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TRIBES
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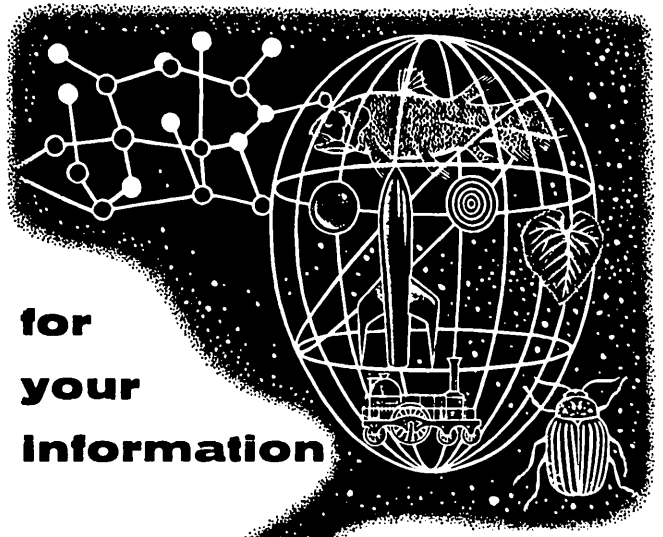

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BY WILLY LEY

TRIBES OF THE DINOSAURS

Illustrated by OLGA LEY

DINOSAURS, said the man, were nature's biggest failure. Since I'm always ready and willing to learn, I was glad to hear this.

Then I added a few figures in my head. The often used term Age of Reptiles, during which the dinosaurs flourished, comprises the three geological periods of the Triassic, the Jurassic and the Cre-

Fig. 1: Moschops capensis, from the Permian of South Africa

taceous. The Triassic and the Jurassic each lasted about 35 million years and the Cretaceous lasted 65 million years. This adds up to 135 million years – and you really should start counting a few million years prior to the Triassic.

So the "failures" were around for at least 140 million years, whereas Man started only about half a million years ago. I'd say that was a remarkably long run for a flop and that, so far, at least, the critical success has merely had an out-of-town tryout.

However, it is not my intention to quarrel with somebody's witless verdict. My purpose is, instead, to discuss the question of what the dinosaurs really were, since the term is used rather carelessly in newspaper stories, magazine articles and the movies. To begin with the word itself, it was pasted together during the last century from the two Greek words *deinos* (meaning terrible, mighty or powerful) and *sauros*, which just means lizard.

THE next statement to be made is one that should be obvious, but I have found that it isn't – namely, that not every reptile is a dinosaur, even though all dinosaurs were reptiles. Reptiles are vertebrate animals which have a dry skin, often scaly, breathe by means of lungs, propagate by laying eggs, and lack a heat-regulating mechanism, so that the temperature of their blood is more or less the same as the temperature of the surrounding air or water.

A crocodile is a reptile. So are a lizard, a tortoise and a snake. But even the largest crocodile, or

the fiercest-looking iguana, is not "an offspring of the dinosaurs." You might as well say that an especially large bull is "an offspring of the elephants"—both these statements are equally silly.

Nor is the mere fact that a reptile is now extinct a criterion. The eight reptilian forms pictured here are absolutely, completely and hopelessly extinct, but half of them are not dinosaurs. They are all reptiles, though, even though the word "reptile" comes from the Latin *repto*, which means "to crawl."

The reptiles got their start way back in the Permian Period, a little over 200 million years ago. The Earth was not precisely "young" any more then; endless periods had already gone by since its formation. There had been at least 2000 million years during which the planet was lifeless, then another 2000 million years when any life that existed was most likely single-celled, and another 600-700 million years with very primitive marine life, of which we know almost nothing, since they left so few fossils.

