CUVIER

e9 Arguments from comparative anatomy < extinctions, migrations >

Monterey County Jail Oatmeal / A lot of powdered-oatmeal
Way too much water / All the sugar the county will let you have.
—the fixings recalled by Jonathan Reynolds.[1]

Georges Cuvier (1769-1832) (hair: startling-red, eyes: bright blue)[2]

In 1812, he published on vertebrate fossils [3] and included a *Preliminary Discourse* [4] on his theory of multiple catastophies to account for the fossil and the stratigraphic rock record in the Paris Basin that he and Alexandre Brongniart had mapped in 1808.[5]

His catastrophist interpretations would be shown to be false, but of lasting value were his clear demonstrations, into which he injected excitement, of how fossil animals could be included in zoological classifications by the study of comparative anatomy.

We know that the passenger pigeon, for the pot and greatly for sport, was netted, shot and machine-gunned to extinction in three hundred years from a population of billions in North America (the last known, a pet named "Martha," died in the Cincinnati Zoo on September 1, 1914).[2] A bird collector, named Rollo Beck on December 1, 1900, bagged 9 of the last 11 of hawk species *Guadalupe caracaras*. Any solipsistic musings of the last of the great auks were rudely challenged on June 3, 1844, as it was clubbed to death off the coast of Iceland. These and other tales of the documented demise of 103 species of reptile, bird, and mammal (as the lesser stick-nest rat, *Leporillus apicalis*, of Australia, last seen July 18, 1933) that have become extinct before 1999 (count beginning 1500), are told by Tim Flannery in *A Gap in Nature: Discovering the World's Extinct Animals*, 2001.

Georges Cuvier, a French zoologist and educator, could have known that gone since the 16th century was the falconer's once abundant quarry, the huge European crane (of 15 extant species of crane, 11, which include the North American whooping crane, are imperiled). However, he is credited for utilizing the science of comparative anatomy in his study of neontology and paleontology to arrive at his most memorable discovery: that species of animals have indeed gone extinct!

The originality of his early notes (1788-95) on marine invertebrates, particularly the mollusks, led Étienne Geoffroy Saint-Hilaire (***Figure e9.1***), professor of zoology at the Museum of Natural History in Paris to enthuse: "Come to Paris and take your place as a second Linnaeus in natural history." So urged by Geoffroy, Cuvier in 1795 joined the museum in the enviable (for advancement) position as *suppléant* to the inept (but happily) aging professor of animal anatomy Jean-Claude Mertrud (1728-1802). In *Lessons on Comparative Anatomy*, 1800-05, Cuvier's "correlation of parts" principle (an animal is a machine needing all its parts to work) is stated: "the anatomical structure of every structural characteristics of organs result from their interaction with their environment."[6] The latter part of this principle did not imply more than "unfolding" (the literal meaning of the word evolution) and implied that each species was created for its own special purpose and each organ for its special function.

"Let us not search further for the mythological animals, the mantichore or destroyer of men which carries a human head on a lion's body terminating in a scorpion's tail, or the guardian of treasures, the Griffin, half eagle-half lion. ... Nature could not combine such impossible features." Fossil strangeness, not nonsense, abounds. Vertebrates, mollusks, articulates, and radiates (echinoderms and cnidarians), have functionally type-anatomies that allow for classification of structural variety within

each group but not between the groups. These four groups, he claimed, are not derivable from each other. So he rejected the idea of evolution that implies change by modification. For that wrong reason, Cuvier was able to break with the erroneous 18th century principle, dating back to Aristotle, that all living things could be arranged in a continuous series from the simplest up to a human.

