draw a segment of a circle on the blackboard, representing the surface of the Earth. Then I draw a similar line at a scale distance of 60 miles above the first, which is the altitude where the air has become so attenuated that no control surface would work any more, even at speeds of several miles per second. That altitude has been surpassed by dozens of V-2, *Aerobee* and *Viking* rockets. Then I draw another line at a scale distance of 110 miles, where the missile as a whole no longer encounters detectable air resistance and where "space begins." That height has been exceeded by several V-2 rockets, at least one *Viking* and, of course, the *WAC-Corporal* which formed the "upper stage" of a V-2 in 1949 and soared to a peak altitude of 250 miles.

Finally, I add one line quite near the ground. The scale distance is 60,000 feet, which is the altitude. where air pressure has fallen so low that the blood of a pilot exposed to it would begin to boil—as you know, the lower the air pressure, the lower the boiling point of a given liquid. Anything which is to be piloted above 60,000 feet, therefore, has to have what might be called "full spaceship equipment" as far as pilot comfort is concerned. And rocket-propelled aircraft has been piloted to beyond 60,000 feet.

It is easy to see that the complex of problems represented by the concept of the manned spaceship is no longer completely unknown territory. Deep inroads have been made into it from various directions for different purposes. High altitude research has furnished much basic information. Missile design has produced what can be called "spaceship instrumentation." High-altitude fighter design has attached and obviously solved the problem of the spaceship cabin.

All right, then, provided that the necessary concerted effort is made, and the money is provided, when will we get the first manned spaceship? If the money is provided soon, I think that it is a safe answer to say: *in about ten years.*

OF course, the first spaceship won't go to Mars or even to the Moon. In fact, we probably won't be able to take off *directly* for the Moon or for Mars for many years to come. As far as the clearly foreseeable future is concerned, such trips will have to start from a space station which circles the Earth. The voyage of the first spaceship, as I have repeatedly said, will go literally nowhere. It will be a vertical takeoff from base, followed by a tilt in an easterly direction so that the ship will travel along an ellipse around the Earth. The captain will stay "up" until all the service tests have been completed, the observing program carried out, or until everybody aboard is thoroughly bored. Then he'll land again, trying to make it as close to base as he can.

For such a trip, the spaceship has to reach a velocity of about 4.5 miles (7 kilometers) per second. If we want to do that with present-day fuels, the ship would have to have an overall mass-ratio of 33:1, which means that its takeoff mass would have to be 33 times as high as its remaining mass, the mass of the ship proper, and its payload.

Such a mass-ratio can only be built as a three-stage rocket, so that the two lower stages can drop off when their fuel supply has been exhausted. That way, they pass their energy on to the final stage, but not their dead weight.

The mass-ratio of 33:1 was calculated on the basis of an exhaust velocity of 2 kilometers per second for rocket fuels. The fuels we have now in reality can do somewhat better than that and further fuel inprovement would, of course, be one of the phases of the effort. It is probably justified to expect an exhaust velocity of 3 kilometers per second within a few years. In that case, the mass-ratio for the same trip would have to be 10.25 : 1 and a spaceship with a takeoff mass of "only" ten times the remaining mass can easily be built as a two-step ship.

You can, if you wish, dream about an exhaust velocity of 5 kilometers or about 3 miles per second, in which case your mass-ratio would drop to 4:1. That is about the mass-ratio of the *Viking* rocket and the result would be a single ship, no longer broken up into steps, even though a booster might be desirable for reasons of stability during takeoff.

Well, why not dream about this? Don't we have atomic energy which should make an exhaust velocity of even 5 kilometers per second seem slow? Unfortunately, we don't, meaning that we do not yet know how to handle it properly for this purpose. We know how to make an atomic explosion. We know how to make artificial radioactivity. We know how to boil water in an atomic pile with the aid of exploding uranium nuclei. But we don't know how to utilize atomic energy for rocket propulsion. That is still a secret of Nature and it is not too probable that it already is a Secret (with a capital "s") of the Atomic Energy Commission.