Only after all this time had passed did paleontological history begin with the Cambrian Period, which opened the so-called Paleozoic Era. That era began about 550 million years ago and lasted

Fig. 3: Plateosaurus longiceps, from the Triassic of Germany

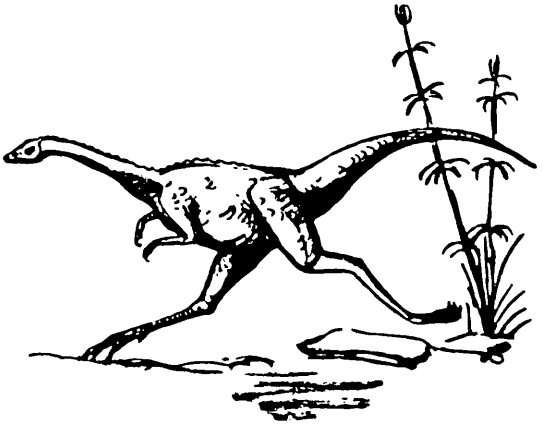

Fig. 3: Compsognathus longipes, from the lithographic slate (late Jurassic) of South Germany

through half a dozen geological periods, with a total duration of 350 million years.

Those half-dozen periods were the Cambrian, then the Ordovician, then the Silurian (the oldest known fishes belong to this period), followed by the Devonian and by the Carboniferous, a period of maximum activity with enormous forests which produced our coal, and with the earliest known insects and salamander-like amphibians.

The last of the geological periods of the Paleozoic Era was the Permian, which produced the earliest known reptiles. They are known from Texas, from Saxony, from Russia (the Permian Period received its name from the Russian district Perm) and especially from South Africa.

The one that is considered to be the grandfather of all the reptiles was found in Texas and named Seymouria. It must have looked like a big ill-tempered salamander with long teeth. In fact, Seymouria was not a "complete" reptile yet, but is perfectly intermediate between the early amphibians which came before and the reptiles which were still to come.

The Seymouria group, also called seymouriamorphs, was, in turn, a sub-group of a larger group called the cotylosaurs, or, in English, the stem reptiles.

Everything that followed began with them.

AMONG their earliest offshoots was a group that goes under the technical name of the therapsids, which quickly produced rather large plant-eating forms. One of the best-known of them is Moschops — the name means calf's head and don't ask me why; I can't see any similarity — from the Permian of South Africa (Fig. 1). The clumsy reptile was six feet long and must have been quite heavy. There were others that were even larger and their pictures are occasionally printed with the caption "early dinosaurs," but they were not dinosaurs yet.

Out of this general muddle of interrelated large and clumsy, small and agile, or even large but agile primitive reptiles sprang a number of branches that were to be fruitful, hence important.

One of them, called the theriodonts (which translates as mammal teeth) actually did produce the mammals in the very next geological period, the Triassic.

Another one moved in direct strides toward the later chelonians, which is the term used by zoologists when they wish to encompass both the turtles and the tortoises.

Still another one goes under the name of thecodonts. The name is compounded of the words for tooth and for box, the reason being that their teeth had roots in separate holes in the jaws, an arrangement we tend to consider the norm, but which was

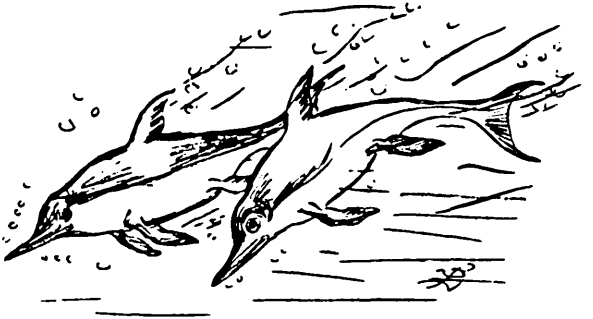

Fig. 4: Stenopterygius quadriscissus (ichthyosaur) from the Lias (early Jurassic) of South Germany

