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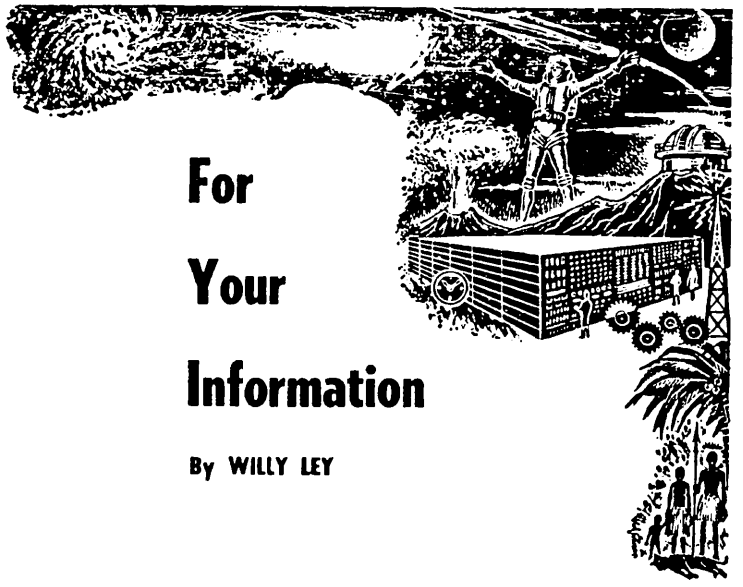
A "HUCKSTERS" UPTOPIA OF THE FUTURE — READ GRAVY PLANET



For Your Information

By WILLY LEY

AT the risk of being blamed for inventing a brand-new variety of nepotism, I'm going to begin this column with an answer to a question asked of me by my own eight-year-old daughter. One day, probably thinking back to a visit to the meteorite collection in the Hayden Planetarium, she asked: "Daddy, has anybody ever been hurt by a meteorite?" I happened to know that this had occurred more than once; naturally, such strange cases were always

recorded, and so I could answer the question in the affirmative.

Let's forget for a moment that there are such cases on record, however, and try to work up the statistical probabilities instead. We all know that meteorites come in all sizes, from particles as small as grains of fine sand, making a barely visible streak of light in the night sky, to hefty chunks like Ahnighito from Greenland, which weighs around 35 tons, and the one at Hoba West near Grootfontein in Southwest Africa, which is still in the ground and has been estimated by some to weigh 60 tons. Those which make impressive streaks of light in the sky and can almost be said to illuminate a night landscape momentarily are nevertheless tiny bits of cosmic matter.

A bright meteor with a visual magnitude of "zero"—like a very bright star—is caused by a meteorite with a mass of ¼ gram. One with a visual magnitude of "minus three" — a newspaper probably would headline it "blinding meteor flashes across city; harmless, scientists say" —has a mass of 4 grams. And there are 28 grams to the ounce. Meteorites that small never even reach the ground.

The next question in our statistical analysis would be how numerous meteorites are. The best available answer is that, counting only those of visual magnitude "zero" or brighter, there are 450,000 per 24-hour day. Among them there are perhaps half a dozen large enough to reach the ground. Every day, Earth sweeps a small truck-load of fine sand, with a few pebbles in it, out of the sky. If that rate has been maintained for the last two billion years, which is doubtful, this accumulation of cosmic sand has increased Earth's diameter by about half an inch.

All right, then, a few pebbles a day. The area of Earth's surface is 197 million square miles. The oceans cover 140 million square miles and, as far as the endangered population is concerned, you can subtract another half million square miles for the combined area of all lakes and another 6 million square miles for Antarctica, where nobody lives. This leaves 50 million square miles of area where somebody might be hit; in round figures, one-quarter of the total surface.

If eight meteorites per 24-hour day are large enough to reach the ground, just two of them will hit inhabited or inhabitable land. You don't have to go on and establish the average number of people per square mile and the percentage of a square mile covered by the area of the average number of inhabitants. From

statistics alone, you'd learn that it is virtually impossible for a person to be the accidental target of a metorite.

The actual historical records tell a different tale. What may be taken as the oldest reported case is the one in the Bible (Joshua 10:11) ". . . as they fled from before Israel, and were in the going down to Beth-horon, that the Lord cast down great stones from heaven upon them unto Azakah, and they died. . . . " The date, roughly, would be 1500 B. C. Of the meteorites mentioned in classical literature, only one is considered as "certain," a "stone the size of a chariot" which fell on the Greek mainland—in Thrace—in 476 B. C. It was described by Pliny the Elder and was still extant in his time, but if it did any damage, that fact was not recorded. The second case of fatalities due to meteorites was located by the French scientist Biot almost a hundred and fifty years ago. In January, 616 A.D., according to Chinese chronicles, a large stone fell in China, crushing wagons and killing ten men.

