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BETWEEN
US
AND
SPACE
TRAVEL

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My Lady
Greensleeves

By

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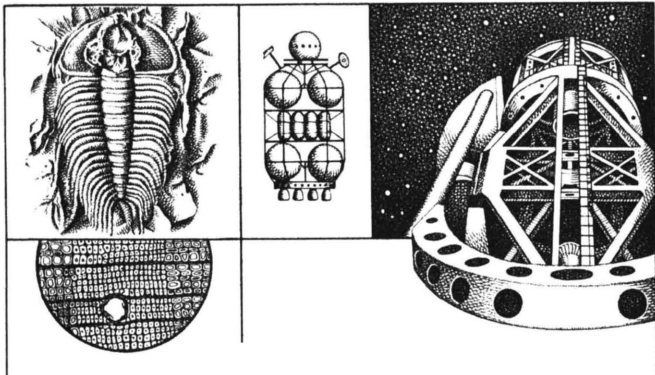
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I Am A Nucleus

By

STEPHEN BARR

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AND OTHER STORIES

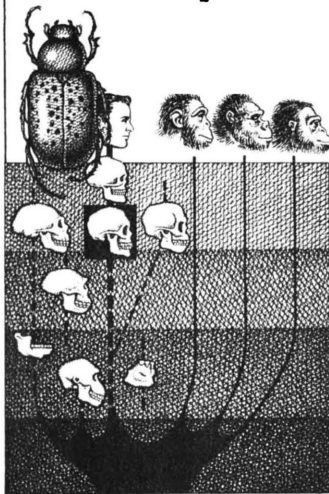




for your information

By WILLY LEY

BETWEEN US AND SPACE TRAVEL



ONE of the questions which most frequently crops up in my mail may be worded about as follows: "Just what is it that stands between us and space travel?" The general impression seems to be that there is something specific which either stands in the way or is still missing.

To give a few examples:

One reader was convinced that the solution to the whole problem hinged on the discovery or syn-

thesis of "a metal which will not melt." Other guesses ranged from "the need for the application of atomic energy" via "lack of money" to "the need for volunteers." One reader wondered whether we might not just be holding back for fear of international complications.

The prize letter (written with pencil on yellow foolscap—that kind of letter usually is) was one advising me to drop the subject of space travel once and for all, because it would not happen for a long time to come, if ever. He also knew the reason: Our government had signed a treaty with the flying saucer people to the effect that they would cease kidnaping humans for vivisection if we stopped trying to reach space!

After you have caught your breath, we can proceed to take a careful look at the situation. To make a one-sentence answer, one may say that the same thing stands between us and space travel which prevented Mr. Donald Douglas from building his DC-7 in 1933. It is all the work that still needs to be done.

ASIDE from that, there isn't anything specific to point to. A new and more powerful fuel, one which contains more energy per pound of weight, would certainly be a help and would be welcomed by everybody con-

cerned. But the discovery of such a fuel is *not* a necessary preliminary.

After all, Dr. Wernher von Braun has shown in various publications that the manned space station, the trip around the Moon, the trip to the Moon with landing, and even a trip to Mars could be accomplished using hydrazine and nitric acid for fuels.

It would be a gigantic undertaking to do it with these fuels, but it is possible. Fuel, therefore, is not the problem.

As regards a new alloy, one which would have a better strength/weight ratio, the story is about the same. If somebody succeeded in producing an alloy somewhat stronger than steel but a little lighter than aluminum, everybody would be happy, of course. But the realization of space travel does not hinge on such a discovery.

To repeat: the whole "art" has to progress for a number of more years to find answers to innumerable detail problems; at one point or another, you may need a new type of thermostat or something like that—something that nobody doubts can be done, but which for some reason had not been done before—and which might prove time-consuming.

But if you insist on the naming of a few specific problems that are known but unsolved at the

present moment, three could be picked out. One is mechanical and in the realm of physics. The other two are physiological and in the realm of medicine.

