Biological Misfits as Evidence of Evolution

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ACCORDING to the mechanism of evolution propounded by Darwin and Wallace, natural selection of variant members of a species best able to survive in a particular environment gives rise to organisms that are well-suited to their surroundings. With time this process can lead to organisms that differ markedly from their ancestors and from contemporary organisms that have descended from the same ancestors. Biology and general science textbooks usually give examples of organisms that have become ideally adapted to their habitat as a result of evolution, one example being the polar bear. This is an animal that has several adaptations that allow it to live on the icy shores of the Arctic Ocean. The most conspicuous adaptation is its white fur color, a perfect camouflage when hunting on ice-floes for seals, the primary prey and staple diet of polar bears.

Variation, so essential for evolution, is entirely a matter of chance. Therefore, contrary to those animals and plants that have progressed to the point of fitting well into their environment, there should also be other organisms that have not advanced to that state, since the appropriate variations have not arisen. Therefore, in contrast to the polar bear, consideration is given here to some examples of poorly adapted organisms. Students and teachers should be aware that imperfections do occur in evolution. Furthermore, imperfections serve to demonstrate the purely chance nature of evolution, since either the beneficial changes have not happened or the modifications that have occurred are less than optimal.

Hawaiian Goose

Geese are migratory waterfowl that inhabit the northern hemisphere and winter in places far south of their breeding grounds. As an adaption for swimming, geese have well-developed webbing between their toes.

The Hawaiian goose (*Branta sandvicensis*) is a relative of the Canada goose (*Branta canadensis*) which breeds in Canada and Alaska, wintering in the southern United States and Mexico.

In contrast to the Canada goose and other species of geese, the Hawaiian goose, known as the nene, is neither a waterfowl nor a migratory bird. Instead it has become a land goose that breeds and remains all year round in Hawaii, where it lives on expanses of lava produced by volcanic activity (Berger 1977). This is a highly unusual home for a goose, and although it shows some modifications, it is not well adapted to its environment. Since there is little or no water for swimming, the Hawaiian goose walks more than other geese. As a result of evolution it has developed longer legs and stronger toes, adaptations that enable the bird to be a better walker. A drawback for living on lava is the bird's webbed feet. Webbing gives no advantage in walking. In fact it is a disadvantage, as webbing reduces the flexibility of the toes for walking. Webbing can also be easily damaged by lava, some forms of which are rough and sharp. Compared with other geese, the Hawaiian goose has reduced webbing. Be that as it may, the ideal condition would be to have no webbing at all.

The introduction of non-Hawaiian animals, and other activities, by human migrants to Hawaii led to near extinction of the nene. Whether it wanted to or not, it could not just turn back to being a migratory waterfowl and thereby escape the harmful situation. One reason lies in the adaptations that have evolved for life on lava. Furthermore, since it is no longer a migratory goose, there has been no need for the evolutionary process to maintain strong flying ability, and the wings of the Hawaiian goose have become reduced in size. Thus the Hawaiian goose is neither a typical goose nor a typical lava-dwelling bird.

Since it is an unusual bird and is unique to Hawaii, the nene has been adopted as the state bird, and is now protected by law.

Arctic Hare

Animals that are active all year in the tundra regions of the Arctic, where snow and ice melt during the summer months, change color, allowing them to blend in with seasonal changes in their environment. For example, the Arctic fox (*Alopex lagopus*) is grayish-brown in summer and white in winter. Color changes are not just peculiar to mammals, but also happen in birds that reside year round in the tundra. Ptarmigans (genus *Lagopus*) have white feathers in winter, making it difficult for predators to see them against the snow. In summer they are mottled gray and brown and thus match the snow-free vegetation where they nest and breed.

