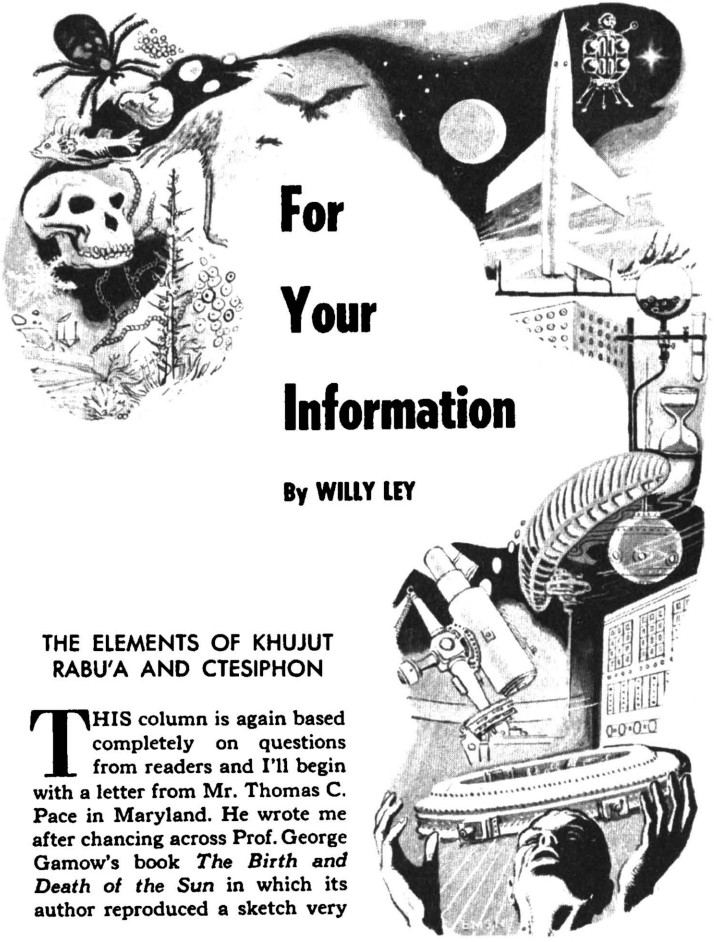
Galaxy
SCIENCE FICTION

DECEMBER 1954
35¢

ANC



For Your Information

By WILLY LEY

THE ELEMENTS OF KHUJUT RABU'A AND CTESIPHON

THIS column is again based completely on questions from readers and I'll begin with a letter from Mr. Thomas C. Pace in Maryland. He wrote me after chancing across Prof. George Gamow's book *The Birth and Death of the Sun* in which its author reproduced a sketch very

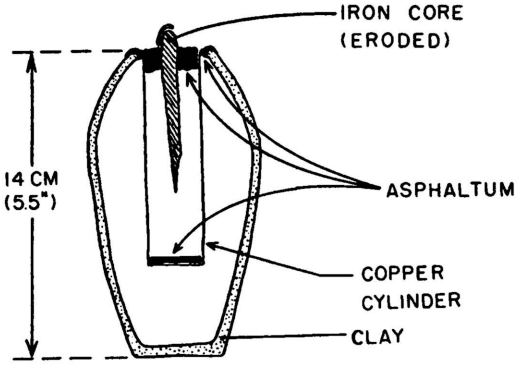
1 Photograph of the artifacts found at Khujut Rabu'a. Left to right, clay vase, iron core between fragments of asphaltum and copper cylinder. The indistinct scale is 10 centimeters long.

similar to Fig. 2 of a device from the time of Christ. This device is taken to be a primitive "galvanic" battery, surprising as that may seem. As a matter of fact, it couldn't be anything else known to Man!

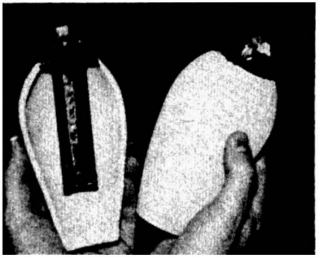
My correspondent stated that he knew, of course, that the ancient Greeks were acquainted with some of the phenomena of static electricity, but that he had never heard anything about ancient batteries. He added that he thinks he should have heard about it, since he earned for himself a degree in Electrical Engineering. And he closed his letter with the question of how it was possible that such knowledge could become a "lost art."

