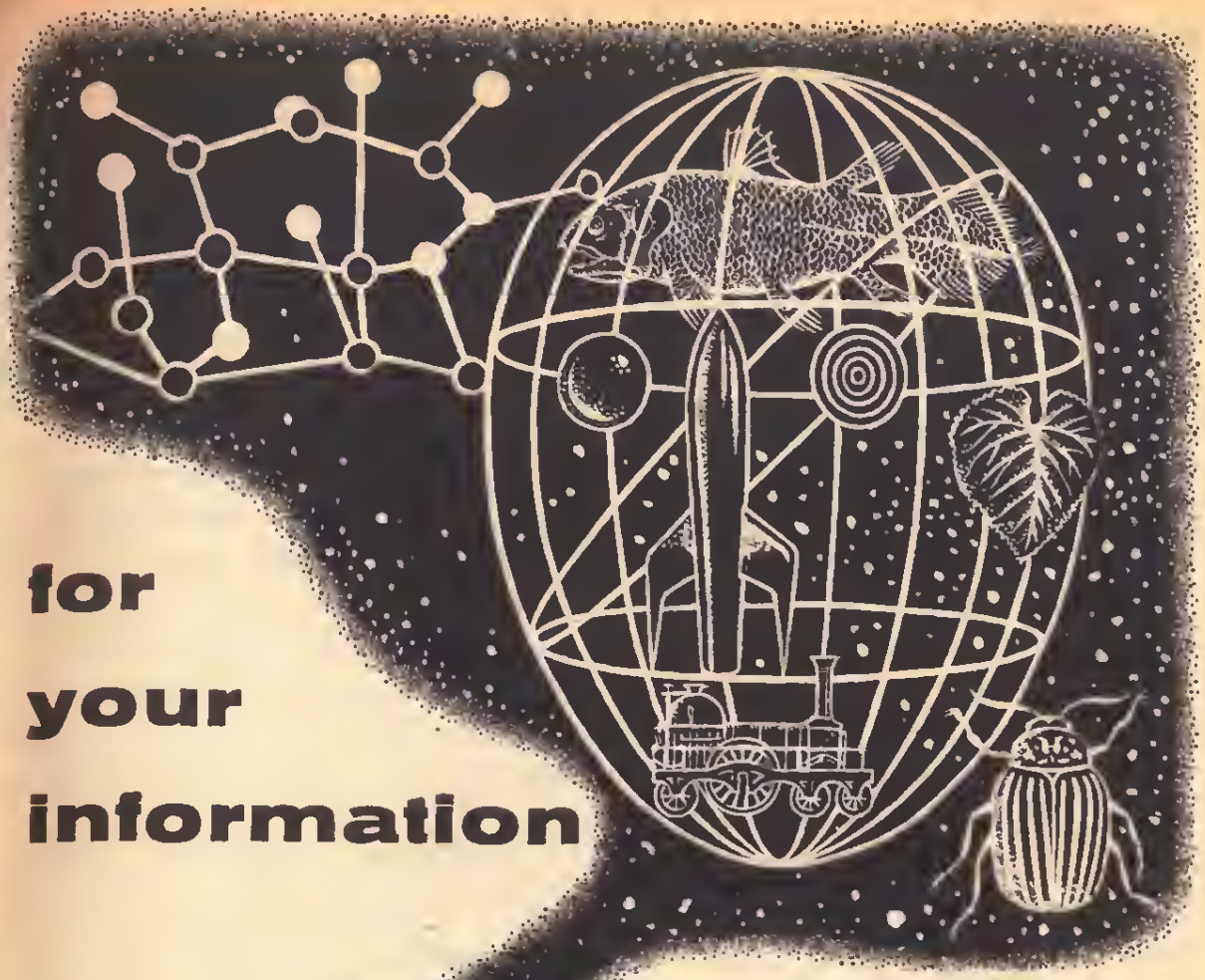


for your information

BY WILLY LEY

DRAGONS AND HOT-AIR BALLOONS

THIS section owes its existence to a letter I recently came across while sorting out old papers. It came to me from China fourteen years ago (and a date stamp shows that I answered it then.) The letter also bears the notation "check Konrad Kyeser," but because of a move from Washington, D. C., to New Jersey which took place soon after I never got around to that . . . until now.