The heat-an-inert-liquid-with-an-atomic-pile method is not too promising. The idea is this: In a chemical fuel, the combustion of the fuel provides both heat and combustion gases which are expelled by the rocket as reaction mass. If we could use an atomic pile, almost anything liquid would serve as reaction mass and the pile would provide the heat. That sounds lovely except that the heat from the pile has to be transferred to the reaction mass and that takes time. Chemical combustion heats much faster, unless you can run the pile at an enormously high temperature.

Doctors Malina and Summerfield once published calculations showing just how hot the pile would have to be run. If we wanted an exhaust velocity of 7 kilometers per second (which would bring the mass-ratio of our ship down to a little less than 3:1) the chamber temperature, using hydrogen as reaction mass, would have to be 5000 degrees F. and the heat required would be almost 21,000 BTU per pound!

While a rocket engineer can safely promise a three-stage spaceship working on ordinary chemical fuels, the atomic engineer could not (and would not) promise an atomic pile of such a performance.

All of which does not mean that there won't be a time when we can build atomic powered spaceships. It just means that a new discovery in the field of atomic engineering has to come first.

But the liquid-fuel rocket engineer does not need new discoveries to build a spaceship. He just needs some time and a lot of money—say, several billion dollars and probably no more than ten years.

Will the funds be appropriated and the project be begun? I think so. It's the next logical step, and logical steps have a way of forcing men to take them.

But we'll have to start right

away if we want to achieve space flight by 1960.

MORE ON C-14

PROF. Libby's C-14 method for dating the past has scored another triumph: we now know the age of Stonehenge. Stonehenge, situated some nine miles from Salisbury, England, on a large plain, has always excited the imagination of those who had seen it. Geoffroy of Monmouth, in 1130, took it to be a Roman monument built with the aid of Merlin—strangely enough, none of the Roman writers mentions it—and John Webb (1625) thought that it had been a Roman temple. John Aubrey (1655) took it to be a Druid temple instead and William Stukely (1723) "knew" that it had been built by Egyptian druids who had left their homeland in 460 B.C. to visit their British friends.

If you add the explanations of amateurs, astrologers and occultists, you get a nice list of possible builders: They were either men of the Late Stone Age, or men of the Early Bronze Age, or men of the Late Bronze Age. Or else visiting Atlanteans, Lemurians or Egyptians. Or visitors from space who wanted to impress the natives and also leave a landmark behind.

The absence of any literary mention prior to 1130 did make it a tough case, for Stonehenge was evidently much older and must have been conspicuous for as long as it existed. The only date which made any sense at all was still based on at least two assumptions. In 1901, Sir Norman Lockyer assumed that whoever had built Stonehenge had worshiped the Sun and that the monument was oriented in such a manner that the midsummer Sun would rise over the central sacrificial stone. That gave 1680 B.C. as the probable building date. Of course, one could reject the assumption that the builders were Sun-worshipers and thereby reject the dating, too.

Stonehenge naturally cannot be dated directly by the carbon-14 method, since this works only on material of organic origin. Recently, however, a so-far untouched sacrificial pit was uncovered and the charcoal it contained could be dated. The result was 1848 B.C. with a margin of error of 275 years either way. It seems that Sir Norman Lockyer's ideas were correct.

But we still don't know who built it.

THE PLANT THAT WASN'T

IN case you like a slightly incredible story, consider the case of the coughing plant. When people cough, the purpose is to remove something irritating from the throat; dust is the simplest case. One day, more than half a century ago, a few people were sitting together in Munich and one who happened to have a cold coughed frequently. The conversation veered to the subject of coughing, its mechanism and its purpose and one suggested that it would be useful if the pores of the skin could cough. "Yes," another chimed in, "that would be especially useful for plants; they don't like to have their pores choked by dust, either." Whereupon one member of the group grew thoughtful and said: "Supposing there were a coughing plant, wonder what its botanical name would be." "Easy," said somebody else. "Cough in Latin is *tussis*. Obviously, the name would be *Tussissia* something or other."

The offshoot of the evening was a little article discussing the discovery of *Tussissia australis,* which was published by the Munich paper *Münchner Neueste Nachrichten*. It was not a hoax because the date of the paper was the first of April, 1900, and anybody on the continent knows better than to believe anything published in an April 1st issue. Printed April-fooling on a large scale is an old continental custom—but sometimes somebody neglects to look at the dateline.

