PHYSIOLOGY

Growths of Fancy

The Photographer's Skill in Producing Illusions Gives Us a Glimpse of a World that Cannot Really Be

By DR FRANK THONE

See Front Cover

ROMANCERS with a modicum of training in science and much more than a modicum of imagination have for many years made a favorite theme of the situation where insects, or spiders, or other "little monsters of the world of grass" have suddenly grown to human or superhuman size, bringing up with them, correspondingly magnified, the strength, the appetite, the fierceness, the other qualities that so impress us when we see them "in the little." Thus a man-sized ant drags off a string of freight cars. A man-sized spider devours half-a-dozen cows. A man-sized pinching-bug routs a company of soldiers. H. G. Wells in his earlier stories, like "Food of the Gods" and "War of the Worlds" did this kind of thing very well; he had plenty of forerunners and has had plenty of successors.

Such writers always leave out of consideration, sometimes naively, sometimes deliberately and for effect, one or another group of physical limitations that make such awesome, often gruesome, miracles of "unnatural history" impossible in actual fact.

Evolution Makes Greater

As well for us that the little monsters can not grow to be big ones, for they probably would if they could. The whole trend of animal development seems to be toward greater and greater size, so long as a species is evolutionally on the up grade. Only after a given line has reached its climax and started toward extinction do its members take the reverse road, back toward dwarfism. Not always even then: did not the dinosaurs die as giants, and are not the elephants doing the same thing? If the bumblebees and the tumblebugs could travel that course they would most likely, even if their end were destruction.

Why is it that the insects and the spiders and the other creeping things do not grow up to our size and thus conquer the world in a few days, instead of the centuries or millenia granted them by such scientific prophets as Dr. L. O. Howard? Why is such a scene as that depicted by the man-versus-spider photograph reproduced on the cover forever impossible? Why must our tiny enemies conquer us (if they finally do it at all) by swarming over us in hordes, devouring our substance by billions of tiny hungers instead of a few big ones?

There are several answers to these questions that we know of, and possibly a good many more that we don't.

Skeletons Outside

To begin with, the basic anatomical plan of the insects and their many-legged kin is not one that permits of indefinite expansion. We vertebrates wear our skeletons inside our bodies, which has permitted us a range in sizes from little shrews and hummingbirds that are actually smaller than some insects, up to Goliaths like the extinct dinosaurs and the living whales. As we pile on muscle and fat and other tissues, our skeletons develop in proportion to support them. But the insects and their relatives wear their skeletons on the outside: the horny shells we see are skeletons as well as armor. An insect's muscles are stretched *inside* its hollow joints, not over the *outside* of practically solid rods of bone, as with us.

Every increase in an insect's size has to be gained by a much larger proportion of its weight devoted to this outer shell-skeleton, if its strength is to be maintained. For the bigger a hollow shell is the weaker it is, unless you increase its wall-thickness. It is easy, for example, to crush a large celluloid rattle or play-ball; much less easy to crush a ping-pong ball.

The few backboned animals that have made the mistake of putting on an outside shell, like turtles and armadillos and medieval knights, afford excellent examples. They are all slowed down badly by the loads they have to carry, but the bigger they are the greater the load, not merely in absolute poundage but also in proportion to their strength. The little box tortoises can get around on land all right, but their enormous relatives, like those of the Galapagos islands, are better off in the water, where some of the load is buoyed up and taken off their muscles. The giant armadillos, the glyptodons, gave up the job long ago and became extinct; only their smaller kin-animals lived on and are still with us.

Weight Limits Size

Slim Prince Hal could case himself in plate armor and still swing a heavy sword, but poor fat Falstaff would have had much ado just to support the steel tonnage that would have been required to encompass his huge girth, even if he could have plucked up courage enough to follow his Prince into battle. So the weight of the shell alone, that is at once support and protection for the insect's body, puts a limit to its possible increase in size.

The limit becomes emphasized when the shell is lacking, as it is on the belly of the spider shown in the fanciful combat depicted on this week's SCIENCE NEWS LETTER by Lynwood Chace, nature photographer. Most of the spiders (which of course are not insects) have shell-skeletons only over their legs and head-chest region. The big abdomen, which must be left free to expand as the crop of eggs matures, is covered only with a relatively thin skin. It is kept in shape mainly by the internal pressure of its contents, like a ripe gooseberry.

But this is not even equal to the external-skeleton arrangement as a means of supporting a really large body.

To go back again to fat Jack Falstaff: think of the woes that poor mountain of mendacity had with his overstuffed, pampered paunch! And even at that, it was partly held in a basket of bone—his pelvis—and set on two thick legs good enough to carry it out of danger in a hurry. What luck would he have had getting away from his imaginary nine foes in buckram if he had had to drag the thing on the ground behind him, like the spider in the picture?