The next case is the most famous one for more than a few reasons. It happened in Crema, a city near Milan in Italy. It took place, by a strange coincidence, during an eclipse of the Sun. And Raffaelo Santi, or Raphael, painted the event. The date was the 14th of September, 1511, and it must have been a large meteorite which entered the Earth's atmosphere and exploded. About a thousand stones pelted the area, killed birds and sheep and a Franciscan friar.

In 1569—oddly enough, also on September 14—several meteorites struck Venice, causing damage to buildings, but no loss of life. In 1650, on September 4th, a small stone descended on the grounds of a Franciscan monastery in Milan, killing one of the monks. In 1654, a sailing ship returned to the Mediterranean from Japan and the captain reported that during the voyage, which lasted a number of years, a meteorite weighing some nine pounds had hit the bridge, killing two sailors.

The more recent the reports, the more specific they are in detail. Lincoln LaPaz of the Institute of Meteorites (U. of New Mexico) recently compiled a list containing the following cases:

1794, June 16, 7:00 PM: fall of chondrites (stony meteorites) at Siena, Italy; one stone pierced the hat of a child, no injuries

1825, January 16: meteorite fall at Oriang (India) killed a man and seriously injured a woman

1827, February 16, 3:00 PM: meteorite fall at Mhow (India) wounded a man in one arm

1836, November 11, 5:00 AM: several cattle killed by fall of stony meteorites at Macao, Brazil

1847, July 14, 3:45 AM: fall at Braunau, Austria, mass weighing 37½

lbs. fell into a room with three sleeping children, covered them with debris without doing other harm

1860, May 1, 12:45 PM: colt killed at New Concord, Ohio

1870, January 23, 7:00 PM: a man was very narrowly missed by a meteorite at Nedagolla, India

1911, June 28, 9:00 AM: a dog was killed at Nakhla, Egypt

1927, April 28, 9:00 AM: at Aba, Japan, a meteorite (preserved, weighing only 0.9 grams) struck and slightly injured the five-year old daughter of Mr. Tahei Kuriyama

1938, June 24, 6:05 PM: at Chicora, Pennsylvania, a cow was found with its hide torn as if by a falling stone. This was immediately after a recognized meteorite fall; meteorites were found in neighboring fields.

To this list compiled by Prof. LaPaz, two cases can be added, one of them doubtful. The doubtful case occurred in 1915 in northern Germany (Pomerania or Mecklenburg), where several sheep burned to death in a fire in a hayloft alleged to have been caused by a meteorite. To the best of my knowledge, the meteorite was never found.

The other case is the so-called Benld Meteorite to which the Chicago Natural History Museum has just devoted a special paper (Geological Series, vol. vii, No. 11.) It fell on September 29, 1938, between 9:00 and 9:10 AM at Benld, Macoupin County, Illinois. It was a rather large chondrite, weighing 1770.5 grams or 3.9 lbs. The Benld meteorite did not injure anybody, but broke through the roof of a garage, the roof of the car parked inside, through the seat cushion and the car's floor. It struck the muffler next, denting it and then bounced back to come to rest entangled in the seat springs.

Against all statistical probability, then, meteorites have hit and killed people. But it may be generations between now and the next instance.

VISITORS to a planetarium often ask whether it is possible to produce a picture of the sky in, say, 2352 A.D. or of the time of Shalmaneser I of Assyria, who began his rule probably in 1276 B.C. Of course, that can be done; in December of every year, most planetariums set their instrument back to the time of Christ. (The director usually winces a bit when December rolls around, for that needs some 20 hours running time, which wears out cog wheels and is hard on the bearings.)

But when you go back to 2000 B.C., you have to be several hours off if you want to reproduce a specific time—say, midnight. The instrument is not corrected for the fact that the length of the day changes slightly. The best present estimate is that the day lengthens at the rate of 0.001 seconds per century. Over an interval of 4000 years, that makes the

day of Shalmaneser's time 0.04 seconds shorter than it is now. Hardly noticeable — but 4000 years contain about 1,400,000 days. The average discrepancy for every day would thus be 0.002 seconds, which totals up to 28,000 seconds, or eight hours.

This, according to Prof. George Gamow, is the reason why the ancients observed eclipses which, if calculated without that correction factor, should have been below the horizon for them.