A few weeks later, a well-reputed German daily printed a little essay on the marvelous tropical plant *Tussissia,* related to the red-flowered string bean of northern Europe.

Another two weeks later, said essay could be read in fine French in the *Journal de la Santé* in Paris. The *Journal de la Santé* reached Sydney in Australia as fast as the mails of the year 1900 would carry it. Three days after arrival, the story could be read, in English, in the *Sydney Mail*.

I don't know just where the coughing plant "grew" for the following years, but in 1919 it was back in Germany, appearing almost simultaneously in the *Rhenish - Westphalian Gazette* and in the *Kölnische Zeitung*. The editors of both apparently believed that it had been a discovery made during the war years and that the news had not penetrated through the front lines.

Five years after that, the coughing plant made one more appearance in an important daily paper published in Hamburg and was taken from there by several Scandinavian publications.

Science fiction editors, beware! If among the "odd little facts of science" which come to your desk is something about a coughing plant — no matter under what Latin name—it is merely an old joke that miscarried.

TWINKLE TWINKLE NEEDLEBEAM

HERE'S a minor item that may come in handy when your children start asking questions about little stars that twinkle. Everybody knows that those distant suns which we, by force of habit, still call "fixed stars" have a twinkling light. A good many people also know that the planets do not. I have often taken advantage of that fact when it came to pointing out planets at night, saying something like: "See that bright star over that tree top? Now look a little to the right from there and you'll see two stars which are fairly close together. The one that does not twinkle is Saturn."

When somebody recently asked, "Why doesn't it twinkle, too?" I had to draw a few diagrams in my mind in order to explain. The twinkling is caused mostly in the lowermost five miles of the atmosphere. It is due to minor disturbances, tiny volumes of greater or lesser density and temperature. Because they are tiny, the presence or absence of twinkle turns out to be a question of beam width.

Let's say that the light beam which enters the eye is two millimeters wide. That is the apex of a cone of light, the base of which is the diameter of the star. Even though the base of that cone may have a diameter of 1½ million miles for a fair-sized star, it can easily be 58,800,000 million miles away. In fact, it is usually much more because the distance just mentioned is merely ten light-years.

Jupiter's diameter is only 86,700 miles, but when the planet looks particularly bright, it is no more than some 400 million miles away. The result of this relationship is that, at a height of about three miles, the light beam from Jupiter has a diameter of several inches. The irregularities of the atmosphere affect only a fraction of that beam at a time.

But the light beam from a distant sun is a "needlebeam." Even at ten miles, it is still just two millimeters. Hence that beam is affected for its full width and seems to twinkle.

—WILLY LEY

ANY QUESTIONS?

Why do a few glaciers, like the Juneau glacier, increase in size although climatologists seem to be in agreement that Earth's weather is getting warmer. Is it?

Joe Gibson
24 Kensington Avenue
Jersey City 4, N. J.

I believe that the agreement on a gradual and slight but persistent increase in the "annual mean temperature" for the whole planet is unanimous. There is little doubt that the fringes of the antarctic ice are slowly crumbling. Icebergs do not seem to drift as far in the direction of the equator as reported from the past, and they also seem to be smaller in size. It is definitely established that virtually all glaciers are slowly receding.

It is not yet known just what is the cause of all this, but there is a kind of general answer: We are still pulling out of the last Ice Age. We know from geological evidence that the Earth was almost always considerably warmer than it is now. There were only two comparatively short periods when it was colder than it is now—the glaciation of the Permian period and the recent one.

Of the recent one, we know that it had at least three "interglacial" periods (the Permian glaciation probably had similar interruptions, but that was too long ago to establish detail), each of which was longer than the period of glaciation. Since the last glaciation missed by just a few thousand years falling into earliest historical times, we are evidently still in the process of pulling out of it.

Whether we are in another "interglacial period" or actually at the end of a cold climate period is something we could answer only if we were certain of the underlying reasons for such cold spells. But in spite of more than a dozen hypotheses, published in more than ten dozen weighty volumes, we simply are not yet sure what caused the Ice Age.