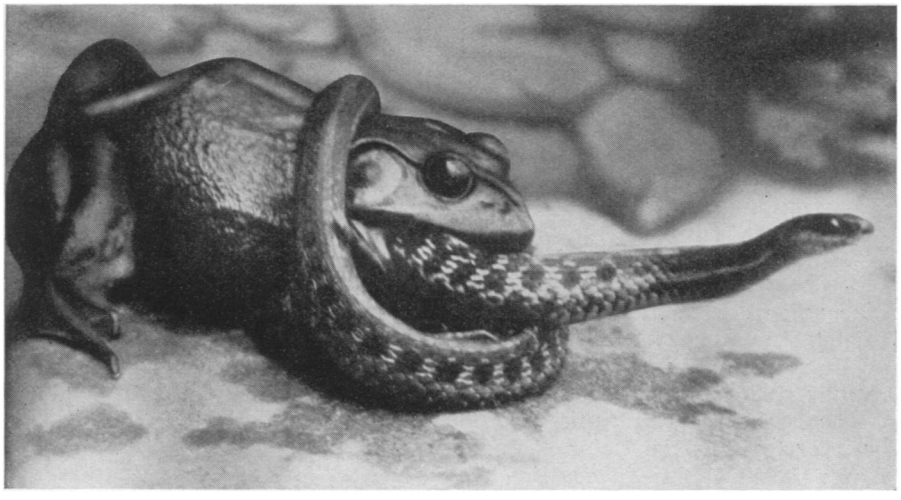
As a matter of fact, these round-bellied spiders do have a lot of trouble, even at their present size, if they find themselves on the ground. They are much happier in their webs, where their "corporosities" are clear of obstacles.

This whole matter of the contrasting methods of body support—internal for vertebrates, external for invertebrates—insures that "never the twain shall meet" on the field of equal size. For as the external-support system prevents the insects and other creeping things from becoming very large, so the internal-support system keeps the boned animals from becoming very small. Hummingbirds, mice and shrews are about as tiny as animals can be and still have strong enough internal skeletons to support them. Any bones smaller than a hummingbird's would have to be made of something besides bone (aluminum, maybe?) to have the needed strength. We hear of the giant water-bugs killing small fish and frogs, of giant tropical spiders that murder small birds; but aside from exceptions like these we are not likely to have our blood chilled by any such encounters, so unnatural-seeming to us. Only the giants of the small world can overcome even the tiniest citizens of the large world.

Lack of Breath

Another factor in keeping the small creatures small would be sheer lack of breath. Falstaff (again!) puffed and panted enough after any exertion to which he was forced. But like all other vertebrates (for he had a vertebral column as well as an abdomen, even if Shakespeare will allow him neither "backbone" nor "guts") he had a good pair of lungs, and red blood corpuscles to carry the oxygen from them to every cell of his huge body. But insects, spiders and the like do not have lungs. Insects have air-tubes that open through rows of little holes along their sides. These tubes branch out through all parts of their bodies, carrying the air directly to the tissues. Any increase in the thickness of an insect's body would greatly magnify the difficulties inherent in this primitive method of oxygen transport. Even in the Coal Age, when there were giant dragonflies a foot long, the bodies of these winged terrors were no thicker than a lead pencil. Spiders' breathing-arrangements are quite as primitive, so that they are in no better position than the insects to grow to superhuman size and terror-inspiring rapacity.

But even though such extremes can not come to pass without reversing some of the fundamental laws of physics and physiology, there are plenty of instances within both the little and the large worlds of animals where the customary roles of eaten and eater are switched.



"WHEN A MAN BITES A DOG"

So also when a frog undertakes to swallow a snake; for it is usually the snake that swallows the frog.

We commonly think, for example, of snakes eating frogs. But on occasion a big frog does not hesitate to tackle a small snake. The photograph caught by Lynwood Chace looks rather like a case of a big frog having bitten off more snake than he could chew; but if the snake had been no bigger than a large angleworm (and plenty of snakes are that small), down like a worm he would have gone. Frogs are cannibals; the big ones eat the little ones whenever they can catch them.

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PSYCHOLOGY

Student of Twins Tells What Quintuplets Can Teach Us

PSYCHOLOGISTS can learn new things from a study of the Dionne quintuplets, says Dr. Frank N. Freeman, University of Chicago professor of psychology. Dr. Freemen has made studies of twins, but has not planned to make a study of the Dionne babies.

"Biologically quintuplets may be any one of several combinations of identical and fraternal twins or quadruplets," Dr. Freeman stated.

This means that they may have come from one fertilized egg, in which case they would all be identical, or from five separate eggs, in which case they would all be fraternal and just like any five sisters born of the same parents. Two of them may be identical and the rest fraternal, or these relationships might be varied in other ways.

"Study of their similarities and differences in the light of the type of their relationship as determined by biological diagnosis would be valuable," Dr. Freeman said.

It would not be very different from studies of twins, but because of the greater numbers might be three or four times as interesting, it appears from Dr. Freeman's statement.

How would it feel to be one of five sisters all exactly alike? Growing up in the same household, would they all be as alike in thought and feeling as in appearance, or would they develop into five different personalities, or would three of them be alike in this way and the other two different? Would they all want the same toy to play with or would they develop different tastes? These are some of the interesting questions that psychologists might be able to answer after studying the quintuplets, but it would require a long time for the study.

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