That my correspondent had never heard about this is not at all surprising to me. This historical item is not yet recorded in the introductory sections of textbooks on electrical engineering. The reason is that the small amount of existing literature is rather scattered and the basic reports are of foreign origin. Consequently, it might be useful to write a reasonably comprehensive report on the Mesopotamian batteries of twenty centuries ago.

THE first publication I know of was written by a Mr. Wil-



2 Diagram of the "element" as found.



3 Photograph of the reconstructed element.
Photograph by Berkshire Museum

helm König and appeared in the weekly magazine section of the daily newspaper of the German heavy industries, the *Deutsche Bergwerks-Zeitung,* under the date of January 16, 1938. König was attached to the Iraq Museum in Baghdad, although he is not, by training, a scientist.

Soon after the date just mentioned, the climate of Iraq in general and of Baghdad in particular got too much for Mr. König and he went home to Germany, where he used his spare time to write a book under the title *Im verlorenen Paradies — Neun Jahre Irak,* or, in translation: *In the (area of) the Lost Paradise—Nine Years in Iraq.* It was published in Berlin in 1940 and copies of it can be found in American libraries.

In this book, he told the story of the discovery of the ancient battery which in itself sounds a little like fiction. Baghdad is at

the Tigris river and, in 1936, the Tigris produced a major flood. The low-lying portions of Baghdad were covered by a few inches of water for a long time and these large and shallow puddles were extremely welcome to female mosquitoes as a place for depositing their eggs. Draining the puddles was apparently impossible and it was decided to fill them in. However, there are no hills in the immediate vicinity of Baghdad and the material needed had to be taken from a small hill a few miles to the southeast of the city. That hill bore the local name of Khujut Rabu'a and happened to be conveniently located at the railroad track which leads from Baghdad to Khanaqin.

As the workmen started loading their carts with sand and dirt from the hill, they came across ruins. Both the Iraq Museum and the government stepped in and their experts were unanimous in declaring that these were the remnants of a settlement from the time of the Parthian kingdom, which existed from 250 B.C. to 224 A.D.

I don't know what happened to the mosquito-breeding puddles in the poorer sections of Baghdad. They were probably left to evaporate. The digging at Khujut Rabu'a, however, turned into scientific excavations.

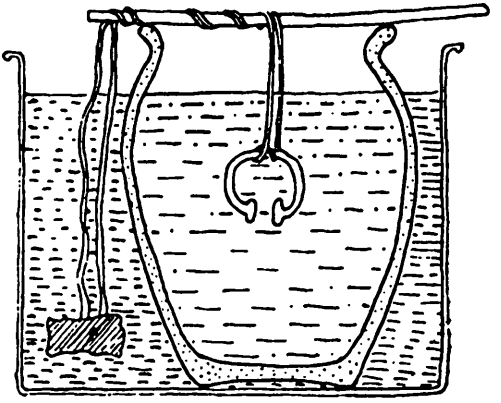
Among the artifacts found was a vase or urn of whitish-yellow burned clay of a well-known type, differing from the standard museum piece in that its neck had been knocked off a long time ago. In view of this handicap, the vase was shorter than usual, measuring 14 centimeters or 5.5 inches in height. Its largest diameter was 8 centimeters or about 3⅛ inch. The hole at the top measured 3.3 centimeters or slightly over 1¼ inch in diameter. There were traces of asphaltum all around the hole.

INSIDE the vase, the investigators found a cylinder of sheet copper, 26 millimeters (almost precisely one inch) in diameter and 9.8 centimeters (3⅞ inch) tall.

The cylinder had been formed by bending a piece of flat sheet copper around a dowel of some kind and soldering the ends together. The bottom of the cylinder was closed by a disc of sheet copper without soldering, the metal having been crimped to prevent the disc from falling through.

At the upper end, the copper cylinder was closed by a thick plug of asphaltum which, in its center, held a rod of iron, about three inches in overall length and sticking out on top about ⅜th of an inch (10 millimeters).

The iron rod was strongly oxi-



4 Konig's sketch of the ancient gold-plating equipment still in use in Baghdad a few centuries ago.

dized and tapered to a point at the time it was found. Quite possibly it was longer originally and it might have rested on the bottom of the copper cylinder, but without touching the metal, because there was a thin (3 millimeter) layer of asphaltum on top of the copper disc.

It was perhaps well that Wilhelm König was not a professional archeologist, for he looked at the find with open eyes and decided that this, records or not, could have been an electric element and nothing else.

