Creating the Nation's first BioPark

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Letter from the Desk of David Challinor
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Man's knowledge of the biological world is and will always remain imperfect. How certain plants and animals become symbiotic, that is, dependent on each other to survive is a mystery that has long intrigued biologists. There are many examples of symbiotic relationships between trees and birds or mammals, for example, and although we generally understand the mechanics of the relationships, their evolutionary origins remain clouded in mystery.

Some seemingly remote "partners" have been coupled by evolution as illustrated in the following examples. The first concerns the extraordinary behavior of the greater one-horned Asian rhinoceros. This endangered pachyderm lives on the flood plains of rivers in southern Nepal and northeast India. About 400 rhinos still survive in Nepal's Royal Chitwan National Park where Smithsonian scientists have been conducting research for almost 20 years. Chris Wemmer and Eric Dinerstein, two Zoo scientists studying rhinos in Nepal's National Park, noticed that Trewia seedlings, a common riverine tree in this area, sprouted thickly and vigorously on rhino latrines (dung hummocks of 10 or 12 feet in diameter where local rhinos come to defecate). Further research showed that this tree species seems to be dependent for its propagation on its fruit being eaten by rhinos or other large mammals, such as the wild Indian ox (Box gaurus). Thus, Trewia trees are not solely dependent on rhinos, for they have taken the evolutionary precaution of producing a seed that can be eaten by more than one large mammal. During the rainy season, the fruit ripens and falls to the ground, where rhinos in particular eagerly consume it. Interestingly, the fruit is generally ignored by bats, birds and monkeys. However, rhino latrines provide especially favorable Trewia germinating conditions.[1] A footnote to this example of coevolution between tree and rhino is that Trewia fruit, when eaten by rhinos, appears to be a natural vermicide for their intestinal parasites, a hypothesis still being studied by Wemmer and Dinerstein who fed Trewia fruit to a rhino in the Kathmandu Zoo. They are awaiting a pharmacological analysis of the fruit pulp to help support their theory.

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[1]Dinerstein, E. and C. Wemmer, 1988. Fruits Rhinoceros eat: dispersal of Trewia nudiflora (Euphorbiaceae) in lowland Nepal. ECOLOGY 69: 1768-1774.

Another example of mutual dependence was brought to my attention by Council Member Jeffrey Short who sent me a paper written by Caroline Tutin and colleagues on the relationship of Cola lizae (a tropical fruit tree) and lowland gorillas in Gabon.[2] In this case, the Cola tree has a relatively limited range and is endemic (not found elsewhere) to the general area of the Reserve. Gorillas enjoy the pulpy mesocarp of the fruit (in an apple, this is equivalent to the white juicy part between the skin and the pits), and swallow its large pit, which is too big to go down the throat of smaller primates. Elephants, which are still common in this forest reserve, evidently do not eat Cola fruit. Evidence indicates that the gorilla is the primary means for the dissemination of this tree, whose seedlings grow best in the open sunlit areas favored by gorillas for their nest sites. Unlike the Trewia tree, the Cola seems to have become evolutionary dependent, not on a few large mammal species, but seemingly on only one: the rare and endangered lowland gorilla.

My third example of a symbiotic relationship is even stranger and more restricted than the previous two illustrations. One of the few documented cases of a plant which may have disappeared as a result of an animal becoming extinct occurred on the Island of Mauritius. This island in the Indian Ocean was the home of the dodo until it was extirpated by humans around 1680. The dodo was a large, flightless bird of the pigeon family that had successfully evolved on this mid-ocean island until man arrived. All evidence indicates that the dodo was a frugivore (fruit eater).

Stanley Temple of the University of Wisconsin found in the early 1970's that the endemic tree, Calvaria major, on Mauritius had become very rare and was reduced to about a dozen individuals. All appeared very old (>300) and in poor condition, but were still fruiting. He found no evidence of regeneration, although there is disagreement about whether some seedlings may have been present in the early 1940's. This large tree had previously been relatively common and regularly harvested for lumber. Temple noticed that the fruit had a thin skin (exocarp), a pulpy, succulent mesocarp, and a very hard, woody, thick-walled endocarp (similar to a peach pit). He hypothesized that the dodo was the only animal on Mauritius big enough to swallow the whole fruit, because the stones in the crop (gizzard) of the dodo were active enough to abrade the surface of the endocarp sufficiently so that when it was either regurgitated or passed through the bird's digestive system, the seed wall could be cracked by the swelling plant embryo to allow it to germinate.

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[2]Tutin, C.E.G., et al. 1991. A case study of plant-animal relationship: Cola lizae and lowland gorillas in the Lopé Reserve, Gabon. J. Trop. Ecol. 7: 181-199.

To test his hypothesis, Temple force-fed some turkeys (about the size of a small dodo) 17 Calvaria pits, some of which stayed as long as six days in the crop. Eventually 10 scarified seeds emerged (seven others were actually crushed by the action of the stones in the gizzard). These 10 seeds were sown under nursery conditions and three germinated, thus, perhaps for the first time in 300 years, Calvaria seedlings sprouted.[3] Although this story has a happy ending in that the Calvaria tree has been saved for posterity by biological understanding, thousands of other plants and animals which evolved to become co-dependent have been lost when one of the partners disappeared.

Only recently have scientists discovered these complicated biological co-dependencies. There is still much research needed to uncover the secrets of co-dependence; if we watch closely enough, we may witness the development of this relationship between plant and animal as it occurs today. This will be very unlikely, however, for the process is a slow one and extremely difficult to recognize. It is just such a challenge, however, that keeps generations of evolutionary biologists carefully observing the organisms of our dynamic planet so that hopefully we can recognize co-dependency at its inception.

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[3]Temple, Stanley A., 1977. Plant-Animal Mutualism: Coevolution with Dodo Leads to Near Extinction of Plant. Science 197: 885-886