LET'S talk about a yard of string now, to give a wonderful example of how "reasoning" can lead you astray. The circumference of the Earth along the equator is 24,902 miles or, since there are 1760 yards in a mile, 43,827,520 yards. Now we'll level all the mountains that happen to be along the equator and put a string around, at sea level, tight. And now we lengthen this string by precisely one yard. How high, provided that it is supported all around the equator at the same distance, would that string be above sea level?

"Reasoning" will say, without a moment's hesitation, that it will be insignificant. Possibly a bacillus, if it really wanted to, could squeeze across the equator under that string. The truth is that a cat could do it, for the string would be about six inches above the ground.

Impossible? Let's see what the radius of the larger circle would be—we are all agreed that it must be larger; being one yard longer, the question is merely whether it would be visible. The original sea level circle was given by $2r \times \pi$, the new circle is obviously $2\ r\ \pi + 1$ (if "r" has been expressed in yards) and the new radius R must be $r + x$. And x turns out to be 1 divided by $2\ \pi$. If we take π as 3.1415, this gives 0.1592 of a yard, or 5.8 inches.

The point is here that the increase of the radius is independent of the original radius. The increase of the radius must always be equal to the increase in the circumference divided by $2\ \pi$.

Go ahead and try it with anything circular you have access to. You'll always find that an increase of the original circumference by one yard will increase the radius by slightly less than six inches.

In case neither the formula nor the experiments fully convince you, you may imagine another example which might help. Here we have a board three yards long —but we imagine it to be so thin that its thickness is negligible— and we tie a string around lengthwise. Obviously the string will be six yards long.

Now we lengthen the string

once more by one yard. The result will be two loops at both ends, each loop sticking out by one quarter of a yard or 9 inches. Here it is apparent that it would not matter whether the board is originally three yards long, or 100 yards, or 77 miles. If you add a yard to the length of the tight string, you'll always get two loops at both ends, sticking out a full nine inches.

Common sense, as you can see, is not always common, which has been noted by others in the past —but neither does it always make sense!

—WILLY LEY

ANY QUESTIONS?

A handbook stated the temperature of the high atmosphere as 2500° Kelvin for an altitude of 650 kilometers and continues: "this would make space flight virtually impossible; this temperature is well above the melting point of most metals and above the vaporization point of many."

Richard Hanna,
83 Edgewood St.
Hartford, Conn.

These figures have proved enormously misleading to many people—they don't mean at all what they seem to mean. You know that the speed of air molecules increases with temperature, so you could express a given temperature by mentioning the average speed of the air molecules. Conversely, you can express the average speed of air molecules by temperature. This is what such tables usually do, and some physicists are careful to refer to them as "kinetic temperatures." But the kinetic temperature of 2500° Kelvin at 650 Kilometers altitude does not mean that a rocket would acquire that temperature up there. The "kinetic temperature" merely states how fast the air molecules move; it says nothing about whether there are enough air molecules up there to matter. There aren't.

For rockets large enough to have the payload capacity to carry a pilot, air resistance virtually ceases as low as 20 miles above sea level. Beyond that, the air is too thin to influence either the movement or the temperature of a rocket.

If interstellar space is a vacuum, with neither matter nor gas present, it is therefore "nothing." What are the physical components of "nothing?"

Dorothy Urman
2652 Euclid Heights Boulevard
Cleveland Heights 6, Ohio

Even if interstellar space were completely empty, it would still not be "nothing."

It may have nothing in it, but it *is* space, something where matter *might* be. Actually, interstellar space is not empty, for it is still filled with radiation. The most typical (and only) characteristic of empty space I can think of is that it does *not* offer any resistance to movement, either of material objects or of radiant energy.

What are the chances of finding planets (or intelligent life on them) circling other stars?

Eddie West, Jr.
2025 North Flower Street,
Santa Ana, Cal.

Excellent—except that we don't know yet how we could get there. Here's the reason why life elsewhere is virtually certain:

In our own galaxy, there are at least 15 billion suns. If we consider only those of the Main Sequence (to which our sun and Sirius belong), we deal with something like 10 billion stars. If only a tenth of them have planets—a rather pessimistic assumption—we get one billion suns with planets. If our solar system is representative, that would make two billion planets like Earth and Mars. Assuming that only one per cent of these planets have produced intelligent life, we get 20 million planets with intelligent beings on them. And if only one per cent of those have progressed to the verge of space travel, as we have, we can count on two hundred thousand planets where beings are writing equations about rockets and mass-ratios and most likely read and write science fiction.

Considerable, eh?

I would like to have your opinion on life not based on carbon like ours. Most authorities are extremely pessimistic, so it would be interesting to hear the other side (providing that there is an "other side"). Also, could you give me references regarding contra-terrene matter?