That a single glacier like Juneau quoted by my correspondent may grow, while the others dwindle, is interesting but not inexplicable. Because more ice thaws, and more water evaporates, a specific glacier elsewhere might get more "food" than it would otherwise.

If you send a rocket up into a 24- hour orbit, would you need any lateral motion? I mean the rocket has the motion it had on the surface and travels around its orbit once every 24 hours, anyway.

Robert McArthur
3470 23rd Street SE
Washington D. C.

Instead of just saying yes or no, I'll let you figure it out for yourself.

A rocket standing at a point at the equator is, in round figures, 3950 miles from the center of the Earth. It has a lateral motion which we'll call "A" and which carries it once every 24 hours around the center of the Earth. The circle it describes has a length of 7900 miles (diameter of the Earth) times *pi*.

A rocket in the 24-hour orbit is 22,300 miles above sea level or $22{,}300 + 3950 = 26{,}250$ miles from the center of the Earth. The diameter of its orbit is, consequently, 52,500 miles. The length of that orbit is 52,500 times *pi* miles. This distance must be covered every 24 hours.

Is the surface velocity "A" enough for that?

In a forthcoming issue, will you please discuss the force of gravity a little? Many science fiction stories seem to take it for granted that some way of overcoming it will be found.

Harold P. Pond
25 *Ship Street*
Brighton, England

The answer to the second sentence is simple—the authors of these stories either indulged in wishful thinking or else they needed a device for making their plotting easier.

As for the first sentence, I am sorry to report that there is no answer. Or at least not yet.

All we know about gravity is that absolutely nothing can be done to or about it. It does obey the inverse square law, but that is the sum total of our knowledge. And that doesn't mean anything, for the inverse square law (the intensity is one-fourth at twice the distance, one-ninth at three times the distance, etc.) is merely the geometrical fact that the area of a sphere is proportional to the square of its radius. Hence the inverse square law also applies to light and heat and other phenomena.

Since there is not much "answer" in this case, I feel like adding a little story which is quite significant in several respects. Around the year 1895, a French newspaper carried a long article with a title like "Krupp's Secret Revealed." Friedrich Krupp in Essen, already famous as a gun manufacturer, had at about that time astonished professional circles by the size and weight of castings and forgings produced for a number of purposes. The article in that French paper "told for the first time" just how Krupp's engineers could cope with pieces weighing from twenty tons up.

The secret was a real secret—somewhere in Krupp's factory there was a gravity-free assembly hall!

The writer of the article

could not tell how that hall was made to be gravity-free, but he had spoken to an eyewitness who had described to him how a 12-ton gun barrel was lifted into place on its undercarriage hanging from a loop of bailing wire; and how a casting of the stern of a ship, comprising two propeller housings and the seating for the rudder shaft, had been manipulated by a single workman with a rope. The conclusion was, of course, that France had to learn Krupp's secret in order to compete with Germany.

Naturally, this article was picked up by other papers and magazines, both French and German. Several Germans felt that their positions were important enough so that they should be invited to see the gravity-free assembly hall. When Krupp's replied that there was no such thing, they were annoyed and did not believe it: "Of course, I realize the need for military secrecy, but since I am a personal advisor to His Grace I strongly feel, etc., etc."

Krupp's knew it wasn't so, but, mostly in self-defense, they started tracking the origin of the story.

It turned out to be absurdly simple.

One night, at a party, Krupp's feats in casting and forging enormous pieces had been discussed at great length and one of the men present, who happened to be an employee of Krupp's, had been questioned and questioned, mostly about things he did not know himself. Finally, to end the interminable discussion, he'd revealed the "secret" of the gravity-free assembly hall.

Unfortunately, it was merely a tall tale, but it seems to have had at least one fine literary result—H. G. Wells's *The First Men in the Moon* was probably inspired by it. In that story, if you remember, he used a gravity-neutralizing substance for interplanetary flight. He was just the first of many to do so.

But truth often follows science fiction, so we may yet find a way to overcome gravity. It might not look like a good betting proposition, but neither were many achievements of the past few decades.