They are:

- (a) the re-entry problem
- (b) physiological effects of cosmic rays
- (c) the effect of zero gravity

The re-entry problem is precisely what its name indicates: the problem of re-entering the atmosphere. A rocket which leaves the atmosphere has all the natural laws working in its favor. Its velocity increases as it climbs, but all the time it is traversing more and more rarefied layers of the atmosphere. If the rocket does heat up because of air friction, it will be so little that nobody has to worry about it and no special measures need to be taken.

But on re-entry, the situation is reversed. The rocket enters with a high velocity and the Earth's gravitational attraction increases it some more. Simultaneously, the air grows denser and denser and enormous frictional heating is bound to occur.

It is rather safe to say that the re-entry problem is not solved at this moment. But engineers feel sure that they can solve it, provided they have exact and reliable figures to work with. The artificial satellites will provide these figures.

IN THE case of the cosmic rays, a good deal has already been learned, but not enough by far to have a basis for an answer which can be expected to be correct, or at least very nearly so.

The experiments carried out by Dr. Van Allan in the vicinity of the northern magnetic pole for the first time gave figures for the number of cosmic rays in the upper layers of the atmosphere. These figures were such that an exposure of a few days or even a few weeks did not look dangerous, even though they had to be multiplied by two. (The measurements were taken in the upper atmosphere, which means, of course, that about half of all cosmic rays were absorbed by the bulk of the Earth below. For open space, with no shielding planet nearby, there should be about twice as many.) The artificial satellites will either confirm or correct the results of these earlier measurements.

At any event, the cosmic ray "danger" looks more like a bugaboo at the moment, only we don't yet dare say so. Besides, there still exists the additional possibility that medical science might discover a way of healing quickly whatever damage may have been done.

The last point, the effect of zero-g, is even harder to evaluate properly. The opposite of

zero-*g*, namely the multiple *g* of acceleration during takeoff, can be duplicated in the laboratory by means of large centrifuges. So this could be investigated and tested and was found not to harbor any insurmountable difficulties.

But zero-*g*, the complete absence of any gravitational strain, cannot be produced easily near the ground. You can imitate it by way of the so-called parabolic flight of a fast airplane with its engine shut off the instant it enters this flight curve. But it lasts for half a minute at the most, and that is not enough to draw any really valid conclusions.

The customary thing to say is that zero-*g* must feel like a never-ending fall. Assuming that it does, this still leaves one very important question open. As the statement is usually made, it contains the hidden assumption that the body will not be able to get used to it. But maybe the body will. Just as you tend to disregard a steady noise after some time, that feeling of falling may "disappear" after three or four or ten minutes.

One may also ask whether it actually will feel like falling. We don't have too much experience even in that. But what experience there is is always contaminated by extraneous sensations. The man who jumps from a high diving board sees things rush by and

up at him. The man who makes a delayed parachute jump feels the air tearing his suit and whistling and may fall through clouds. But how does falling feel when *all* these other sensations are missing? Does it still feel like falling?

The answer is that we don't know yet.

But we'll find out. And when that has been done, another barrier between us and space travel will have been removed.

DURABLE FORGERY

A FEW months after the skull of *Eoanthropus dawsoni*, better known to many people as the Piltdown skull, had been exposed as a forgery by British scientists, I had some correspondence with a reader who apparently took this quite to heart. At least, he wrote, this must have been the most successful forgery in the sense that it had fooled the largest number of people and had lasted for a very long time until exposed.

I replied that it certainly had lasted a long time — the "discovery" was announced on December 18, 1912, the exposé on November 21, 1953, giving it a lifetime of 41 years — but I suspected that other forgeries had lasted longer. As for the number of people taken in by it, I pointed out that the scientists of continental Europe had never completely ac-

cepted Pilt-down man and their mentions of it were usually accompanied by qualifications like "still needing investigation" or words to that effect.

I received a reply which said, "Well, if you don't think that Pilt-down was the most successful forgery, which one was?"

Without much hesitation, I stated, "Of those I know about, I would say the Königinhofer Manuscript."

Back came the query: "What is the Königinhofer Manuscript?" This was one of those short questions which require a long answer. I promised to let him know in print. And here is the story.