Cuvier, excavated and reconstructed complete skeletons of *espèces perdues* (lost species). Large quadrupeds that had lived in the environs of Paris were giant salamanders, flying reptiles, and mammoth (which latter name the less than respectful called him in later years when he had become grossly more than embonpoint). These, had all become extinct for they were too big to be hiding anywhere; an argument advanced in 1768 by William Hunter (1781-1783)[7] for his conclusion that *American incognitum* ("Ohio animal" or American "mammoth" as Charles Willson Peal had misnamed it) was of an extinct genus (*Mammut*) that in 1806 he named "*Mastodonte*."[8] Although such an argument would unlikely have persuaded naturalist Thomas Molyneux who in describing the remains of an Irish elk (*see* Topic *e13*) in 1697 wrote, "No species of living creatures is so utterly extinct, as to be lost entirely out of the World." Au contraire! The reality of extinctions was there (***Footnote e9.1***). While ignoring the theological question "why" some well-adapted creatures had gone globally extinct, Cuvier sort to answer the scientific question "how."[9]

In 1814, Giovanni Battista Brocchi, who reintroduced Arduino's *Tertiary* as the appropriate name for the formation older than the *Alluvial* that could be recognized as younger than the *Chalk* for the absence of any ammonites and belemnites in its included marine strata, offered the charming (though false) naturalistic conjecture: "why not admit that species perish in the same way that individuals do, and like them they have a fixed and determinate period for their existence?"[10]

But sound ingredients despoiled by Diluvian thinking are hard to sweeten. In *Discourse on the Revolutions of the Globe,* 1825, Cuvier made his findings widely known. In duration, pre-Adamite time had been indefinitely long. The opossum fossil from the plaster stone near Paris dated to "thousands of centuries" ago.[11] Alternations of marine and continental sedimentary strata mapped by Cuvier gave credence to his concept of catastrophism involving a series of revolutions: sudden land upheavals and floods. In line with Deluc[12] and Dolomieu,[13] Noah's flood, *Genesis* 7, verses 19-20, he supposed had been the last and the most dramatic revolution.[14] Regions laid waste by such paroxysms were repopulated by migration of surviving animals from areas that had been spared.

In 1828, Cuvier wrote: "If there are resemblances between the organs of fishes and those of the other vertebrate classes, it is only insofar as there are resemblances between their functions." In 1829 (when also Robert Peel created the first modern police force, the London bobbies),[15] Geoffroy wrote: "Animals have no habits but those that result from the structure of their organs; if the latter varies, they vary in the same manner all their springs of action, all their faculties and all their actions."

In Cuvier's mind, his friend, the younger but senior in position, Geoffroy had tipped over the edge when in 1830 Geoffroy enthusiastically greeted as proof of the unity-of-plan shared by all animals the claim by two young naturalists, Pierre-Stanislas Meyranx and Laurencet, that vertebrate and cephalopod anatomies were based on the same structural plan.[16] (In the UK, as "honorary vertebrates," squids, cuttlefish, and octopuses are protected by laws forbidding cruelty to animals.[17] "Nature is cruel, but we don't have to be," says Temple Grandin.)

From February to April 1830 were conducted the "functionalist" *Cuvier and* "formulist" *Geoffroy* (eight) *Debates*.[18]

For his part, Geoffroy had long whole heartedly accepted the ideas of Lamarck (invertebrate zoologist at the museum) that the environment causes the inheritable form of an organism to change—but differed strongly in that he saw no evidence of progressive evolution of forms from simple to complex and his metaphysical philosophy urged him to discern what Forms (as in Plato's Cave analogy) cast their shadows. As Forms were not once-living ancestors, his zoology was not to find the origins of organisms. Rather, he studied embryology and teratology (abnormal development) to discern when structures in different organisms were variants of the same type. The good rules he laid down were carried forward under the heading of homology by Owen.

For his part, Cuvier had long considered Lamarck (d. 1829) to be a foolish old man (Had he not been rebuffed publically when he handed his last manuscript to Napoleon? "I accept this only out

of respect for your white hair.") and had no time (pun intended) for Lamarck's concept of slow and gradual evolution of species from simpler forms as a continual process in the scale of being.

For both, the Biblical Flood was an historical reality. Antediluvian (before the Flood) life as recorded by fossils was different. (According to Cuvier this was because of extinctions. The same, according to Geoffroy was because changes in embryological development occasioned bursts of morphological change.) Acceded were savants' variously arrived at world-age (beginning with Arduino's ordering and thickness measurements of strata) of a hand-waving, million solar years.

