Creating the Nation's first BioPark

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Letter From the Desk of David Challinor
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All animals need nutritious diets in order to grow and to remain healthy. Humans are more conscious today than they once were of nutrition and of what they eat, and the law requires that information on nutrient content be visible on breakfast food cartons and other food packages. Public interest in nutrition is not surprising when we consider how important to our well being is a properly balanced diet.

Zoos are similarly concerned with the nutrition of their animals. This letter will discuss what zoos in general, and the National Zoo in particular, are doing to insure that zoo animals stay healthy, not a simple goal. For example, about 20 years ago, before the National Zoo had a professional nutritionist on its staff, some of our older hoofed stock sickened and died. When they were necropsied (equivalent of an autopsy on a human), their muscle tissue, instead of being a healthy dark pink, was almost white. This symptom is characteristic of "white muscle disease" caused by a selenium and/or a vitamin E deficiency. This deficiency causes cell membranes to become fragile and break down, resulting in cell death and affecting the color of muscle tissue. The disease is hard to diagnose in a living animal; it is usually not discovered until after a necropsy. The zoo staff immediately analyzed the hay bought locally and identified a deficiency of the micronutrient selenium. A micronutrient is a substance that in minute amounts is essential to life. Zinc, copper and boron are examples of micronutrients.

Once identified, the deficiency was then easy to remedy by using another hay source. Selenium and all other micronutrients are normally found in most soil, but their individual concentration can vary greatly. When a soil has a low content of a certain mineral, the roots of trees and plants growing in it cannot absorb the deficient mineral; plant growth will suffer as will the herbivores that consume the plants.

Perhaps even more challenging than preventing "white muscle disease" through diet is to design nutritionally equivalent meals for highly specialized eaters. For example, the giant anteater of the South American savannahs has evolved a pointed head and long sticky tongue to prey on ants and termites, the nests of which it opens with its powerful forelegs and long claws. Its high protein diet consists mostly of insect muscle tissue. However, the chitinous exoskeleton of these ants and termites is also consumed, and when prepared in a zoo, the meal should

contain some form of roughage equivalent to chitin. Fortunately, chitin is a byproduct of the shellfish industry and can be bought commercially.

About two years ago the zoo opened Amazonia and exhibited some large carnivorous fish called arawana in big tanks. They normally feed by leaping out of the water higher than their body length to snatch insects grazing on leaves overhanging the water. It is impracticable to feed them live insects, so Dr. Mary Allen, the zoo's nutritionist, developed an imaginative substitute that is made in the Zoo's Commissary in 100 lb batches! She prepared a puree containing all the vitamins and minerals the arawana would normally obtain from eating insects and mixed them in a gelatinous compound designed to hold together in water. This "jello" is enclosed in a PVC and mesh bag and hung in the water. The arawana (2 to 2-1/2 feet long) have excellent internal clocks and just before feeding time roil in tight circles where the mesh bag will hang. The fish reach through the holes in the mesh and bite off pieces of "jello." Herbivorous fish have their own "jello," as well as pieces of kale, broccoli, etc., which are sunk in the water.

Feeding the big cats is not simply a matter of throwing them a hunk of raw beef or horse meat. The nutritionist must understand how and what these carnivores eat in the wild. Lions and tigers, for example, almost always consume first the viscera of their prey and for good reason, because there essential vitamins and micronutrients are concentrated. Liver is an important source of vitamin A; consuming it from a prey species is the only way a carnivore obtains this essential element which is otherwise only available through such vitamin A precursors as carotenes, which are found in certain plants. A haunch of beef contains muscle protein, some fats and calcium in the bones. If fed only such cuts, the big cats would soon sicken. The Inuit people in the far north followed the same strategy as carnivorous mammals, acquiring their essential micronutrients and vitamins from the internal organs of seals. Today, however, vitamin capsules are readily available to these people.

There are so many lions, tigers and other big cats in North American zoos and circuses that pet food manufacturers market balanced big cat food. Muscle tissue, bone (for calcium) and entrails are ground up and fortified with essential vitamins. The mixture is extruded into a large sausage-shaped plastic container and frozen. It is unfrozen at the zoo and normally fed directly to the lions, tigers, leopards, etc. Because the National Zoo has its own staff of nutritionists, they check the contents of these sausages to see that they are up to zoo standards. Big cat food is a highly specialized market and only one or two large pet food conglomerates can afford to market it.

My final example of a nutritional problem at the zoo is still not completely solved, but progress is being made on what ails our iguanas in Amazonia. The first indication that something was wrong occurred when an iguana fell from a tree (where it normally lives) into the water of the large fish tank. It did not even try to swim, although iguanas normally do so easily, but rather it sank to the tank's bottom from where it was promptly rescued. It was clearly sick. The veterinarian took a blood sample before the poor beast died a few days later. The blood analysis indicated a remarkable lack of vitamin D, whose most common source is the ultraviolet range of sunlight.

However, supplementing the iguanas' diet with as much as 3000 units of vitamin D per kilo of food was unsuccessful in raising the level of vitamin D in their blood even after a year and a half of treatment. Dr. Allen will now try to increase the units of vitamin D in their diet by a factor of four or five to see if there is some level at which this vitamin might be made to enter the bloodstream. It is perfectly possible, however, that iguanas evolved to access their vitamin D needs only through direct exposure to sunlight rather than using a dietary source. As folivores (leaf eaters) iguanas have to spend a lot of time basking on tree branches to allow their gut flora to break down the cellulose in leaves, which are hard to digest. It may be that they have no need for, and therefore no ability to use, an alternative vitamin D source.

Barring success with diet, there is no simple solution on how to treat this deficiency in iguanas. Replacing all the translucent panels in Amazonia's roof with ones that would allow UV light to pass through would be too costly for the zoo. Installing small UV lights throughout the canopy would not be practical as these reptiles do not realize what is good for them and would only bask under these lamps by sheer chance. If the proposed vitamin megadose fails to be absorbed into the iguana's bloodstream, the keepers may have to catch each one and maintain it in an enclosure with a sun lamp long enough for it to build up its vitamins to a healthy level.

From the previous examples, one can appreciate the complexity of feeding zoo animals. It is surprising that of over 250 accredited zoos in North America, only about eight have full-time nutritionists on their staffs. Not only must a daily diet be sound nutritionally, but for many mammals, diets have to be supplemented during gestation, and particularly lactation, when the female has greater than normal nutrient demands. In birds, when eggs are removed from a broody female, she will often lay a substitute -- a bird breeder's action known as multiple clutching. In ostrich farms, hens have been induced to lay as many as 50-60 eggs per year. In the wild, a major female might lay 5-11 eggs per clutch/year, while minor females lay only 2-6

eggs per clutch/year. Given the thickness of an ostrich egg, it is not surprising that farm-bred hens require supplemental calcium.

The pet food industry in North America and Europe is large and competitive. By working closely with scientists at these commercial operations, zoo scientists both contribute to and learn from joint projects in nutrient research. Pets undoubtedly enjoy healthier diets now than ever before and zoo animals are beneficiaries also of this new focus on diet and nutrition.

The strength and size of the pet food industry in the developed world, in contrast with the shortage of nutritious food suffered by so many people, raises troubling moral, social and even political questions, but these will have to be considered in a subsequent letter. Meanwhile, rest assured that your favorite animals at the zoo have healthy diets and the best professional care.

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