The letter was written by a

Russian by the name of G. Larikov. By way of introduction he told me that he was a graduate of the Imperial Russian Artillery School and that he fled Russia after the revolution and made his home in China. There he became a civilian employee of the Chinese Ordnance Department during the Second World War. After this introduction G. Larikov proceeded to the reason for writing his letter:

"During my stay in Szechwan Province during the first half of the recent war," he wrote, "I lived for several years in a deep valley, something like your canyons, where our arsenal was located for protection against Japanese bombers. Soon after our arrival in that valley the guards started to send reports that from time to time mysterious lights appeared floating far above our arsenal. Our men were greatly alarmed and immediately decided that it was some kind of Japanese deviltry. I tried to reassure them that those lights, after all, did not cause us any harm. But they also reported the story to the local Chinese police and insisted on a thorough investigation. At long last it was found that the farmers who lived in the mountains around our valley had the custom of sending into the night air paper balloons with small oil lamps attached to them when somebody was sick or when they wished to send a message to their dead ancestors. We have found later that this custom, like all Chinese customs, is very old, dating back not hundreds but thousands of years and so well forgotten in other, less remote, parts of China that even very few Chinese ever heard of it."

Considering that mountainous Szechwan *is* a remote place, where one would hardly expect the farmers to construct hot-air ballons of the Montgolfier type as a pastime, the anxiety of the guards and the surprise of their superiors both become understandable.

But the fact is that the farmers did. And that raises the inevitable question of how they learned it and from whom. (That the custom is "thousands of years old" is a statement that can safely be disregarded. The Chinese were in the habit of claiming every one of their institutions to be thousands of years old.) My correspondent did not try to answer that question, but said that possibly "in former years, some missionaries brought the idea of hot-air balloons from China to Europe, where it was adapted by the brothers Montgolfier for their flying experiments."

I probably answered at the time that I felt sure that missionaries—more specifically French

missionaries—were involved, but that the idea of the hot-air balloon probably traveled the other way. So that the "thousand-year-old" custom would perhaps date back to around the year 1800.

MY reasons for passing judgment like that were the following: If, at a time when nothing in Europe took to the air but birds and insects, hot-air balloons from China had become known via a returning missionary, that fact would have been written up at great length. Nor would their Chinese origin have been concealed in any way. Just at that time Europeans were very much interested in things Chinese. On the other hand, the Montgolfiers' hot-air paper balloons did cause an enormous stir and everything connected with them was written down by somebody. Because of that we know precisely how the invention came about.

The brothers Montgolfier (Jacques Etien and Joseph) began by wondering what kept the clouds up. And they saw, of course, that smoke from a chimney rose and formed "clouds," too. Was smoke powerful enough to carry something up with it? Well, sometimes you could see a half-burned piece of paper rising. So they first built a kind of inverted paper bag to catch the smoke, and they saw to it that the fire was quite smoky by throwing wet straw into it.

In spite of all their mistakes it worked.

They knew—or found out for the purpose—that the sphere was the body combining largest volume with smallest surface. They learned that smoke was not indispensable. And on June 5, 1783, they made their first public demonstration, with an unmanned paper balloon about 35 feet in diameter.

One year later the first hydrogen balloon was built, though not by the Montgolfiers.

How quickly the news got around is shown by the fact that on December 27, 1783, Johann Wolfgang von Goethe wrote to a friend about the attempts of the Court Apothecary Buchholz in Weimar "to master the art of Montgolfier." One can still see the smile on his face when reading his description. "Buchholz tortures the air but without success. The spheres refuse to rise. One of them hastily rose to the ceiling, but only once." Interestingly Goethe continued that he "had resolved to progress slowly, and hope to be the first to chase an enormous paper ball into the air."