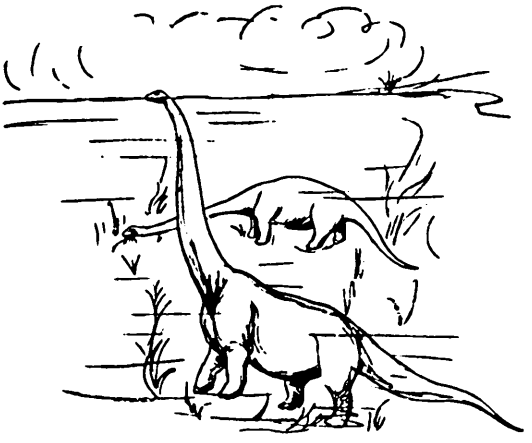

Fig. 5: Helotus zdanski, from the early Cretaceous of Meng-Yin-Sien in China

by no means the norm then.

This "order" of the thecodonts had two sub-orders, called parasuchia and pseudosuchia. Translated, this gives us near-crocodiles and pseudo-crocodiles — of all things, the *Egyptian* name for crocodile is hidden in these terms — but one should not translate here, for they were not related to the crocodiles, which are a branch of their own.

The parasuchians at least looked somewhat like crocodiles, but the pseudosuchians were a bunch of radical innovators. Some started to climb trees, others ran on their hindlegs only, still others alternated between bipedal and quadrupedal walk. Some were armored and others were not.

In time, one sub-branch of the versatile pseudosuchians evolved into the flying reptiles of the Jurassic and Cretaceous Periods — the pterosaurs, to use their technical name. Another sub-branch of the pseudosuchians — *not* the same — learned to fly, too, by changing its scales into feathers and became the birds. And further sub-branches evolved into the dinosaurs.

A real "early dinosaur" is Plateosaurus (Fig. 2), of which fine specimens have been found in Germany, where Plateosaurus apparently had to migrate across a desert area every year, with a few falling by the wayside and some

of them becoming fossilized.

Unfortunately the German deposits have yielded fine skeletons but no footprints. The reason this is regrettable is that we do know footprints from Connecticut which could have been made by Plateosaurus or a closely related form. But in Connecticut, no bones have been found.

Though it had not yet attained the impressive dimensions of later dinosaurs, Plateosaurus was quite big. The length of the tail alone was about eight feet.

WHEN paleontology was a relatively young science, it seemed for a while as if all the dinosaurs should or could be sorted into two orders which could be told apart with half a glance, one walking on all fours, while the other strutted around or its hindlegs. I am sorry to report things aren't that simple.

There are two orders of dinosaurs, all right, but the distinguishing mark is not whether they walked on two or four legs. The distinguishing mark is the shape of the pelvis.

Very many of them have a pelvis which reminds anatomists of the pelvis of birds. They are the Order of the Ornithischia and are sometimes, for simplicity's sake, referred to as the "birdlike" dinosaurs. This just proves again that we should not translate scientific

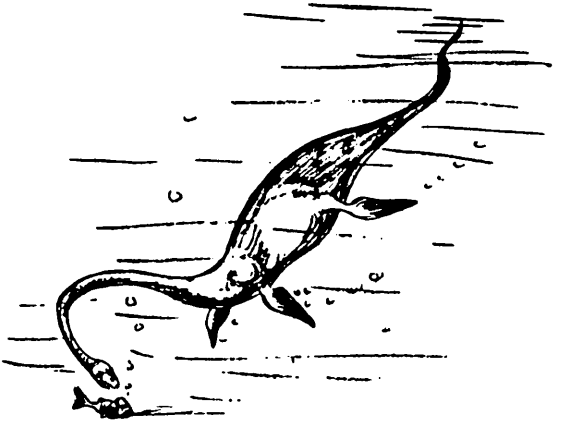

Fig. 6: Elasmosaurus platyurus, from the late Cretaceous (Niobrara Sea) of Kansas