He had the various components analyzed. The copper turned out to be rather pure with only traces of zinc, lead and iron. (The report on the analysis was published in *Forschungen und Fortschritte,* 1938, No. 1.)

He then inquired of archeologists whether anything like this had been mentioned in records; the answer was negative.

The next inquiry was whether anything like it had been found earlier. Yes, at a somewhat earlier date, four similar vases had been found near Tel' Omar, the ancient Seleucia-on-the-Tigris, some 25 miles downriver from Baghdad, lying opposite Ctesiphon on the other bank. The Tel' Omar speci-

mens lacked the iron cores and the copper cylinders were closed at both ends and were found, on opening, to be full of plant fibers. Their discoverer, at a loss what to think about it, had tentatively concluded that the plant fibers had originally been writing material which had fallen apart after twenty centuries of drying. Next to the urns, one thin, almost wirelike bronze rod and three wirelike iron rods were found.

What gave the whole a special flavor was that these urns were not found in a grave, as the excavating archeologists more or less expected, but were lying among the ruins of a house that was well away from the other settlements. Moreover, they were associated with bowls that the experts proclaimed to have been magic paraphernalia. Obviously the separate building had been the warlock's house, where strange things went on.

BY the end of 1938, nothing of all this had been published in any language other than German and, since nobody had written up even the bare facts in English, I did so in the form of two short reports. One was published in this country in *Astounding*, the other in England in *Discovery*, both, by coincidence, in the March issues of 1939. Prof. Gamow's remarks in his own book must be based on one of these two pieces, which were both written and published before König's own book appeared in 1940, and which lack much detail I did not know until I read the book.

Wilhelm König, as has been mentioned, queried archeologists about similar finds. When he went home to Germany, he was shown an unexhibited find in a museum in Berlin. It had been made in the ruins of Ctesiphon and dated from a somewhat more recent period, the Sassanian kingdom which lasted from 224-651 A.D. The find consisted of three fairly large clay vessels. One of them contained ten copper cylinders, the second had ten iron rods and the third held ten asphaltum plugs with holes in the centers.

Ten elements ready for assembly, lacking only the clay urns which evidently could be bought from any potter in town.

One thing König apparently did not do was to find out how well a reconstruction of such a battery would work. This was done in this country as a direct result of my first article. Mr. Willard F. M. Gray, an electrical engineer at the General Electric plant in Pittsfield, Massachusetts, wrote to me to obtain all the information available for the purpose of building a replica of the ancient battery.

The dimensions had been given by König and the composition of the metals, established analytically, was reasonably close to that of commercial sheet copper and iron rods of today, so there were no special difficulties as far as materials were concerned. The only unknown factor was the nature of the liquid electrolyte used by the "magicians" of the Parthian and Sassanian kingdoms. This simply was not known, but the choice was somewhat narrowed down to substances that could have been in use then.

Mr. Gray decided on a solution of copper sulphate as a likely electrolyte. He reported that this "worked quite well for a short time." The reconstructed battery is now on exhibit at the Berkshire Museum in Pittsfield, Mass.

Nobody who knows all the facts doubts that they did have "galvanic" batteries in Baghdad at about the time of Christ and for a few centuries thereafter. But when it comes to the question of what was done with them, we still have to resort to conjecture. Such a battery is rather weak and even if the "magicians" learned the trick of using several of them in conjunction, the output of current is small. Of course you can "taste" it and this might have played a rôle in what might be called magical experiments. Maybe it was even used for an assumed curative value, since somebody might have had the idea that the "taste" was similar to medicinal herbs.

AS for actual work, about the only thing you can do with such a weak current is the electroplating of small objects. Wilhelm König pointed out that some of the metal bowls from that time show what look like traces of plating. Moreover, he discovered that the silversmiths of Baghdad still used a primitive method of gold-plating (Fig. 4) earlier in this century. They did not know when this method had been introduced. They merely knew that it was "old" which, unfortunately, can mean anything that goes back prior to the birth of the speaker.

That these silversmiths used a primitive gold-plating method very much their own had probably been noticed by earlier travelers, but the obvious conclusion had been that they had imitated an early type of western device, lending it a local flavor by using home-made materials.

König rather suspects that their device goes back in an uninterrupted though devious line to the batteries of old Baghdad. This suspicion also answers Mr. Pace's question of how such knowledge could ever become a "lost art." It didn't. It merely failed to do

the one thing we expect any useful device and invention to do—it did not spread.

That trade secrets stay confined to places or, sometimes, families and groups of families is not novel. The batteries of Baghdad merely represent an extreme case.