The name of the case is, as has been mentioned, the "Königinhofer Manuscript." This is the German name. The Czech name is "Královédvorský Rukopis." Both versions mean the same thing and the reference in both is to a place name, that of a small town, about a hundred miles from Prague at the Elbe River, which is called Dvur Králové in Czech and Königinhof in German. The English translation of either name is "Court of the Queen" because the town's founder, King Wenceslas II of Bohemia, had given it to his wife Elizabeth. Since Wenceslas II died in 1305, it is an old town, but it never grew to be a large one—only within the current century did its population

manage to pass the 15,000 mark.

Local historians stated that Dvur Králové or Königinhof had suffered in some wars of the past. But they had to admit that it had never been important and that, outside of Bohemia, it was probably unknown.

IT WAS in 1817 that a young man by the name of Vaclav Hanka found an old manuscript somewhere in the steeple of the church of Königinhof. Hanka, who later became librarian of the Bohemian Museum, told interested people that he had thought at first that he had found a Latin chronicle written on vellum. He said that he put it aside to finish whatever it was he had been doing when he came across the manuscript.

An hour or two later, when he was finished, he looked at it again and saw to his surprise that the language was not Latin at all but ancient Bohemian. Looking through it some more, he noticed that it was poetry and not really a "manuscript" as the word is now used, but a "fair copy." It had been written, or copied, by a very careful hand, using inks in various colors. I have seen colored reproductions of a number of pages. They look as if they were engraved; they are far too beautiful to look either printed or written.

Vaclav Hanka took the manu-

script to Professor Josef Dobrovsky in Prague, who was considered to be the greatest living authority on Czech and related languages. After going through it carefully, Professor Dobrovsky saw to it that it was published. Apparently the Czech language had undergone considerable changes since the thirteenth century, the alleged date of the manuscript, for the first printed edition is accompanied by a translation into modern Czech.

The thought that the manuscript might not be genuine does not seem to have occurred to Professor Dobrovsky. The vellum was old and so was the language. And the story of the discovery sounded convincing — a church steeple would be just the place where a manuscript might be first hidden and then overlooked through centuries.

A year or two after the Czech version, a German translation was published. In the course of the years, other translations were made. There was one into French and another into Russian. Then came a revised and improved German edition. Finally, in 1852, there appeared a volume entitled "Polyglotta Královédvorského rukopisu," a collection of translations into most modern languages.

So far, nobody had any doubts. Old Professor Dobrovsky, who had died in 1829, had accepted

it and the other outstanding language experts of the time, like Professors Palacky, Jungmann and Safarik, also thought it was genuine. And it was known especially of Professor Dobrovsky that he was highly critical. About a year after the Königinhofer Manuscript became known, history seemed to repeat itself. One Josef Kovar, paymaster of the estate of Grünberg, had found another old manuscript which was dubbed the Grünberger Manuscript. It was much shorter than the find from Dvur Králové, consisting of just two poetic fragments, the end of one poem and the beginning of another one. But it was much older, dating all the way back to the eighth century!

PROFESSOR DOBROVSKY only saw a copy of these poems made by somebody and at once declared that the Grünberger Manuscript was a forgery. In a letter to an English colleague, he mentioned the Grünberger Manuscript and called it deplorable that some young men tried to foist such fakes upon the world of letters: "Not being satisfied with the Königinhofer Manuscript from the thirteenth century, they manufacture others said to be older so as to outdate the older folk songs of the Germans and others . . ."

In 1858, there began faint

rumblings in the form of a number of anonymous articles in a German-language newspaper in Bohemia, which doubted that the manuscript was as old as it was said to be. It is doubtful whether many people paid attention to these articles. To begin with, they were anonymous. Secondly, they appeared in a daily newspaper, not in a learned journal or a literary magazine. Finally, the Germans and Czechs in Bohemia were in each other's hair all the time, so that a German attack on a Czech manuscript could be discounted for that reason alone.

THAT the historian professor Büdinger in Vienna openly doubted the genuineness of the manuscript and the story of its "discovery" was more serious. That was in 1859.