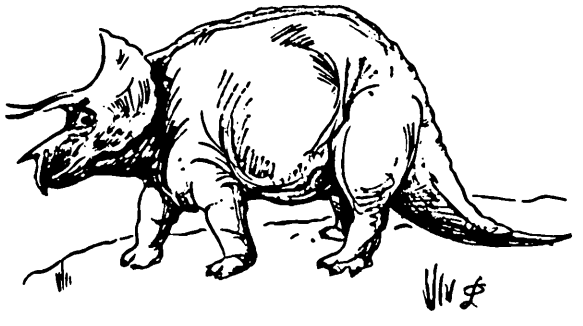

Fig. 7: Tricateratops horridus, from the late Cretaceous of Wyoming

terms, for one of these "birdlike" dinosaurs is the rhinoceroslike – but bigger – Triceratops (Fig. 7).

On the other hand, little Compsognathus (Fig. 3), which did not quite reach the dimensions of a domestic cat, is not one of the "birdlike" dinosaurs. It belongs to the other order, the one which has a pelvis like a reptile, the Order of the Saurischia.

Now *inside* the Order of the Saurischia, the old distinction into quadrupeds and bipeds *does* hold true. The bipeds are officially the Sub-order Theropoda, and Compsognathus is one of them. So is the flesh-eating Allosaurus of the North American Jurassic and so is Tyrannosaurus of the North American Cretaceous.

The second sub-order of the Saurischia is the Sub-order Sauropoda, and they are what the layman usually thinks of when the word dinosaur is mentioned. Brontosaurus was one of them and so was Diplodocus, both from the North American Jurassic. Another member was Brachiosaurus of eastern Africa, which was probably the biggest of the lot, and finally the somewhat more recent Helotus from China (Fig. 5), which was not at all small itself, measuring some 65 feet from nostrils to tail tip. The reason Helotus is pictured grazing at the bottom of a lake is simply that its remains were found in fresh-water deposits.

We now know, because of footprints found in Texas, that the very large sauropod saurischians could walk on dry land. This is a point worth making since, for quite a number of years, it was thought that the legs of the sau-

ropods, while massive, could support the body only if shallow water helped them to carry it. They probably did not go hiking for fun, but if they had to cross dry land to get from one lake to another, they could.

As I said, the old distinction of bipeds on the one hand and quadrupeds on the other hand can still be made, provided you stay inside the Order of the Saurischia. In the other order of the true dinosaurs, the Ornithischia, you can do the same, except for one main difference. The quadrupeds belonging to the Order Ornithischia are so different from each other that they form separate sub-orders.

LET'S look at this in a little more detail. The first sub-order of the Ornithischia is that of the Ornithopoda (bird-footed). In the Jurassic Period, this sub-order was represented by the bipedal dinosaur Camptosaurus, which hasn't received much publicity in other than professional books. But the ornithopods of the Cretaceous are well known; they are the so-called duck-billed dinosaurs, of which Trachodon is the favorite example.

The remaining three sub-orders of the Ornithischia are all quadrupeds and they are called Stegosauria, Ankylosauria and Ceratopsia.

The first of these three is rep-

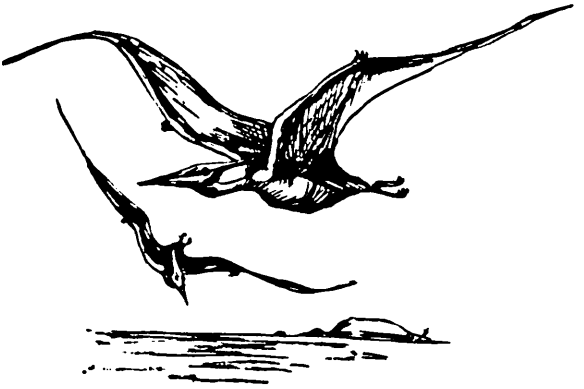

Fig. 8: Pteranodon ingens, from the late Cretaceous (Niobrara Sea) of Kansas

resented, of course, by the well-known stegosaur, which bore a crest of enormous triangular bony plates on its back, with a few paired sets of spikes on the tail to make the defensive armament complete.