But there are two things we still would like to have to consider the case definitely proved. One would be a two-thousand-year-old artifact which has been both electro-plated and well-preserved. The other would be a remark in some manuscript that the artisans or magicians of Baghdad could change bronze to silver and silver to gold.

ANY QUESTIONS?

Looking back through the 1953 *calendar, I noticed something that bothers me. On the* 23*rd of December (as a "for instance," it seems to go this way all through the year), the Sun rose at* 6:59 *and set at* 4.59. *The next day, it rose at the same time, but set at* 5:00 P.M. *Can you explain why one time stays the same while the other jumps?*

Thom Perry
4040 *Calvert St.*
Lincoln 6, *Nebraska*

This is something that has once been called by an astronomer "The increase of the day during the afternoon only" and which has puzzled many people. The real reason is that the orbit of the Earth around the Sun is not a circle but an ellipse.

If it were a circle, this apparent discrepancy would not take place. Since it is an ellipse, the Earth moves somewhat faster along its orbital path when the northern hemisphere has winter because, at that season, the Earth is closest to the Sun. (The seasons are due not to the distance from the Sun but to the tilt of the Earth's axis and, of course, its equator.)

The time needed for the daily rotation of the Earth stays the same, but because the Earth moves a longer distance during this time interval, the movement of the Sun across the sky seems to be different.

If we adhered to the definition of "noon" as the instant the Sun is highest in the sky, we would be forced to have days of somewhat different length for the different seasons. A sun dial will indicate such "proper noons," but you cannot run industry on sun dials. Hence, if you compare the sun dial to "standard time," which makes the interval from midnight to midnight the same all year round, your sun dial will be "fast" some of the time and "slow" some of the time.

To be specific, the sun dial will be "fast" from April 16 to June 15 (as much as four minutes in the middle of May) and "slow" from June 15 to September 2nd with a maximum of a little more than six minutes on July 27). From September 2nd until December 26, the sun dial will be "fast" (over 16 minutes on November 4) and "slow" from then on until April 16, the slowest day being February 12th, with some 14 minutes.

All of this simply means that the "noon" of standard time coincides with the noon of the sun dial only four times per year—on April 16, June 15, September 2nd and December 26. At all other times, the sun dial noon differs from standard noon and, during the first months of a year, the increase of daylight time is all added *after* the artificial standard noon. On a sun dial, equal time would be added before and after "noon," but, as has been said, you cannot run industry by sun dials.

In an old travel book, I found a statement about penguins living somewhere near Newfoundland. It cannot be a simple mistake, such as observation from a distance, because it is mentioned that the sailors collected the penguin eggs for food. I thought penguins lived only in the antarctic regions. Were there some in Newfoundland a few hundred years ago?

Karl F. Seifert
Emerson, Wisc.

Both you and the author of the old book you read are correct; it is a case of transfer of names. The bird now called "penguin" is restricted to the area of Antarctica with one species which, having once been subject to extreme wanderlust, settled on the Galápagos Islands directly under the equator.

The "penguins" of the Newfoundland area were not penguins in our sense. They were auks — specifically, the Great Auk (scientific name: *Alca impennis*), which attained the size of penguins, had wings too small to be useful for flight and bore a general resemblance to penguins in coloration.

The Great Auk originally inhabited the North European shores along the North Sea, Iceland, the southern tip of Greenland and the eastern shore of the North American continent from Labrador to about the coast of Virginia, with single specimens and small groups occurring as far south as northern Florida. It is now completely extinct, having lasted longest on a few small rocky islands off

Cape Reykjanes, south of Iceland.

It was this Great Auk that was the original bearer of the name of "penguin," derived from "pen-gwyn", meaning "white head". The name referred to two blinding white spots on an otherwise nearly black head.

At the time this name was in use, the southern hemisphere penguins were still unknown. Sailors who were acquainted with the northern "pen-gwyn" simply transferred the name, much in the manner in which English settlers in North America began to call a North American thrush a "robin" because of the similar coloration of the feathers on its chest, even though the two birds are neither related nor even of the same size.

The great French naturalist, Count Buffon, was very much disturbed by such careless nomenclature and suggested that the southern penguins be called "manchots". But only a few learned men followed this suggestion and not for long.

However, the confusion is minor, not only because the Great Auk is now extinct, but because the two birds lived in different hemispheres. The Great Auk never got close to the Tropic of Cancer and the penguin—excepting the Galápagos variety — never reached the Tropic of Capricorn.

