Galaxy
SCIENCE FICTION

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SPY

By J. T. McIntosh

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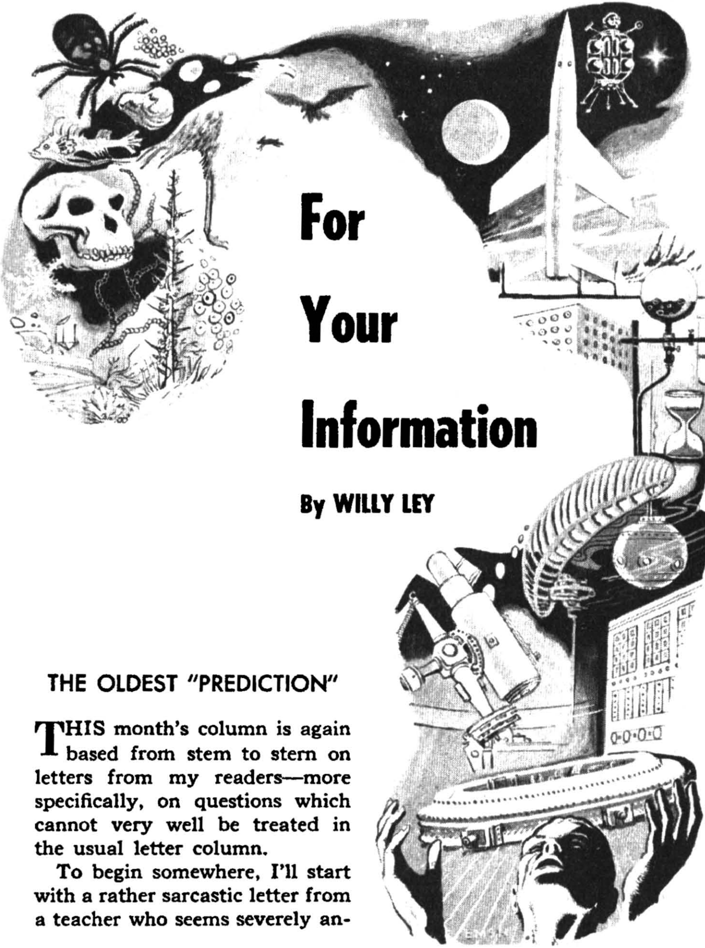


For Your Information

By WILLY LEY

THE OLDEST "PREDICTION"

THIS month's column is again based from stem to stern on letters from my readers—more specifically, on questions which cannot very well be treated in the usual letter column.

To begin somewhere, I'll start with a rather sarcastic letter from a teacher who seems severely annoyed by the reading habits of some of her pupils.

"If you science fictionists," she wrote, "call some vague statements in one of Jules Verne's stories a prediction of the periscope and some remarks about unbreakable glass a prediction of transparent plastics, why don't you call Munchausen's (*sic*) story about the post horn in which the melodies froze until thawed out a prediction of the gramophone?"

You're perfectly right, madam—why not, indeed? Let's proceed to do exactly as you ironically suggest.

THE theme has been considered sufficiently meritorious to be treated at length in an erudite paper with the title *Antiphanes und Münchhausen* by the Historic-Philosophical Department of the Academy of Sciences of Vienna. The story of the "frozen words" did not occur only in the fabulous Baron's fabulous adventures, but goes back to the "pseudo - Mandeville" and, via Rabelais, to classical antiquity, the trace ending (for the present) at about 400 B.C. The oldest known source is Antiphanes Bergaios, who must not be confused with the Antiphanes who was a playwright of Athens.

Circumstances vary in the many different versions, but the idea is always the same: the preservation of sounds, particularly speech.

The most appealing version, in my opinion, is the one of Baldassare Castiglione, who died in 1529. He tells it as the "true experience" of an Italian merchant of Lucca who, in the course of his travels and trading, had come to Poland.

