Creating the Nation's first BioPark

National Zoological Park · Smithsonian Institution · Washington, D.C. 20008-2598

Letter from the Desk of David Challinor
May 1993

In the operetta "HMS Pinafore," Buttercup, one of the characters, sings an aria entitled "Things are seldom what they seem." The lyrics describe various things that can be confused with each other because they look alike. In nature, the same condition arises when genetically diverse animals evolve to appear the same. The evolutionary forces which develop such similarities are mimicry and convergent evolution.

An example of mimicry is evident in the evolution of the nontoxic Emperor butterfly to look like the Monarch butterfly, which is toxic to its predators. Both butterfly species are sympatric, or share the same range. Convergent evolution occurs when two geographically separated and unrelated species evolve to look the same in order to occupy similar ecological niches. An amazing example of this is the nearly identical appearance of the Eastern (USA) meadowlark and the African yellow-throated longclaw, both of which are meadow dwellers but have evolved from two unrelated families. The unravelling of the problem of identifying animals and plants by their physical characteristics has been made easier by recent research conducted by geneticists. DNA analysis of species is becoming a more accurate way of determining relatedness than the consideration of physical characteristics.

Genetic studies to avoid inbreeding within a species are important not only in zoos, where breeding of animals is relatively easy to control, but also in the wild, where knowledge of relatedness may be crucial to the management of populations. A decade or more ago, for example, the herd of Dorcas gazelles at the National Zoo seemed to have an abnormally high neonatal death rate. Katherine Ralls, a Zoo scientist, reviewed the Zoo's records on Dorcas gazelle births over a few generations and found that the percentage of neonatal deaths was directly tied to how closely the parents were related; unrelated parents had healthier young. The problem was ameliorated by introducing unrelated breeders into the zoo herd. Artificial insemination reduces the expense and risk of transporting an animal for breeding because male reproductive cells can be shipped frozen over long distances with little loss in viability.

Although inbreeding in mammals and birds tends to produce look-alike populations, zoos have learned the risks of allowing it as in the case of the Dorcas gazelle. Nonetheless, other look-alike species seem to have survived despite their close relatedness. Cheetah are a good example. This species evidently went through a genetic bottleneck many thousands of years ago when for some unknown reason their total population was drastically reduced. When the survivors started expanding again,

there must have been massive inbreeding to account for their lack of genetic variation today and the resulting high percentage of deformed (and thus not viable) reproductive cells. Despite this handicap, they are still fertile enough to maintain themselves.

Pérè David's deer, another inbred mammal, no longer exist in the wild. The current world population of several hundred animals are all descended from less than ten deer from the private herd of the Duke of Bedford, which he imported from China to England in the late 1800's. Despite this narrow genetic base, Pérè David's deer are still breeding prolifically at the National Zoo's Front Royal Conservation Center. Our herd of over 100 deer has already produced five healthy fawns this spring, with a high percentage of pregnant does still waiting to deliver.

Like Pérè David's deer, Grant's gazelle, a small antelope that is widespread in the plains of East Africa, is also a look-alike species. Scientists from the Institute of Population Biology in Copenhagen and the National Museum in Nairobi took DNA samples from 44 of these animals living in six separate areas of Kenya. Although all the antelopes sampled looked physically the same, DNA analysis showed unexpected variation and identified three genetically distinct populations. The results of this research showed that although the three groups sampled live close to each other with no apparent physical barriers separating them, they do not interbreed. Scientists can only speculate as to why these three groups remain genetically isolated. Either there are barriers between the three populations that humans cannot recognize, or the three groups may have been separated by an inhospitable barrier, such as a large swamp or a rain forest, hundreds of thousands of years ago. Such barriers would have caused them to evolve isolated from each other. Although more recent climate changes may have removed these physical barriers, the separate groups may have become so genetically different from each other over time that they cannot, or will not, interbreed. Whatever the reason, these three populations of Grant's gazelle seem to be developing into separate species, or at least into subspecies.

In contrast to Grant's gazelle, two subspecies of waterbuck, another African antelope which appear physically quite different from each other, evidently interbreed readily. What few genetic differences still exist between them should eventually vanish. The common waterbuck has a distinctive white ring circling its dark brown rump, whereas the Defassa waterbuck has a much lighter brown coat; instead of a white ring, it has a completely white rump. These visible differences in their markings, however, do not represent a corresponding overall genetic difference.

As scientists delve deeper into basic genetic distinctions between species and subspecies, it is becoming increasingly clear that chromosomes and the genes they contain are what finally determine degrees of relationships, not only within plants, but within the animal kingdom as well. Physical appearance can be deceiving, as Gilbert and Sullivan's Buttercup pointed out in her song.

For example, individuals in a population that are interfertile belong by definition to one species. Thus all domestic horses are interfertile. Across species, such as between a horse and an ass, the first generation cross (a mule) is almost always sterile, an evolutionary device which keeps species apart. However, some separate species, such as dog and coyote (both in the genus Canis), when crossed produce fertile offspring which look much more like coyotes than dogs, showing that looks can be deceiving. Such cross-breeding was common when coyotes moved east from Michigan to New England in the 1950's. Once the coyote population became established in the new area, the wild invaders stopped breeding with domestic dogs and the hybrids became increasingly rare.

In some unusual cases, fertile hybrids have been produced between two separate genera, as when a fertile female hybrid was born in 1985 as a result of a cross between a Bottle-nosed dolphin (genus Tursiops) and a False killer whale (genus Pseudorca). This year she produced her own young when back-crossed to a Bottle-nosed dolphin. Although these two marine mammals are about the same size, they are quite different in appearance. Very different looks in this case were deceiving in that an intergeneric cross was fertile. The breeding occurred in a large oceanarium in Hawaii and would not likely have happened in the wild where pods of these two cetacean genera would not normally mix together.

The examples given illustrate that physical appearance alone is not always a good indicator of relatedness. Normally physical, behavioral, and certain genetic barriers keep species separated. Human manipulation, however, such as keeping two cetacean genera in the same tank, can inadvertently breach genetic barriers. In the example of the dolphin and the whale, even generic differences were shown to be less of a barrier than once thought. Further research and manipulation may uncover unexpected kinships, even in wild populations, to support the evidence that "Things are seldom what they seem."

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