History does not know anything about a hot-air balloon built and launched by Goethe. Either somebody succeeded before him in his area, or else he

was simply too busy to bother.

What is even more interesting is a sketch for an article (dated April 11, 1821) which he intended to write but never did. Its theme was that he was very lucky to have lived through the second half of the 18th century and to have seen how such a large number of inventions and discoveries was made. He then listed the discoveries and inventions. After the word "Balloons" he wrote, "How close I was to making this discovery. Some misgivings that I didn't do it myself. But consoled myself soon." Nobody knows just what he meant by these words. Possibly, as a young man, he had also watched smoke rising and had wondered whether it might carry something.

NOW for my long delayed resolve to "check Konrad Kyeser."

When I read Mr. Larikov's letter suggesting that the Montgolfier brothers were not the original inventors of the hot-air balloon. I remembered that somebody else had said the same thing. This somebody else had been a Swiss engineer by the name of Franz Marie Feldhaus, who later became famous as a historian of technology. (When I met him about thirty years ago he told me how this had come about. In principle it was quite simple. He did not have a job. While waiting for one to come along he went to the University library, asking the librarian for books on the history of inventions. Finding these books most inadequate he resolved to write better books himself. And did.)

But Feldhaus (I don't know just what kind of engineering was his specialty) had one weak spot: aviation in any form or shape. In a book which he wrote in 1907 he still maintained stoutly that airplanes were a very unlikely invention. If they could be built at all they would have no practical value as a means of transportation but would be the aerial equivalent of a racing yacht. Helicopters, the same book says, were a senseless project. And as late as 1929 space travel was just a fantastic dream to F. M. Feldhaus.

Well it was Feldhaus who pointed his finger at a device which he said employed Montgolfier's principle long before Montgolfier. This device was the so-called Dragon Standard (see figure), which must have existed around the year 1400. No such dragon standard has been preserved anywhere, for reasons which will become apparent very soon.

We know about them through a book called *Bellifortis*, written by Konrad Kyeser von Eichstaedt and finished during the last week

of August, 1405. Several manuscripts are known. The one from which this picture of the dragon standard is copied is considered to be the original. It is not, the bibliographical experts believe, in Konrad's handwriting; but it is called "the original" because it was written down under Konrad's supervision.

Of course, the Latin text calls the standard *draco volans* (flying dragon) and tells that the head is made of parchment, the body of linen and the tail of silk, each of a different color. The purpose of the gay monster was twofold. It was to signal to your allies where you were, and it also was to frighten the enemy (who, like enemies at any place and any time, was supposed to be not only evil but also somewhat stupid). At night a lamp was to illuminate it from within. Konrad Kyeser wrote that this lamp should have a wick soaked in *Oleum benedictum*. The latter was his term for "kerosene" and it seems as if he wasn't too sure just what that was.

KONRAD KYESER also added that one could use a rocket for illumination and said that this rocket should be put in the dragon's tail.

Feldhaus, after examining the picture and a few similar ones from later hand-written copies of the *Bellifortis* (it never was printed), came to the conclusion that these dragon standards had been early hot-air balloons. Possibly—no, very likely—the artisans who made them knew nothing about the lifting capacity of hot air, Feldhaus said, but as soon as they started using these devices during the night and had to put lamps into them to make them visible they must have noticed that the dragon standards no longer needed to be lifted but had to be tethered instead . . . as can clearly be seen in the picture.

When I read this for the first time I thought "how interesting." It did not occur to me to make a calculation.

But if you do, you realize very quickly that a little calculating is what Feldhaus should have done

Dragon Standard of 1400 A.D.

before he proclaimed the dragon standards to be the forerunners of the hot-air balloon. Unlike the sphere, this dragon shape has litle volume and lots of surface. And because of its shape it cannot be a simple cloth bag, it needs reinforcements in various places. In short, the amount of buoyancy which hot air could produce would be far less than the weight of the standard.

