GALAPAGOS EVOLUTION CONTINUES

by

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With the Darwin centenary year now drawn to a close, it is already clear that it has produced a rich harvest of new information on the man and his work. Of the many papers, books and symposia produced in his honour, Darwin himself might have liked most to attend the last public event — a symposium on 'Evolution in the Galápagos', organized by R. Berry and hosted by the Linnean Society on 8 December in London[1].

Before Darwin, there was little appreciation of the biological uniqueness of islands, as A. Cain pointed out in his historical introduction. Cain ascribed this failure to the 'naive taxonomy' of the time. The lack of explanations for disjunct distributions of taxa or for the difference between convergence and affinity hindered 'amateur naturalists' such as Darwin when he set sail on the *Beagle* in 1831.

This theme was pursued further by F. Sulloway in discussing his own historical detective work on Darwin and the Galápagos[2,3]. Sulloway dismissed as a myth the idea that Darwin had been converted to the theory of evolution by a 'Eureka!'-like experience in the Galápagos; instead his fuzzy grasp of systematics blinded him to the evolutionary significance of inter-island variation in the tortoises, mockingbirds and the now famous Darwin's finches. Darwin not only failed to separate correctly his finch specimens by island in the Galápagos, but also helped his shipmates eat their way through tortoise variants that were not collected agàin until years later.

What did happen was that in the second week of March in 1837, after his return to England, Darwin had a meeting with John Gould to discuss the *Beagle* bird specimens. Darwin was stunned by Gould's findings, and hastily scribbled the main points on the back of a scrap of museum paper. It seemed that, among other things, the motley group of birds Darwin had identified as a mixture of finches, wrens and blackbirds was in fact a closely related subfamily of passerines, new to science. Realizing the importance of knowing which forms had come from where, Darwin began the frustrating task of quizzing Captain Fitzroy and other shipmates, who had fully labelled specimens. Darwin was never entirely happy with the result, and perhaps for this reason omitted any mention of the finches from his *Origin of Species*. Sulloway suggested that this group of birds became closely identified with Darwin and evolutionary theory largely because of David Lack's book *Darwin's Finches*.

The "Warbler" Finch *(Certhidea olivacea):* one of the unfinchlike finches that puzzled Darwin
Photo by Alan Root

Large Ground Finch *(G. magnirostris)* on Daphne Major, beside *Bursera* berries
Photo by Dr. Peter T. Boag

Recent geological work in the Galápagos and an improved understanding of the plate tectonics of the region (B. Rosen and T. Simkin) show that the islands are younger than previously thought — no older than 3-5 million years. They have never been connected to the mainland, and remain among the 12 most active areas of vulcanism on Earth. The likely evolutionary age of several Galápagos vertebrates was reduced further still in J. Patton's discussion of genetic processes in Galápagos organisms. His electrophoretic studies of the finches, tortoises, lizards and rats suggest that with the possible exception of the land and marine iguanas, the small genetic distances among most taxa indicate evolutionary histories of under one million years[4 5]. Biochemical characters produce phylogenetic trees very similar to those suggested by traditional taxonomic approaches but show a small and constant rate of change relative to changes in some morphological characters. This supports recent suggestions that evolutionary changes in structural genes occur in a clock-like fashion, while morphological changes can occur at different rates as selection acts on 'regulatory genes'.

Recent research on Galápagos land birds, and on Darwin's ground finches in particular (P. Grant), shows interesting developments in at least four areas, including the origin of Darwin's finches, the discovery of the first fossil finches, the study of contemporary evolution in the *Geospiza* and the confirmation of David Lack's model of adaptive radiation[6 7]. A widely distributed South American emberizid, the blue-black grassquit *(Volatinia jacarina),* has recently been proposed by D. Steadman as the direct ancestor of all the Darwin's finches. Steadman has also discovered the first vertebrate fossil in the Galápagos, confirming the previous abundance of two finch populations rendered extinct since Darwin's time and suggesting that other finches as well as native rats went extinct before ever having been recorded[8 9]

Specific island populations of tortoise are being identified by T. Fritts, partly to aid captive breeding programmes by including animals of unknown origin located in zoos. The small genetic distances between tortoise populations have hindered this task, as has the apparently high degree of morphological convergence seen in different tortoise populations in similar environments. H. Snell has also looked at the similarity of various iguana populations in the Galápagos, as recent assaults by feral dogs have nearly obliterated two land iguana populations. Prompt work by Snell and his colleagues has led to the successful captive breeding and reintroduction of these animals, in concert with programmes to eliminate the dogs [10]. Snell found that on the basis of morphology, land and marine iguanas are very similar to each other and different from mainland species. Patton had suggested that the large genetic distances between the marine and land iguanas indicated that they were unrelated and colonized the Galápagos separately a long time ago. But in a surprising announcement Snell revealed that he had been studying what appears to be a land-marine iguana hybrid for three years. The hybrid shares features of each genus — it has, for instance, unwebbed front toes but webbed rear toes.

Y. Lubin and D. Porter discussed recent work on introduced invertebrates and plants. Lubin has been following the invasion of the fire ant *(Wasmannia),* which probably arrived in the islands in the 1930s, but is still dispersing at rates of up to 170m yr^{-1}. As it enters an area, native ant species disappear, as do other arthropods such as scorpions and spiders. Porter pointed out that up to 26 per cent of the 738 known Galápagos plant taxa are now introduced, most within the past century[11]. There is no sign that the rate of invasion or redistribution of introduced plants is slowing and although many of the 'weeds' occur in disturbed habitats, several invaders threaten natural areas.

Finally, in a discussion of the role of man in the accelerated rate of 'evolutionary' change in the Galápagos, P. Kramer argued that in addition to trying to understand how native Galápagos plants and animals evolved and attempting to control introduced species, biologists should also monitor the process of invasion. Understanding why particular introduced plants or animals succeed or fail and how native species respond to introduced species may in the long run contribute as much to our understanding of evolution as research on native organisms[12]. This brought home a bitter-sweet message about evolutionary research in the Galápagos: much less is known about evolution in the Galápagos than most people think, but Galápagos populations and communities are probably now changing faster than ever.

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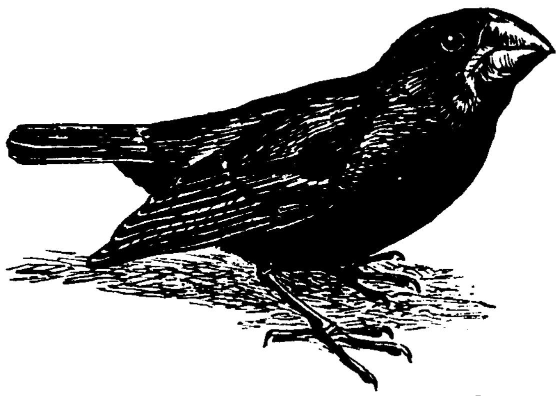

Large Ground Finch
Geospiza magnirostris
Drawing by Peter Scott