What did in the dinosaurs: Warm blood or soft eggs?

Nobody has ever seen a live dinosaur, so paleontologists must deduce what they looked like and how they lived from their anatomy and probable environment. Complete information on the life and times of dinosaurs may eventually allow scientists to explain their sudden extinction 65 million years ago.

Recently, two theories about dinosaurs, one concerning their system of temperature regulation and the other a change in their reproductive success, have recently gained ground. Both theories bear directly on the dinosaurs' ability to survive.

Anatomical similarities between dinosaurs and birds or mammals have led some scientists to surmise that though they were reptilian, dinosaurs might have been endothermic, or warm-blooded. Modern-day reptiles are ectothermic, or cold-blooded.

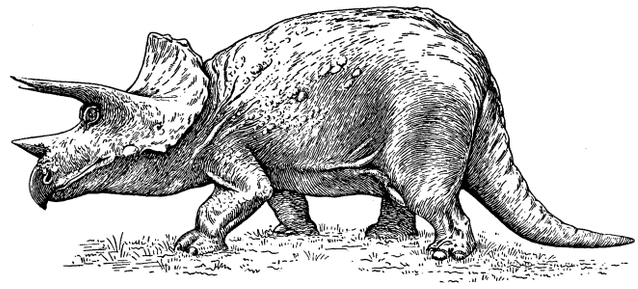
In the July 14 NATURE, Robert T. Bakker of Harvard University's Museum of Comparative Zoology combines anatomical and ecological evidence to argue that dinosaurs were indeed probably endothermic.

The amount of energy an animal must expend for locomotion increases with speed. The maximum energy output, and therefore the maximum speed, of a cold-blooded animal is much less than that of a warm-blooded animal of the same weight. Bakker estimates that if dinosaurs were cold-blooded a ten-ton tyrannousaur could run only 5.8 kilometers per hour. A good racehorse can do upward of 60 kilometers per hour. But fossil evidence indicates that dinosaurs were quite active. Some, such as hypsilophodonts, appear to have been capable of speeds of 50 to 80 kilometers per hour.

Another argument for endothermy is the sheer size of dinosaurs. The smallest specimens found must have weighed 50 kilograms when alive. An animal's ability to generate heat depends on the volume of its body; loss of heat is a function of surface area. As the size of an animal increases, volume increases more rapidly than surface area. Small endotherms thus lose a greater proportion of their heat through their skin than do large endotherms, and need insulation, in the form of hair or feathers to prevent excessive heat loss. Large tropical endotherms, such as elephants, can maintain a constant body temperature without skin insulation.

Fossilized impressions of dinosaur skin show that the animals were hairless. Endothermy is thus consistent with both the size and skin type of dinosaurs.

An endotherm must eat more than an ectotherm of the same size. In a balanced community, the ratio of predators to prey animals depends on whether the dominant predator is warm- or cold-blooded. Where the predator is cold-blooded, carnivores constitute about 25 percent of the total population. In a warm-blooded community they amount to less than 4.5 percent. In three Canadian rock groups, Bakker says, only 2.0 to 3.3 percent of the fossilized dinosaurs were carnivorous.



Smithsonian

Triceratops and his kin may have been warm-blooded.

Nicholas Hotten of the Smithsonian's National Museum of Natural History agrees that dinosaurs may have been endothermic. "We know they had doggone good heat control." He cautions, however, that conclusions based on predator-prey ratios must be tentative because of the sketchiness of the fossil record.

Bakker concludes that the combination of large size, endothermy and naked skin may explain the extinction of dinosaurs. About 65 million years ago there was a sharp drop in temperature. Bakker believes that dinosaurs, lacking skin insulation and too large to burrow underground, radiated away too much of their body heat under the colder conditions and could not survive.

Meanwhile, evidence has come from southern France that dinosaurs in that region underwent a change in reproduction that might have destroyed them. Last year researchers from Bonn University found fragments of dinosaur eggs in four successive layers of rock in Provence. The eggshells in the oldest rocks were two or more millimeters thick. In the younger rock layers, the shells became progressively thinner. Those in the youngest rock layer were thin enough to have been easily broken.

Now the Bonn paleontologists have found another batch of dinosaur eggs in the Corbières region of the Pyrenees in rock about the same age as the youngest layer in Provence. These eggs were likewise extremely fragile. In fact, the researchers believe the eggs were too fragile to support the growing embryo.

Such eggshell thinning would have been a result of hormonal changes in the animals. DDT is known to be causing similar thinning of bird eggshells. The Bonn scientists believe the hormonal change in the dinosaurs of southern France may have been triggered by overcrowding. But whether eggshell thinning could account for extinction of dinosaurs elsewhere remains to be seen.

Cryobiology: Cells on ice

Cryobiology, the study of the effects of low temperatures on living cells, is a research frontier. Probably no more than 400 scientists in the world are pursuing it. Nevertheless, probing the effects of low temperatures on cells is bringing benefits—better understanding of the behavior of normal cells under stress and the use of cold to destroy malignant tissue. At present single cells, such as blood and sperm, can be kept alive while frozen. Although efforts to revive frozen organs have been unsuccessful to date, banks for various tissues and organs are the goal of some cryobiologists. Cryobiology may also answer some esoteric questions, such as whether microorganisms from earth might contaminate other planets, or whether bodies frozen at death might be revived at a later date.

Two years ago, Peter Masur and colleagues Stanley Leibo and Robert H. Miller of the Oak Ridge National Laboratory in Oak Ridge, Tenn., reported in SCIENCE that successful freezing and revival of yeast cells depended on optimal freezing and warming temperatures. If these cells were cooled too rapidly, they turned into icebergs; if they were cooled too slowly, they became dehydrated and shrunken. If frozen cells were warmed rapidly, the effect was generally beneficial, if they were warmed too slowly, ice started to