What it really is is a so-called fish kite.

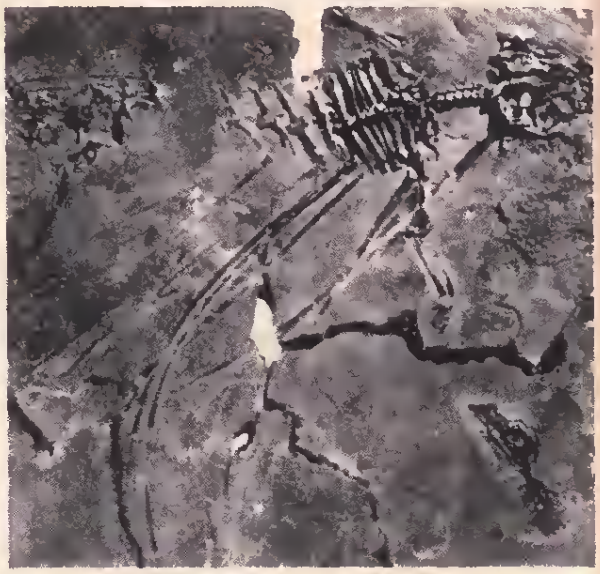
But if it were a kite shouldn't it be shown trailing the rider? Yes, it should be. The reason why it doesn't is probably that the artist wanted a nice composition on the manuscript page. It is also possible that the artist had never seen one of these kite standards demonstrated. And it is just as possible that the artist was just careless. Paintings of sailing ships with the sails billowing one way and the flags streaming the other are no rarity.

If one of these kite standards had been preserved we could see with our own eyes that it was a kite and not a hot-air balloon. But none has been preserved, I suspect because of the wick soaked in *Oleum benedictum*. They probably all burned up in action.

THE ORIGIN OF FLIGHT

This is going to be about a fossil, and I should wait until the formal scientific description has been published before I write about it. But the case is not only unique but so surprising in many respects that I prefer telling an incomplete story to waiting.

Preliminary Reconstruction of the North Bergen Fossil.



The North Bergen Fossil (Courtesy: American Museum of Natural History.)

The fossil in question is from the black shale of an abandoned quarry in North Bergen in New Jersey. That black shale is rather reliably dated as being 175 million years old, which means it was

formed during the latter part of the Triassic period. The area then was a large freshwater lake, well populated with small coelacanth fishes. Among more or less well preserved coelacanth fossils three young men in the upper teens, Alfred Siefker, Joe Geiler and Mike Bandrowski, found a fossil 7½ inch lizard-like reptile, which they later handed over to Dr. Edwin H. Colbert, head of the Department of Vertebrate Paleontology of the American Museum of Natural History.

It turned out to be the earliest known "flying reptile." Since the scientific description isn't out yet I don't know what its name will be. Following normal scientific usage the name could be *Pamprotopteryx,* but there are a few drawbacks to that name, aside from the layman's customary complaint that it would be hard to pronounce. In the first place, naming a new genus is the privilege of the discoverer or of the man who produces the first scientific description. In the second place the name is slightly wrong. The Greek root words would mean "first of all to fly" but the root word for the last part of the name *pterón* means "wing" or "fin" and can be stretched to mean "paddle." At any event, it implies something active. But the reptile from North Bergen did not fly actively.

It did not have wings. It had what is best called a parachute; and for very good reasons there is neither a classical Greek nor a classical Latin word for parachute.

The fact that it did not have wings is the big surprise. A winged reptile from the late Triassic period would have been a novelty but it would have been quite logical. The two periods which followed after the Triassic were the Jurassic and the Cretaceous periods, and we know winged reptiles from both of htem. In fact, we know two types, a short-tailed version, the pterodactyls, and a long-tailed version, *Rhamphorhynchus*—the latter known so far only from the upper (which means more recent) Jurassic of Bavaria. The short-tailed pterodactyls are known to have lived from the very early part of the Jurassic period until the end of the Cretaceous period, when they became extinct.