"Since he was in Poland, he decided to buy a large number of sable pelts which he wanted to bring back to Italy for a big profit. Because the King of Poland and the Duke of Muscovy were at war, he could not travel to Moscow personally, but succeeded, through intermediaries, in having a few Muscovite merchants come to the border with their sables. When he came to the shores of the Borysthenes (Dniepr river), he found it frozen as hard as a stone.

"The two parties signaled to each other across the frozen river and the Muscovites began to shout the prices they demanded for their sables. But the cold was so intense that the merchant of Lucca and his interpreters could not hear the words, for they froze before they had traversed the width of the river. The Poles, who were used to this occurrence, decided to light a large bonfire in the middle of the river because, they reasoned, the words had remained warm for about this distance. The river was frozen so hard that it could easily stand the fire.

"When the bonfire in the middle of the river was lighted, the words which had been frozen an hour earlier began to thaw and they could be understood clearly even though their originators had departed. The merchant decided, however, that the prices asked were too high and discarded the project, returning home without any sables."

I grant that it's impossible to consider this a direct and explicit prediction of the phonograph. But the idea is identical; we *have* learned how to "freeze" words on wax and tape.

Verne's description of the periscope is anything but vague; there is no important difference between his prediction and the reality.

He was necessarily less clear about plastics, for only one, celluloid, was in existence in his day. Nevertheless, he used that as a basis for extrapolation, envisioning a stronger and better substance. So did the chemists who brought about our present-day plastics.

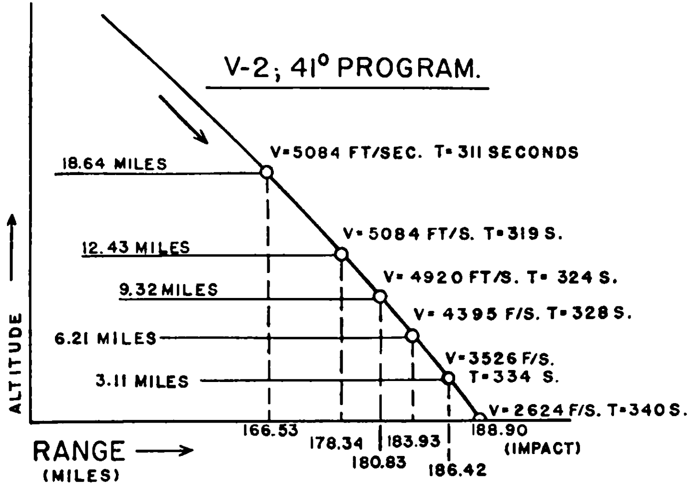
However, my irritated correspondent misreads the function of science fiction. Its purpose is to explore entertainingly, not to predict.

But I will make a personal prediction: You, madam, will live to see many of its guesses come true. You already have, but you will see more.

IMPACT END OF TRAJECTORY

RECENTLY I had several letters from British readers asking for clarification of a number of points having to do with the impact end of a V-2 trajectory. My correspondents did not live in London when the V-2 were falling out of the stratosphere and do not live there now, but they talked to people who had been there during the rocket attack. Apparently they got quite contradictory reports and finally drew up a short list of questions which might be of general interest.

One of my correspondents states that an informant insists that at least some of the V-2s were equipped with a proximity fuze. He must be mistaken, for we have the word of the former commanding officer of the Peenemünde Institute, General Dr. Dornberger, that the Germans did not have a proximity fuze. The concept was familiar to them and they had laboratory models, but they did not progress to production. The warheads of the rockets were armed with impact fuzes.



Figures along trajectory show velocity V in feet per second and time T elapsed since takeoff. "41° Program" refers to angle of firing (after vertical takeoff). It was 41 degrees of arc from the vertical.

Another item of disagreement that can be settled is the angle at which the rockets fell—"some say they came in slantwise and others say they arrived vertically." For an answer, look at the diagram drawn according to a set of available figures. The rocket clearly entered the denser layers of the atmosphere at a slant. For the last six miles, the trajectory became slightly steeper, but not anywhere near vertical. However, to an observer half a mile beyond the impact point, more or less directly in the line of fire, this might have *looked* vertical.