Then Professor Julius Fejfalik of Prague went to work on the problem of the historicity of the manuscript and came up with an almost devastating case. The vellum was old, he wrote, but the ink seemed to be much more recent than the vellum. As for the shape of the letters, they were very nearly—but only very nearly—what one could expect of a scribe of the thirteenth century. Besides, they were much too careful—they looked as if they had been drawn one by one, rather than written.

A point which Professor Fejfalik stressed at great length was that the poems occasionally showed an anti-German attitude. As a person, Professor Fejfalik may very well have been anti-German himself, but as a historian, he knew that the German-Czech animosities which pervaded daily life in Prague were comparatively recent; the two nations had hardly been in touch with each other at the time of the alleged origin of the poems.

Moreover, they were supposed to be folk songs and there something else came in. Wrote Fejfalik: "A hero was either a friendly hero or an enemy hero, but the people cared only whether he was friend or enemy and did not think in terms of nationalities."

There was one poem that Fejfalik pounced on especially. It was a song of a peasant girl, complaining that her lover had been "led away" (presumably drafted into somebody's army) and that she would write him a love letter if only she had parchment and some ink and a quill! A letter-writing Bohemian peasant girl in the thirteenth century was too much for Professor Fejfalik's credulity.

After that treatise had been published, most historians were ready to call the manuscript a fraud. But what could have been

a simple exposé of an admittedly skillful forgery developed into an issue involving national honor.

Two Czechs, the brothers Jirecek, violently attacked Professor Fejfalik, who could no longer answer, since he had died in 1862. Professor Johannes Gebauer of the University of Prague, the outstanding expert on Slavonic languages of the time, continued where Fejfalik had left off. He did not say outright that the manuscript was not genuine, but he cited reasons for doubting its genuineness—whereupon his older colleague Martin Hattala called him a traitor.

BETWEEN 1870 and 1880, the line of discussion was as clear-cut as it was silly. If you spoke of the manuscript as having been found in Dvur Králové, you automatically asserted that it must be genuine. If you said it had been discovered in Königshof, you were convinced that it was a forgery.

In 1886, a still comparatively young (36 years) Czech patriot stepped in. His name was Tomáš Garrigue Masaryk, the man who from 1918 until 1935 served his country as first president of the Czechoslovak Republic.

"The manner of controversy cannot possibly be reconciled with honor and truthfulness," he declared, and went on to say: "I

fail to understand how anybody could say that the defense of the genuineness of the manuscript is a question of national prestige and national honor. National honor demands the defense and/or the finding of the truth and it certainly needs more courage to admit an error than to defend one, even if it is deep-rooted in a whole nation."

One might say that the men who really proved that the manuscript was a forgery were the historian Goll and the philologist Gebauer. But without Masaryk's aid, hardly anybody would have heard their voices. Gebauer could show that the poems were not folk songs but were poems in folk style written by one man. The grammar was not the Czech of the thirteenth century, but what thirteenth-century Czech was thought to have been in 1815.

During the seventy years that had gone by since then, philologists had learned quite a number of facts not known in Dobrovsky's time.

Professor Goll took the historical hints in the poems and showed conclusively that they did not agree with actual history. Masaryk directed his own criticism at the sociological implications and declared that these alone were grounds for suspicion. He summed up by saying that one would have to "sacrifice the

results of *all* the sciences *plus* logic" to accept the manuscript as genuine.

By 1895, the question was settled. But neither Masaryk nor anybody else could ever prove who had actually written the poems. The chief suspect is the "discoverer" of the manuscript, Vaclav Hanka. As has been mentioned, the language of the manuscript is not what it actually was during the thirteenth century, but what philologists of about 1815 thought it had been. And Hanka, a few years before he made his "discovery," had published a book on old Bohemian, containing just these mistakes. Still, that does not *prove* that he wrote the poems, for others of the same time made the same mistakes.