For Cuvier, species were immutable (fixed). In the debate, his *coup de main* (pronounced *coo duh mah,* and meaning: a surprise attack that overwhelms)[19] on the bastion of Lamarck's evolution theory was that mummified cats and ibises (birds), which Geoffroy (who had accompanied Napoleon's invasion of Egypt in 1798) had himself brought back to Paris, showed that no transformations had taken place in 5000 years.

Five-thousand-year old ibis carcasses in every detail identical to living ibises was tantamount to proof of no changes in all of time. Cuvier's protégé Alcide d'Orbigny (***Figure e9.2***) concurred but to explain away the observation that some young species *never* occur in older layers, he added the creative touch that all species were completely wiped out at times of catastrophe that demark the end of Periods.

Figure e9.1 **Étienne Geoffroy Saint-Hilaire** (1772-1844)
"The external world is all-powerful in alteration of the form of organized [organic] bodies. ... these [modifications] are inherited, and they influence all the rest of the organization of the animal, because if these modifications lead to injurious effects, the animals which exhibit them perish and are replaced by others of a somewhat different form, a form changed so as to be adapted to the new environment." —Geoffroy, *Influence du monde ambiant pour modifier les formes animales* (Influence of the environment in changing animal shapes), 1833.[20]

Figure e9.2 **Alcide Dessalines d'Orbigny** (1802-1857)
Naturalist d'Orbigny toured the southern part South America during the years 1826 to 1834. He had been encouraged to make this trip by Cuvier (who died while he was away) and by Humboldt (who had explored the northern part). In Patagonia, he made ethnology observations of the (Tehuelches and Hapuches) indians, bagged 800 birds (scooping Darwin's later collecting there of the lesser rhea), and assembled the first major collection of South American fossils (over a hundred thousand items) from the strata of the Paraná Basin. Returned to the Museum of Natural History, Paris, he published *Voyages dans l'Amerique méridionale* (Travels in southern America),[21] and *Prodrome de Paléontologie Stratigraphique* (Forrunner to Stratigraphic Paleontology)[22] in which is described some eighteen thousand invertebrate species. He noted, as had his mentor Cuvier, that some fossils occurred only in certain layers of a geological formation. These, by their relative age according to stratigraphic superposition, could be arranged into a sequence of twenty-seven stratigraphic stages, each with its particular fossils. By so doing, for what we now know to have been on a small part of the Jurassic system, d'Orbigny founded the science of stratigraphical paleontology, and his subdivisions (stages) are still used today in a utilitarian way. However, d'Orbigny remained convinced of Cuvier's concept of fixed species and to explain why fossils in certain subdivisions are absent from others, he proposed a sequence of twenty-seven whole new creations which had followed catastrophes (one to end each stage) that wiped out all life—the last, being the Biblical Flood, exceptional for the Ark. ❑

Footnote e9.1 [22] The dodo

The candles whisper / As they draw close to watch / The great nothing hoard its winnings. —Charles Simic..[23]

'Nature red in tooth and claw,' penned Tennyson in 1849 still mourning the death of his friend A.H.H. in 1833.[24]

The dodo (***Figure e9.3***), *Raphus cucullatus* (incorrectly known as *Didus ineptus*), in modern awareness a "synonym for extinction,"[25] is the large, clumsy, flightless bird that Charles Lutwidge Dodgson made loveable in *Alice's Adventures in Wonderland* by *Lewis Carroll* (1865). He knew of this bird from his often visits to the Oxford University Museum of Natural History, England, completed in 1860, where on view was a perfect, stuffed, one, willed in 1662 by John Tradescant's son to Elias Ashmole (whose cabinet formed the original "Ashmolean" installed in 1683).[26]