Flying Reptile Pterodactylus from the Jurassic of Bavaria

Since even the earliest Jurassic pterosaurs (to use the all-inclusive term for the extinct winged reptiles) are rather definite types, it is obvious that there must have been earlier forms. These earlier forerunners of the Jurassic types are to be sought in Triassic rocks. They couldn't be anywhere else. Hence the discovery of early Triassic pterosaurs, though it hasn't happened yet, is something to be expected.

But the fossil I misnamed *Pamprotopteryx* above resembles in construction something which has been in the books, as a living reptile, for around 200 years. It is a tree lizard from Java and adjacent islands with an overall length of about 8 inches, of which the slender tail accounts for 5 inches. Carolus Linnaeus named it *Draco volans* (I can't seem to get away from "flying dragons" in this column!) and zoological handbooks state that there are about 35 different species of them. Nobody is too specific about the number of species. Some of them may be mistakes because the coloration of the incidentally very beautiful "flying dragon" varies considerably from one specimen to the next.

Now *Draco volans* has a "parachute" spread on each side of its body by a number of "false ribs" —six of them, in the most common species. The North Bergen fossil shows the same arrangement, but with fourteen rib extensions. Its "parachute" is larger than that of *Draco volans;* the rib extensions are five inches long on either side. The living *Draco volans* has been observed to cover distances up to twenty yards. One observer swore that it can avoid obstacles while gliding. When it reaches the tree trunk where it wants to land it lowers its tail—held stretched out while gliding—and seems to throw its head back, obviously getting the "parachute" surface into a braking position. As a glider, the performance of the North Bergen reptile must have been at least as good as that of the living *Draco volans.*

As the pictures show, there can be no direct connection between the Triassic parachute reptile from North Bergen and the pterosaurs of the Jurassic. The latter had developed a real wing, a skin stretched by one enormously elongated finger—the one anato-

One of the Species of "flying dragon".

mists call the fourth finger and which women refer to as the "ring finger." (The bat's wing, to get rid of a possible misunderstanding, is stretched by all four fingers, with the thumb forming a free hook.) As for the ancestry of the pterosaurs, we know that they sprang from a group of usually fairly small reptiles, probably largely tree-dwelling, which bear the scientific name of *Pseudosuchia*. There is not much sense in translating a label like this, but one might refer to them as the pseudocrocodiles.

During the period preceding the Triassic, namely the Permian, they had come from an older group of reptiles which had split into two groups. The pseudosuchians are one of these two. The other group is labelled parasuchians and there isn't much to be told about them. But the pseudosuchians had gone on to glory. From them sprang the pterosaurs, the dinosaurs, the crocodilians and even the birds.

It would be most interesting if it turns out that the North Bergen fossil is a pseudosuchian too. If so, this group would have invented flying three times, once in a gliding form constructed like the living *Draco volans* (as far as the gliding mechanism is concerned), once in the shape of the pterosaurs and finally in the form of the birds.

I wish I could tell now what forms led to the living *Draco volans* but this is, unfortunately, not known. The living form decidedly belongs to the lizards—which did not become important until fairly recent geological times, namely the Tertiary. But *Draco volans* is now an isolated form. It has no near living relatives and no fossil ancestors are known.

THE BIGGEST GUNS

I did not get many good questions this month, but one which came from a reader in Salt Lake City will probably use up what space I have left.

The gentleman made a trip to Russia last year and, like all tourists who come to Moscow, he was taken to Red Square and shown the "Czar Pushka." (*pushka* is just the Russian word for "cannon.") During the return trip another passenger told him that one of the Sultans had an even bigger cannon built. The question is, simply, about the dimensions of the Czar Pushka and whether there have been bigger guns.