The Königinhofer Manuscript, then, was a forgery with a lifetime of about seventy years, nearly thirty years longer than that of the Piltdown forgery. And I could claim a lifetime of nearly a full century if I wanted to include one diehard named Martin Zunkovic. He published a book still defending the manuscript in 1912. His main reason for defending it was that the doubters had based their criticism on printed editions without working from the original.

As if this argument were not weird enough, Zunkovic admitted in his book that he had not seen the original, either!

OUR CAPSIZING EARTH

RECOUNTING the longevity of the fraud of the manuscript of Königinhof made me think of another story which has been around, on and off, for nearly a century now. It is a bit hard to pin a label on it, for it does not really fit into any category. It is, to begin with, not a hoax, even though it is completely without foundation. It is not really fiction, though it comes close to it in content, but not in intent. And it certainly isn't science, though it claims to be.

The story is that Earth is bound to capsize within a not too distant future, say a few thousand years.

But let us begin with the actual scientific facts. The orbit of Earth around the Sun is an ellipse which is so nearly circular that no drawing made on a piece of paper small enough to be handled conveniently can show the difference. But in reality the difference — meaning the actual distance between the Sun and the Earth — amounts to three million miles.

The Earth, when passing through the perihelion (the point of its orbit closest to the Sun) is a full three million miles closer to it than when passing through aphelion — the point of its orbit farthest from the Sun. In the course of one year, the Earth,

naturally, passes through both these points, through perihelion early in January and through aphelion early in July.

The interesting point is, of course, that we on the northern hemisphere are experiencing heat waves just when our planet is farthest from the Sun and freeze when it is closest. It merely proves that the tilt of the Earth's axis is far more important climatically than this comparatively minor difference in the distance from the Sun.

To the inhabitants of the southern hemisphere, especially Australia, things are reversed: They do have summer when closest to the Sun and winter when farthest from it. But like our northern summers and winters, the season is caused by the tilt of the Earth's axis; it just happens to look more "reasonable."

There is one additional factor that should be mentioned. The Earth, like any other planet, moves a bit faster in its orbit when near perihelion and somewhat more slowly when at aphelion.

Consequently the summer of the northern hemisphere is extended a little and the winter shortened by an equal amount.

THUS far, everything that has been said is definitely established. Now we enter the realm

of conclusions which are not completely certain.

The southern summer is shorter and should be somewhat hotter than the summer of a corresponding spot on the northern hemisphere. Consequently the southern winter must last a little longer and should be colder. There are some statistics which claim that this is actually so, but not everybody believes them, for the weather in a specific place is usually influenced by local factors.

But discounting local factors — which is something one mustn't do — the southern hemisphere should accumulate ice under the present state of astronomical affairs. One theory holds that even though the southern summers are hotter, they cannot take care of all the ice which accumulated during the longer and colder winter. Hence ice will accumulate through the millenia — and everybody knows that the southern ice cap of our planet is larger and thicker than the northern one.

But we are not completely done with the astronomical facts yet. Although the axis of rotation of our planet is always tilted by about $66\frac{1}{2}^{\circ}$ to the ecliptic (or $23\frac{1}{2}^{\circ}$ from a line vertical to the ecliptic), it does not always point at the same point in the sky. Right now, it points almost directly at the star Polaris, but 6000 years from now, it won't

any more. The result of this "precession" is that, in the course of the millenia, the situation will shift. In time, the northern hemisphere will have summer when the Earth goes through perihelion and will have winter when the Earth passes aphelion.

If the reasoning quoted before is correct, ice will then accumulate at the northern pole and the ice cap of the southern pole will be the smaller one.

To forestall any possible misunderstanding or confusion, I wish to repeat once more that all this is established astronomical knowledge. The only uncertain point is whether the larger ice cap of the southern pole is solely due to the southern "aphelion winter" or whether it is mostly due to the fact that the South Pole area happens to be high land (under the ice) while the North Pole is at sea level. It may be this elevation of the south polar area which really makes the difference.

Natural philosophy and, with it, a charming kind of fantasy entered the field in 1842. In that year, Monsieur Alphonse Joseph Adh mar, teacher of mathematics in Paris and author of a few mathematical textbooks, published a work which explained all these facts to the readers and then proceeded to solve a few mysteries.