The name stegosaur is based on the Greek word for roof — apparently the first discoverer thought that the triangular plates were lying flat on the body as armor, giving the effect of shingles. We now know that they did not and it probably was the weight of these plates which made stegosaur into a quadruped. The study of his anatomical features makes it perfectly clear that this type was bipedal and re-adapted to walking on all four legs only after it had already acquired the features that go with a usually upright position.

The next sub-order, that of the Ankylosauria, is not too well known to the public and the main representative Ankylosaurus is not very easy to describe. The difficulty begins with the name, for the Greek word *ankylos* can mean curved or crooked or else stiff-jointed. Both meanings apply, the curved to its ribs, the stiff-jointed to its general appearance. It has been called the "tank of the Cretaceous Period," squat and heavy in build, with a broad armor-plated skull, a heavy stiff tail with a clublike bone at the tip, and, for all we know, with horny spikes along the sides.

The last sub-order of the Ornithischia was also massive in build and heavily armored, at least in front. They were the Ceratopsia (Fig. 7).

And there you have the tribes of the dinosaurs, all six of them: the Theropoda (example: Tyrannosaurus), the Sauropoda (example: Brontosaurus), the Ornithopoda (example: Trachodon, the duck-bill), the Stegosauria, the Ankylosauria and the Ceratopsia. There weren't any others when the dinosaurs were at their peak.

But how about things like the plesiosaurs in the sea, the flying saurians in the air?

They were reptiles and can be called saurians, but they were not dinosaurs. The ones usually called plesiosaurs form a reptilian order of their own, the Order Sauropterygia. These long-necked "sea serpents" with their four paddles became more long-necked as time went on. The plesiosaurus of the Jurassic Period was already giraffe-necked. What happened in the Cretaceous with Elasmosaurus can be seen in Fig. 6.

MORE numerous than the plesiosaurs were another type of marine reptiles of the general shape and size of a dolphin, the ichthyosaurs (Fig. 4). They also form a reptilian order of their

own, the Order Ichthyosauria, from Greek *ichthys* for fish and *sauros* for lizard.

How well distributed they were can be told by a survey of their life history. The earliest known types of the ichthyosaurs were found mostly in California. A somewhat later type, but still from the Triassic Period, was found in Spitsbergen and named *Mixosaurus nordenskjöldi*, and another one of the same age — give or take half a million years — came to light in Nevada. The vast majority of the ichthyosaurs of the Jurassic Period, however, is concentrated in South Germany and South England.

To forestall questions as to why the ichthyosaur of Fig. 4 has a different name, I have to explain that during the Jurassic Period — more precisely, in the first of the three sub-periods of the Jurassic Periods, when they were most numerous — three main types were around in quantities. They could be told apart best by the shape of their paddles (*pteryx* in Greek), which were either broad (*europs* in Greek) or else narrow (*stenops*) or slender (*leptos*). Hence the three types received the designations *Europterygius, Stenopterygius* and *Leptopterygius.*

The ichthyosaurs did not continue beyond the end of the Jurassic Period and their last representatives were weak-looking and very nearly toothless types. Apparently they disappeared because they had too much competition from other marine reptiles which grew large then — with teeth to match — and from the sharks, which all of a geological sudden produced a number of formidable types.

And the flying reptiles?

They are a separate order, too, that of the Pterosauria — that Greek word *pteryx* can mean wing as well. We do know that nimble tree-climbing pseudosuchians were their ancestors, but we can't tell just when and where they put in their first appearance. When they did show up, in European deposits from the Jurassic Period, they already came in two sharply distinguished types.