Could an explosion (like we've already had) cause the Earth to deviate from its course? If so, will the deviation be toward or away from the Sun and how soon could it be detected? Would it need months or years?

James A. Velazquez
Far Rockaway, N. Y.

Theoretically, any explosion will influence the course of the Earth to a small extent. The direction in which this influence is exerted would depend on the time of the day. In the movement of the Earth around the Sun, the front side is the "dawn side". Hence an explosion at dawn would retard the Earth slightly, while an explosion at dusk would accelerate it.

If the Earth were accelerated by an explosion at dusk, it would drift "outward" in the Solar System and take up a new orbit slightly farther away from the Sun. If decelerated by an explosion at dawn, the Earth would drift "inward" and take up a new orbit somewhat closer to the Sun.

But because of the enormous mass of the Earth, all this is just theoretical. Even if all the explosion of two World Wars and all atomic tests took place

simultaneously, the result might very well be too small to be detected. Most likely it would amount to far less than the "perturbations" suffered by the Earth as a result of the gravitational pull of its two neighbors in the Solar System, Mars and Venus.

We are told that all motion will cease at absolute zero. Would the electrons around an atomic nucleus continue to revolve around it?

John F. Schenck
Rt. 1
Mexico, N. Y.

The statement that all motion will cease at absolute zero is meant to apply to molecular motion only. Nothing is said about the motion of sub-atomic particles.

I can understand to a certain extent how energy can be released in a fission bomb such as the A-Bomb, but how is it released in a fusion bomb? Please explain.

William E. West
Box 520
Madison, So. Dakota

In one respect, the two types of bombs may be said to be alike—in both cases, some matter is destroyed to appear as energy.

In the fission bomb, the heavy atoms of either uranium-235 or of plutonium are made to fall apart. They break up into two heavy atoms of roughly equal mass plus a number of smaller "splinters". The important point is that the total mass of the "splinters" of all sizes does not quite add up to the mass of the original atoms. The "missing mass" has been turned into energy.

In the fusion bomb, light atoms of individual masses smaller than "4" are made to reassemble into helium atoms. Again the resulting helium atoms do not quite have the mass of the atoms from which they were formed, the "surplus" being released as energy.

This question may not really belong in GALAXY, *but I wonder whether there is any truth in the legend of the vampires of Romania. If so, is there any connection between that legend and the vampire bats?*

Estelle Taylor
P.O. Box
Graymoor Village, N. Y.

The answer, offhand, would be "no," but there is a minor mystery, or perhaps just an interesting coincidence, connected with the vampire legend.

As far as one can tell, the vampire legend of various countries on the Balkan peninsula is

quite old, though nobody has been able to pinpoint its age, for unfortunately the carbon-14 method cannot be applied to legends. When it came to the shape of the vampire, folklore imagined something like a large bat. This folklore impression was strong enough to force its way into scientific zoology.

When Central and South America became known, it was also learned that there were blood-sucking bats in the New World. A few enormous bats which had been caught and preserved were at once suspected to be the culprits (simply because of their size) and were catalogued as *Vampyrus Spectrum.*

Later, it turned out that this bat was a completely harmless fruit-eater and that the actual blood-sucking vampire was a small and insignificant bat which received the scientific name of *Desmodus rufus.* This was in about 1840.

When it became known among European zoologists that a blood-sucking bat was a reality, they naturally jumped to the conclusion that the legendary bat-shaped vampire of the Balkans was based on such a fact.

But to this day, nobody has turned up a southeast European bat with blood-sucking habits. No known species is even under suspicion.

The present version of the vampire legend, much used in fantasy, where the vampire has human shape and is "undead," seems to be fairly recent.

As you know, the vampire is supposed to be immortal and only subject to the compound accident of suspicious peasants, zealous country priests and sharpened stakes. On the other hand, everybody who dies because of a vampire is supposed to turn into one himself.

Now if you start the chain with just one vampire, you may assume that, during the first year of its activity, one victim dies. By the end of the year, you have two vampires. If they each make one haul per year, the vampire population doubles every year. At the end of the tenth year, you'll have 1,000 full-fledged vampires — under the assumption that two dozen of them succumbed to attrition by stakes. After 15 years, you'll have 32,000; after 20 years, over one million.

After half a century, everybody would be a vampire!

Having thus pulled a prop out from under a whole category of stories, I close this last column of the year with sinister glee.

—WILLY LEY