It must be stated here that it was apparently not at all difficult to see a V-2 rocket approach in daylight, provided you knew in which direction to look and when, and provided also, of course, that there was no dense overcast.

The Germans fired about 150

rockets from the artillery proving ground of Blizna in Poland and *placed their own test evaluation staff in the target area.*

The theory behind this surprising practice was that, in firing over a range of nearly 200 miles, the precise target would not be hit, but that the missiles would fall close enough to be easily observed. It worked that way, too. The impacts took place between 1000 feet and three miles from the observers. They were informed by radio when a rocket was under way and knew that impact would take place about five minutes and 20 seconds later. Half a minute before the impact time, they would look up and catch it in their glasses.

ONE discrepancy in the statements that is still not completely settled is night observation. If any actual eyewitnesses read this, I'd like to hear from them.

During the war, some Londoners said, and British newspapers reported it, that on occasion a rocket had been seen descending "glowing red hot." Experiments have shown that some portions of the sheet-steel skin do grow hot enough by air friction to reach a temperature which would be described as red hot. But the rocket as a whole did not. The Germans who spent weeks in the target area during their own test firings never saw anything like that.

Dr. Dornberger reports one case in which he followed virtually the whole trajectory of a test rocket, from takeoff to almost impact, with his field glasses after dark. At one point, he wondered what it was he still saw and realized that it was the four graphite vanes in the exhaust blast. The exhaust blast had winked out minutes ago, but during the 65 seconds it had been in operation, the four graphite vanes had been raised to white heat and remained visible for the whole duration of the flight.

Maybe this is the explanation, but possibly the misunderstanding arose in another manner. During test shots of V-2 rockets and also in at least one Viking shot, the timing turned out to be such that the ground was already dark. But the rocket, climbing rapidly for 30 miles, arrived at a height where it could still be reached by the rays of the Sun, which had disappeared below the horizon as far as the ground observers were concerned. The rocket then looked so bright so suddenly, it was thought at first that a belated explosion had occurred.

Likewise, an observer in London might have caught sight of an incoming rocket that was still in sunlight, even though the observer was not. Between the time it disappeared from his view (having entered the shadow of the Earth) and the impact, there would then be some 20 to 30 seconds, a time interval of which the observer was either unaware in his excitement or which, if he was aware of it, he did not mention specifically in later retelling.

THE "HIGHEST" MOUNTAIN

MOST of the letters I receive are, quite naturally, of the kind that *ask* something. It is a rare event when a letter *tells* me something. But soon after the appearance of the May issue, in which I touched briefly on the story of a supposedly very high mountain in eastern Asia, designated in the reports by the name of Amne Machin, I received a letter from a lady in South Carolina that can be labeled a contribution to geography. I print it just as my correspondent wrote it, merely abbreviating a few names for very obvious reasons:

"The story [about the mountain Amne Machin] was created out of thin air, solely to pull the leg of an unpopular newspaperman. And the imaginary mountain was never one mountain but two, and they were named for the most flat-chested girl known to the two pilots who started the story, on the theory that since real mountains are named for Jane Russell, who has real—er—attributes, then non-existing mountains ought to be named for a girl whose attributes were non-existent. The girl's name is Ann McN———.

"This newspaperman, whom I'll call Nameless, had attached himself to a certain Air Transport Command Group at Kurachi, India, during that period when 'flying the Hump' was drudging, soul-wracking misery. Whenever pilots would come in from a flight, even before they had had time to be thankful that they had made another trip and were still alive, there would be Nameless, his pencil at the ready, asking 'Did anything happen? Did anything happen?' Since a routine, uneventful trip was the best thing that *could* happen, the pilots became somewhat fed up with Nameless.