The hemisphere which happens to have "aphelion winter" does

form a larger ice cap, the professor asserted. And because it is so large and massive, it slightly shifts the center of gravity of the whole planet, with the result that the waters of the oceans have a tendency to assemble in that hemisphere.

JUST look at a globe, Adh mar advised, and you'll see how far land extends in the north. But in the south, there is a wide rim of ocean around the ice cap, the direct result of its weight. (If Adh mar were right, all this should be drowned land, which implies a comparatively shallow sea. In reality, it is deep ocean, but that was not known in his time.) Now, he continued, as things go on and the earth's axis slowly points in the direction of other stars, the north is going to get the colder winters. Ice will accumulate around the North Pole and the southern ice will diminish.

And then, one day, the northern ice will be stronger. The last southern iceberg will melt in the warming seas. The center of gravity of the Earth will shift along the Earth's axis in a northerly direction and the waters of the oceans will rush to the north with dramatic suddenness, drowning the land areas around the North Pole which are now dry, even if cold.

Then he drew some additional

conclusions. The last shift must have been from north to south — this is indubitably the event reported in the Bible as the Flood. The shift before that must have been from south to north — this scooped up elephants in Africa and transported them to Siberia. (This was written before complete bodies of the Siberian mammoth had been secured and examined. Adhémar could not know how well adapted the mammoth had been to a cold climate.)

We can leave Monsieur Adhémar alone now; he had to be quoted mainly to show where the later elaboration of his thought originated. The later elaboration, which, as I have mentioned, has cropped up at reasonably regular intervals ever since, adds one more touch. It is not just a question of a minor shift of the center of gravity which makes the waters rush from one pole to the other. It is, instead, a capsizing of the planet as a whole, in which the two poles chance place!

Just why the Earth should capsize has never been explained by any of the many who advanced this as a brand-new and original idea. The Earth is, after all, not a ball floating on the surface of some liquid, but a massive body moving in the gravitational field of the Sun, which is another story entirely. If a very large mass could accumulate somewhere near

the equator of the Earth, it would affect the rotation. But a large mass centered on one of the poles of rotation couldn't possibly have such an effect.

In order to pursue the case to the bitter end, let us see just how large a mass *could* accumulate. Obviously the worst that could possibly happen is that *all* the water of our planet freezes around one pole. It isn't at all difficult to calculate how much that would be.

ACCORDING to the *Smithsonian Physical Tables*, the total land surface of Earth is 153,500,000 square kilometers. The water surface is more than twice that large, namely 365,500,000 square kilometers. The average depth of the oceans is 12,450 feet, which equals 3,795 meters. Multiplying the water area by the average depth, you get 1,388,900,000 cubic kilometers — rounded off, 1,390 million cubic kilometers.

Since one cubic kilometer of water weighs 1,000 million metric tons (or 1,102 million short tons), the total weight of the oceans must be 1,390,000,000,000,000,000 metric tons, which can be expressed better in the space-saving manner of the mathematician by writing 1.4×10^{18} metric tons. (Or 1.5×10^{18} short tons.) This is the maximum that possibly could

accumulate at a pole, simply because that is all the water there is on our planet.

It is no doubt a very impressive figure, but it is not the whole story. We must compare the weight of the water with the weight of the Earth as a whole.

The mass of the Earth as a whole is:

5.983×10^{21} metric tons

or

6.595×10^{21} short tons

As one can easily see, this makes the ratio of all the water on Earth to the planet as a whole like 1400

in 6,000,000 or, if you prefer smaller figures, like 1.4 in 6,000.

In short, the weight of all the water on Earth is negligible in comparison with that of the Earth. Even *if* the Earth were like a ball floating on a liquid (which, of course, it is not), and *if* all the water could freeze near one pole, it would not make Earth capsize.

We may be in for all kinds of natural calamities, plus all kinds of human foolishness—but the stability of the Earth is one thing we do not have to worry about.

—WILLY LEY

HOLD IT!

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