Robert O. Woods
1836 Pennington Road
Trenton, N. J.

I'm afraid there is no "other side." Within the temperature range in which we know chemistry best, only the carbon atom is versatile enough to form living compounds. Whether this may be different in another temperature range is simply beyond our knowledge.

For contra-terrene matter, see: *Astrophysical Journal*, March 1940, pp. 257-260 (Rojanski); *Physical Review* 1935, p. 108 (Rojanski), *ibid.* 1935, p. 169 (Zwicky); *Pop. Astronomy* February 1941, pp. 99-104, *ibid.* May 1941, pp. 265-

267, *ibid.* June 1948, (Herrick, La Paz *et. al.)*; George Gamow: *Structure of Atomic Nuclei (Oxford 1937)* Part I, Chapter 5; P.A.M. Dirac in Heisenberg's *Die moderne Atomtheorie,* Leipzig 1934, p. 45ff.

Is there any material known (with the exception of large chunks of space itself) which will insulate a piece of iron from the attraction of a magnet?

Betsy Curtis
R.D. 2
Saegertown, Penn.

There is no insulator known. For practical purposes, one can use a shield of Permalloy or Mu-metal (both highly magnetic) which will bunch up the magnetic lines within themselves so that the lines don't pass through. By analogy with electricity, this would be a short circuit rather than an insulator.

I have read that in some parts of the Milky Way there are interstellar whisps of gas, mostly hydrogen. Why doesn't this gas diffuse in the vacuum of interstellar space?

Is the mention of the planet Vulcan—supposed to be inside the orbit of Mercury—in a few science fiction stories based on any factual evidence?

Joseph Russo
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Brooklyn 4, N. Y.

The whisps of gas would diffuse into space if they were warm enough. Some of them are definitely black and visible only because they obscure portions of the Milky Way; others which are luminous do not glow with heat. In short, they are cold enough so that the mutual attraction of their particles holds them together.

As for the planet Vulcan inside the orbit of Mercury, astronomical circles believed in its existence for some three-quarters of a century. It was assumed to exist because the orbit of Mercury seemed to require another planet nearer the Sun. Observers, both professional astronomers and amateurs, set out to watch for it, especially at the occasion of solar eclipses.

One observer (a German living in China) thought he had seen Vulcan pass across the disk of the Sun. But the Observatory in Madrid, having bigger instruments, recognized it as a roughly circular sunspot. Two observers (one American, one Englishman) thought they had discovered it during an eclipse, but it turned out to be a small reddish fixed star that happened to be in line of sight. A French country doctor named Lescarbault actually received

the *légion d'honneur* for "the discovery of Vulcan" in March 1859. He had "seen" it cross the disk of the Sun.

But if Vulcan really existed, we should have found it by now. What Lescarbault actually saw was probably one of the planetoids which approach the Sun more closely than the Earth on occasion. Since the existence of these planetoids was not known then, and since Vulcan was on the list of things to be found, his mistake is easily explained.

Ronald Demovsky (no address given) wonders about the statement in my first column where I said that J-IV (Callisto) has been seen "perfectly black," since a "perfectly black" body would be invisible. Or did I mean that J-IV was in Jupiter's shadow?

I did not mean the term "perfectly black" quite so rigorously. But even a perfectly black body can be seen—against a lighter background. This, of course, is what the observers meant; they referred to a transit, not to an eclipse.

In your book Rockets, Missiles and Space Travel, *you state that the condition of apparent weightlessness occurs only rarely and for very short periods.*

I would like to know just when it takes place.

S. Petinga
4129 Winchester Avenue
Atlantic City, N. J.

It takes place when man is falling freely; for example, when jumping from a diving board, and during the early stages of a parachute jump before the parachute is opened, when air resistance has not yet slowed the person down. One other possibility is a carefully controlled power dive where the plane develops just enough power to overcome air resistance. Since this may prolong the state of weightlessness for many minutes, Dr. Haber of the USAF Department of Space Medicine has suggested using such controlled power dives for the study of the problem.

More on "Homeless Facts"

Every scientist is aware that there are facts and observations that cannot be reported through fear of ridicule, loss of professional standing, even outright dismissal. In the April 1952 issue, GALAXY offered to serve as a clearing house for those unreportable facts.

The response has been stimulating, in some cases actually startling. After they have been verified, you will see some of this previously withheld data in future issues.

If you have any such facts that should be made available to research, send them to GALAXY. They'll be treated soberly, earnestly, every effort made to investigate . . . and your name will be held in strictest confidence, if you choose.