One of these, presumably the somewhat older, was the pterodactylus type, with a very short tail and usually tiny in size, ranging from about that of a sparrow to that of a pigeon or slightly larger. The other was the rhamphorhynchus type, which had a long tail with a tiny skin rudder at its tip and which tended to be somewhat larger, about like a duck. The pterodactylus type seems to have been insect eaters (some have rather large eyes, indicating nocturnal flying) while the rhamphorhynchus type probably was fish-eating.

The pterosaurs did produce one giant, Pteranodon (Fig. 8), which hovered over the Niobrara Sea that covered Kansas and adjacent states during the last part of the Cretaceous Period. One find of Pteranodon has led to the suspicion that its shape may have been even more unusual than shown. It is possible that it had a large throat pouch for pre-digesting or simply storing fish. The experts, so far, only say that this is possible and the artists hope that they won't become definite on this point, for a dangling throat pouch under this head is hard to draw convincingly.

NOW, of course, the inevitable question will come up why all these abounding forms became extinct at the end of the Cretaceous Period. There is no simple answer to this question because there was no single cause for the extinction of the dinosaurs and those other reptile tribes.

Let's turn this around first and see what is left of the Class of the Reptilia. The following is a listing of all the orders — at this point, I have the choice of either following the system of the late Professor Othenio Abel of Vienna University, or that of Professor Baron von Huene of Tübingen University, or that of Professor Alfred Sherwood Romer of Harvard University, and I have decided in favor of Harvard — with notes pertaining to their fates.

Order COTYLOSAURIA, the stem reptiles, extinct even before the days of the dinosaurs.

Order CHELONIA, tortoises and turtles, still with us.

Order ICHTHYOSAURIA, extinct since end of the Jurassic Period.

Order SAUROPTERYGIA, plesiosaurs, extinct since end of Cretaceous Period.

Order EOSUCHIA, ancient reptiles, extinct at an early date.

Order RHYNCHOCEPHALIA, another type of ancient reptiles, most of them extinct at an early date, but one, Hatteria, still alive on islets near New Zealand.

Order SQUAMATA, which has two sub-orders, the LACERTILIA or lizards and the OPHIDIA or snakes, both still with us; the snakes are the most recent reptilian type to have evolved.

Order THECODONTIA, ancient reptiles, as explained, extinct.

Order CROCODILIA, crocodiles and alligators, still with us; they don't date back past the Jurassic Period.

Order PTEROSAURIA, flying reptiles, lasted only through Jurassic and Cretaceous.

Order SAURISCHIA, dinosaurs,

two sub-orders, extinct.

Order ORNITHISCHIA, dinosaurs, four sub-orders, extinct.

Order PELYCOSAURIA, very early forms, extinct.

Order THERAPSIDA, very early and somewhat mammal-like forms, extinct, but the mammals sprang from one of these last two orders.

Though the glory of the reptiles is gone, there are still plenty of reptilians left. As for those that vanished, one can figure out the reasons in a few cases, though not for all. But it must be kept in mind that saying "they became extinct at the end of the Cretaceous Period" is putting it very vaguely indeed. That statement still leaves a leeway of a few million years, and after all dinosaurs had been extinct on Continent A, they might still have been thriving on Continent B.

The reasons? A large forest fire, set by lightning, could easily wipe out a tribe of pterosaurs. The ichthyosaurs succumbed to competition after they, presumably adapting to a diet of squid, had shed their own teeth. Many tribes, especially when living on small continents or very large islands, could have been eradicated by egg-eaters. Small mammals like eggs and so do birds — and so do snakes, the last offspring of the reptiles themselves.

The large forms probably succumbed to fairly minor climatic changes, simply because they were large. Reptiles lack sweat glands and die of heat stroke if the sun is hot and no water and shade are available. A minor earthquake resulting in the draining of a few sets of large shallow lakes would indirectly kill off whole armies of sauropods. A small lizard can shade itself in underbrush or in cracks between rocks; a brontosaurus could not.

But even though the tribes are all gone, I can't get myself to label them failures. For they did well for a long, long time. The mammals will almost certainly last as long. But will Man?

— WILLY LEY