In Mauritius, where the Dutch, beginning with their first stop over in 1598, supped upon them and dogs, cats, rats and monkeys let loose on the island, predated their eggs and hatchlings, the dodo was driven to extinction by 1681. For those returned to Europe, domestication was not to be a saving grace as their flesh was deemed unpalatable.[27] The feathered specimen that Lewis viewed is too no more. It was burned (regretfully now) more than a century ago in a clean-out of rotting specimens in mahogany drawers and in vitrine exhibits. The Museum, currently displays a dodo skeleton made up from isolated sub-fossil bones found in Mauritius (although in 2006 comes a large cache of dodo bones).[28] Alongside this is also a full-sized feathered mockup by Andrew Kitchener.[29]

Three dodo species constitute the family Raphidae: *Raphus cucullatus*, Mauritius, *R. solitarius* (where, ca. 1507, Portuguese sailors were the first to see them), Réunion and *Pezophaps solitaria*, Rodrigues. An abundance of low-level food and absence of predators on these islands did not require maintenance of flight for foraging and escape. The islands are volcanic and emerged in the Indian ocean some 10 million years ago. Evidently, dodo's evolution from flighted ancestors was rapid.

Flightlessness and gigantism adaptations for its island living made understanding the evolutionary history of the dodo and classifying it based on body characteristics difficult, reports Hillary Mayell: "Over the years, the dodo has been grouped with the carnivorous raptors, ratites that include emus and ostriches, parrots, and shorebirds. Since the mid-1800s, the dodo has been classified as [a vulture by Richard Owen, or] part of the family that includes pigeons and doves [by J. T. Reinhardt and by Strickland & Melville]."[30] And pigeon is correct, as confirmed by molecular analysis in 2002 of DNA retrieved from a dodo specimen at the Oxford University Museum. The dodo's closest, still living, relatives are large island-dwelling birds that spend a great deal of time on the ground: the Nicobar pigeon of the Nicobar Islands and Southeast Asia, the crowned pigeon of New Guinea, and the tooth-billed pigeon of Samoa.

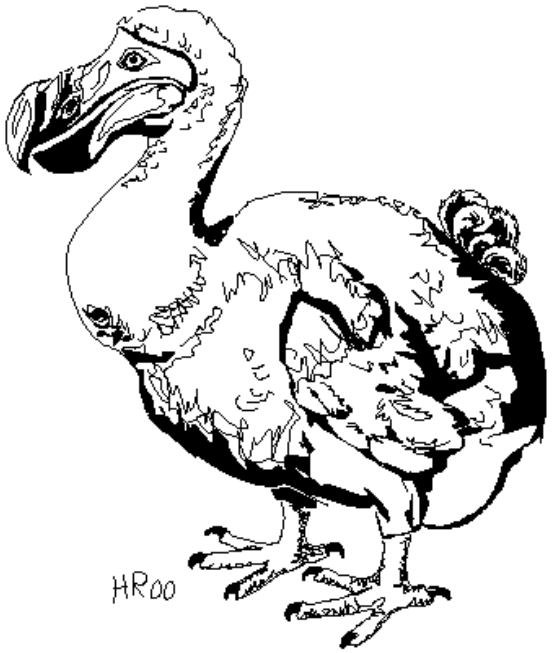

Figure e9.3 The **dodo** had a large body (13-23 kilos), weak wings, which could not lift it into the air, and a large hooked beak. Its plumage was grey toned with an adornment, high on its rear, of white feathers. Unfazed by human visitors to its domain, the dodo could be easily clubbed to death as it approached seeking friendship (?). France Staub notes: "The summer-time Dodo met by the crew of Vice-Admiral Van Warwick in 1598, [was] so lean, hard-fleshed and 'tough even after hours of cooking' that it was branded *Walgvogel* [bird that nauseates], and the winter-time Dodo, seen in June 1627, July 1658, and August 1602 respectively by Thomas Herbert, François Cauche and Captain Wilhem Van Westzanen, [was noted for its fatness by all, and was named] by the latter *Dodaerse* [killer-arse], which altered to Dodo and so was to remain."[31]