"The informant is my brother J. B., who was a captain in the Air Transport Command. He wrote twice weekly and all his letters have been kept and I have just spent several hours rereading them to be sure my memory was accurate. On one return leg of a Hump flight, my brother and his co-pilot, Lieutenant B.S., were blown off course and arrived several hours late at Kurachi. There had been some excitement over their tardiness and, of course, Nameless was there to get the details practically before they landed—with, I might add, half a teaspoonful of gas in their tanks. In reaction to some hours of danger, my brother and his co-pilot were in high spirits and it was then that the story was born.

"It quickly got out of hand, for Nameless believed every word, and other pilots added to and embellished it with subsequent trips. They grew to love that story and they were very disappointed when their C.O. made them stop. But, of course, even though they did stop, you can't smother a good story even if it isn't true . . ."

Well, if this is the inside story of the origin of that mountain—and it sounds mighty convincing to me—I can only hope that the majority of the people who remember the original story will also read this letter.

ROCKET FUELS

ONE theme that crops up with fair regularity in my correspondence is rocket fuels. There seems to be a widespread impression around that further rocket research and especially the preliminaries to space travel are held up "because we have to wait until chemists find a more powerful fuel." I don't think anything is holding up research work at all—not counting some red tape which indubitably gets into the gears in places—but I can say without hesitation what *could* be holding it up. That would be plain lack of money.

Sometimes the suggestions made to overcome this imaginary obstacle are quite simple.

One correspondent remarked hopefully that rocket engineers may one day find out how to make dynamite safe enough to use it for a fuel. Well, nobody intends to load up a rocket, especially a manned one, with dynamite, but if it could be done, there would be a considerable *loss* of propulsion. The theoretical exhaust velocity would be 10,800 feet per second. From comparison of the theoretical values obtained by fuels in actual use, however, one can conclude that the actual exhaust velocity of a dynamite rocket would be more like 5000 feet per second. Alcohol and liquid oxygen produce an exhaust velocity of 7000 feet per second.

Others were not deceived by the violence of commercial explosives, but looked for a real criterion, the energy content of various substances which could be used as fuels. One correspondent stated that, as far as he could tell, the most powerful combination should be ozone and beryllium metal—which is correct. But then he wondered about the problem of how to feed a powder (the beryllium metal) into a rocket motor with some 300 lbs. per square inch of injection pressure and asked my advice on how this could be done. If there is a suitable method, I don't know it. Moreover, if I did know it, I might not trust it.

Another letter writer suggested liquid oxygen as the oxidizer and lithium or magnesium metal as the fuel, stating that the metals, "of course," would have to be fed into the rocket motor in the molten state. Well, the melting point of magnesium is around 1200 degrees Fahrenheit while that of lithium, though considerably lower, is still 370 degrees Fahrenheit. But the temperature of the liquid oxygen in the tank next to the hot tank for the molten metal is slightly below *minus* 350 degrees Fahrenheit.

The engineer would, at the very least, have a formidable insulating problems on his hands, not to mention his mind.

STILL another correspondent suggested that the following combinations be investigated and tried: ozone with molten picric acid; fluorine nitrate with molten yellow phosphorus; chlorine monofluoride with boron hydride; and, finally, liquid hydrogen peroxide with "liquid" carbon dioxide—he probably meant carbon monoxide and made a typing error.

Another correspondent merely wanted to know why rocket engineers consistently disdain hydrogen as a fuel, even though the high energy content of a mixture of hydrogen and oxygen must certainly be known to them.

The only way to answer all this is to explain the criteria for the selection of a fuel. Naturally the energy content of a fuel or fuel combination is, if not the most important, at least the one which attracts attention first. It can be expressed in two ways, the older one being to calculate its exhaust velocity.

I'll list a few *theoretical* exhaust velocities of fuels that have actually been used at one time or another, all of them assumed to be burned with pure liquid oxygen.

The value for 100-octane gasoline is 15,100 feet per second, for ethyl alcohol 14,400 feet per second, for aniline 14,700 feet per second, for vinyl ether 14,600 feet per second and for hydrazine hydrate 14,000 feet per second.