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The Arctic hare (*Lepus arcticus*) is widespread in the tundra of northern Canada and is also found in parts of Greenland. Different subspecies of Arctic hare inhabit different areas. Some subspecies remain white during the summer, whereas others change their color. The permanently white subspecies stand out markedly in summer when the ground-hugging plants, so characteristic of the tundra, show a variety of colors. Adding to the hare's problem of being conspicuous is the phenomenon of continuous light in far northern latitudes during the summer. Thus in addition to being readily seen, it can be seen 24 hours of the day in summer. Consequently, it does not have the opportunity to be active under the cover of darkness and remain in a hideaway when it is light. Although it is light day and night during the summer, the light is less intense for several hours of the day when the sun is low in the sky. The Arctic hare takes advantage of this and feeds in the subdued light, thus reducing the chances of being seen by a predator. The hare also takes advantage of any snow patches remaining in summer, using its white coat when possible as camouflage from its enemies (Miles & Salisbury 1985). As the foregoing reveals, the Arctic hare has to compensate the best it can for not having evolved the ability to change its coat to a fitting summer color. That color change is a highly successful evolutionary adaptation can be ascertained from many species of tundra animals that do so, including the Alaskan and snowshoe hares.

Tree Kangaroos

Kangaroos comprise the family Macropodidae (big-footed) of marsupial mammals and are native only to Australia and nearby New Guinea. They have elongated feet, long and powerful hind legs used for leaping, and small forelimbs that are weak and not used in locomotion. Their long thick tail is used for balance when leaping and as a support when resting. Some species of kangaroo can bound along at 50 kilometers per hour, and their jumping style of locomotion is as efficient as the galloping of the horse. All kangaroos are herbivores, occupying the place held in other parts of the world by grazing and browsing placental mammals.

Tree kangaroos (genus *Dendrolagus*) inhabit the tropical rain forests of New Guinea and northeastern Australia. Unlike their terrestrial ancestors, they have taken to an arboreal way of life and feed on leaves and fruits. Tree kangaroos show some adaptations to life in trees. They have somewhat smaller hind feet and legs, and stronger forelimbs and hands with greater gripping power. The trend toward reduction in size of

their rear feet and legs is beneficial, since large feet and legs are troublesome for both movement and resting in trees. Likewise, the modifications to the forelimbs and hands are helpful, as they make for less difficulty in climbing and moving about in trees. Although arboreal kangaroos have retained a long tail, it is no longer used for support when resting, but as an aid for balance when moving around on branches.

Despite the forementioned adaptations, tree kangaroos are not ideal arboreal animals. There is a need for additional modifications to the limbs, feet and hands. Furthermore, a prehensile tail, so advantageous and often found among tree-dwelling mammals, is lacking in tree kangaroos. Alfred Wallace, who had firsthand knowledge of tree kangaroos, noted:

> *These animals do not differ very strikingly in form from the terrestrial kangaroos, and appear to be but imperfectly adapted to an arboreal life, as they move rather slowly, and do not seem to have a very secure footing on the limb of a tree. The leaping power of the muscular tail is lost, and powerful claws have been acquired to assist in climbing, but in other respects the animal seems better adapted to walk on* terra firma (Wallace 1869).

Writing 119 years after Wallace, another observer of tree kangaroos noted:

> *Tree kangaroos are, nevertheless, still clumsy climbers and as they make their way through the tops of trees, they look very much what are—animals that once had their feet firmly planted on the ground* (Vandenbeld 1988).

One hundred and nineteen years is virtually no time at all on the evolutionary time scale. Therefore, it is not suprising to find recent observations of tree kangaroos to be similar to those of Wallace published in 1869.

As a consequence of limited adaptations to an arboreal habitat, tree kangaroos, when on the ground, no longer have the capability of terrestrial kangaroos. Thus, they are not well fitted for life in trees or on land.

Conclusion

The three animals discussed herein are not the only ones showing imperfections of evolution, but are presented as examples of an aspect of evolution that is usually neglected in textbooks. This is unfortunate, since misfits eminently illustrate the fact that evolution is a chance process, something that is not so obvious when using examples of organisms that are ideally adapted to their environment.

References

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