The dimensions of the highly ornamented bronze *pushka* are: length of barrel 22.2 feet, caliber 45¼ inches, weight of barrel 4310 pounds. Apparently the piece was considered more a work of art from the outset, for it was

literally never fired (Voltaire made a crack about it, saying that the two outstanding items of the Kremlin are a bell which was never rung and a cannon which was never fired) and has been on public display since the year it was cast, which was 1586.

The other big gun which was mentioned by the fellow passenger of my reader was probably the Mohammed II, built for that Sultan by a man called "Urban the Hungarian" in about 1460. It weighed about 2100 pounds and its bore was 31 inches. The barrel was 21.5 feet long.

It was in every dimension a bit smaller than the Russian piece, but, to make up for it, it was fired. As Gibbon tells the story in Chapter LXVIII of his *Decline and Fall of the Roman Empire:* "The stone bullet weighed about six hundred pounds. A vacant place before the new palace was chosen for the first experiment; but, to prevent the sudden and mischievous effects of astonishment and fear, a proclamation was issued that the cannon would be discharged the ensuing day. The explosion was felt or heard in a circuit of a hundred furlongs. The ball, by the force of the gunpowder, was driven above a mile; and on the spot where it fell it buried itself a fathom deep in the ground. For the conveyance of this destructive engine, a frame or carriage of thirty wagons was linked together and drawn along by a team of sixty oxen. Two hundred men on both sides were stationed to poise and support the rolling weight; two hundred and fifty workmen marched before to smooth the way and repair the bridges; and near two months were employed in a laborious journey of one hundred and fifty miles."

It is likely that the gun did go into action, but it cannot be proved. The contemporary writers were careless or ill-informed. They confused several big guns used at the time, and even Mr. Gibbon did not succeed in disentangling their chaotic accounts.

The next big gun was British. It was a siege mortar designed by a Mr. Robert Mallet. The bore of these mortars (two were built) was 36 inches. The barrel length was eighty inches above a 48.5 inch long conical powder chamber, with an average diameter of 16 inches. The projectiles were cast iron balls 35.6 inches in diameter which came in three weights: 2365, 2550 and 2990 pounds. They had room for a bursting charge weighing 480 pounds.

One of the two mortars was never test-fired. The other fired a number of rounds during the fall and winter of 1857. The two mortars were meant to be used in the

Crimean war but never left England.

Two large guns which really saw action both are German, one for each of the two World Wars. The "big gun" of the first World War was the "Paris Gun"—also called (by the German press) "Kaiser Wilhelm Gun" and miscalled (by the French press) "Big Bertha."

Its caliber, as the official designation states, was 222 millimeters (8.74 inches.) The length of the barrel was 110 feet; the shell weighed 260 pounds; the range was 80 miles. The gun itself weighed 154 tons and the cradle 26 tons. The barrel stood only about 60 rounds. Using up a total of six barrels, the gun fired a total of 367 rounds, all into Paris.

For the second World War the Germans rebuilt one of these guns, and in 1941 it was assigned to Battery 701. But even official German sources do not know whether it was used. A German gunnery expert who tried to find out received the answer, "Since the Army had the piece they probably fired it. But there are no records."

But the "big gun" of the Second World War was the one called "Dora." Its caliber was 800 millimeters (31.5 inches.) The length of the barrel was 106.6 feet, the weight 1485 tons (short tons of 2000 lbs. each) and the range 29 miles. The shell was 4½ calibers long, weighed 7.8 (short) tons and required a propelling charge of 4400 lbs. It could fire three times per hour.

To build the firing position for Dora took 4000 men and five weeks. Firing the gun required only 500 men.

Dora pulverized the fortifications of Sevastopol and was then brought to Leningrad (needing three trains just for the gun), but did not see action again. By then the German High Command had come to the conclusion that Dora was too big. Two other guns of the same type that had been built were not even sent to the front lines.

— WILLY LEY