They all look pretty much alike, don't they? They look even more alike if you don't take these theoretical figures, but the figures you *actually* obtain, which are almost precisely half of the theoretical exhaust velocities.

The second and more recent method for evaluating this particular aspect of a rocket fuel is to work out its *specific impulse,* also called *specific thrust.* This is done by measuring the thrust of a given rocket motor and dividing the thrust by the fuel consumption per second.

The figures you obtain in this manner are all remarkably close to 200. Some fuels will come out as having a specific thrust of 190 while others will have a specific thrust of 210, but this is about as much deviation as you get. The only one that stands out is hydrogen, for its theoretical exhaust velocity would be around 18,500 feet per second and its specific impulse 280.

But the exhaust velocity, or the specific thrust, is only a comparatively small portion of the whole story. There are the so-called secondary considerations which, because of the close similarity of the specific thrust of most fuels, turn very rapidly into primary considerations. Hydrogen happens to be a fine example of a high-energy fuel that invalidates this advantage by a number of practical disadvantages.

LET'S begin with the specific gravity of the fuel. Remembering that the fuel consumption is not a question of volume but of mass, logically you can pack more mass into a given tank if the fuel has a high specific gravity. If your fuel is very "light," you need a larger tank; a larger tank will weigh more and the rocket will have a greater dead weight.

The specific gravity of liquid oxygen is 1.15 or a little higher than that of water. But since the specific gravity of liquid hydrogen is 0.07, you can immediately see how much larger the tanks would have to be. Furthermore, liquid oxygen is known to be very cold, but at the temperature of liquid oxygen, hydrogen is still in the merry gaseous state. To keep it liquid, its temperature has to be below *minus* 252.6 degrees centigrade or, translating into Fahrenheit, below minus 423 degrees. The hydrogen tank would need much better insulation than even the oxygen tank, which adds to the dead weight.

Another factor: no metal can stand up under the temperature of burning rocket fuels, hence the motor has to be cooled. This is done most efficiently by circulating the fuel (or the oxidizer) through the cooling jacket of the motor before it is injected. A liquefied gas is about the worst possible substance for this purpose. Though cold, it cannot absorb much heat. Because it is likely to be at or near its boiling point, it would turn into a gas, choke the flow and blow up the motor.

One of the criteria for a rocket fuel combination, therefore, is that at least one of the two liquids is suitable for cooling the motor. In the case of the customary combination of lightly watered ethyl alcohol and liquid oxygen, this is, of course, the alcohol. In the case of the other customary combination of nitric acid as the oxidizer and aniline as the fuel, either one can be used for this purpose.

More "secondary" considerations: benzene (benzol) has many of the earmarks of a good fuel, *but* it is not a liquid unless the temperature is above 5.4 degrees centigrade (42 degrees Fahrenheit) which means that on a cold day, or in the Arctic, you'd have to thaw your rocket out before you could fire it. You want a liquid that stays a liquid over the temperature range the weather bureau is likely to predict. Nor do you want a liquid that has the nasty habit of requiring pressure to stay liquid. Consequently, a pressure tank is bound to be a heavy tank.

You naturally want storability. Ideally, a good fuel can be put away in drums and be used three, six or twelve years later. If at all possible, you want your fuel to be neither corrosive nor toxic, but in practice this demand has been relinquished to the extent that corrosive and toxic substances are accepted if the crew can be protected by special clothing. The hope is, of course, that one day a non-toxic or non-corrosive substitute will come out of the laboratory.

Finally, there is the problem of availability. The fuels must not be based on raw materials that are rare or especially difficult to process. The raw materials, in short, should be abundant and cheap. Here you can draw an even finer line. Alcohol as well as gasoline are both in good supply. But in the case of an emergency, everybody — Army, Navy, Air Force, the Marines, the Coast Guard and most of industry—will scream for alcohol and gasoline.

To my mind, a fine rocket fuel also has the characteristic that it will be completely useless for any other type of engine. Hydrazine, not much used right now, but strongly advocated by many, is such a fuel.

—WILLY LEY