i13 Drift versus land bridges < *Mesosaurus* >

> We find ... the Irati shales are identically lithologically and palæontologically with the carbonaceous ... "White Band" of the Dwyka, each containing the reptile *Mesosaurus*—though the species are said to be different—not known in other parts of the world. —du Toit.[1]

Francis (Fran) Parker Shepard (1897-1985) in 1963 could be certain that deep seafloor has nowhere been *flexed* up to become land. Sampling of deep seafloor sediments showed that, "If such an area were elevated into a continent, it should be relatively easy to recognize it from a study of the formations."[2] Deepsea sediments only occur above sealevel in *fold* mountain ranges. However, the question of possible land bridges across the oceans had not been settled.[3]

Submarine topographic features that nearly shoal, or are at intermediate depths, could be sial. This was not ruled out by Thomas Frohock Gaskell's (1916-1995) guarded conclusion in *Under the Deep Oceans*, 1960, that "the structure that has been found by seismic measurements for the oceans is not that to be expected from a sunken continent." [4] So the Greek fable of "The Lost Land of Atlantis" could still conjure up the image of the Mid-Atlantic Ridge above sealevel. Dredging the ridge to check on this had given equivocal results. For example, Robert Wilhelm Kolbe's (1882-1960) contention in 1955 that freshwater diatoms from the east flank of the equatorial portion of the ridge indicates a former landmass [5] was moot given the antecedent 1937 discovery by Otto-Ernst Radczewski of large numbers of wind-transported diatoms in eolian dust.[6]

Faunal evidence of a connection between southern Africa and South America was accounted for by Bailey Willis (1857-1949) in 1932 by a system of "Isthmian Links."[7] This remained reasonable when deep-seafloor topographic mapping later showed something like his Trans-Atlantia bridges in the submerged Walvis Ridge that from Lat. 18°S Namibia, Africa, leads SW to the Mid-Atlantic Ridge where Rio Grande Ridge leads on NW to the coral reefs off the Brazilian coast at Lat. 21°S.

Our information is different.

The Pratt-Heyford model of isostasy (which assumes a variation in the mass-density of the floating crust or, for our updated purposes, the lithosphere and asthenosphere to a depth of compensation, say 125 km)[8] best accounts for oceanic rise-ridge systems, such as the Mid-Atlantic ridge. These nowhere shoal (the mid-ocean ridge crest is on average 2 kilometers deep) except where they have been added to by the accumulation of hotspot basaltic outpourings (for example Iceland). The ridge that originates by seafloor spreading lies between and does not connect between separating continents.

The Airy-Heiskanen model of isostasy (which assumes that masses of mountains are compensated by the crust there being thicker) [8] applies to intraplate aseismic ridges such as the Walvis and Rio Grande ridges. An aseismic ridge is built of volcanoes that have gone extinct as they are carried away by plate movement from their hotspot feeder. The aseismic ridge, as part of the oceanic crust, floats in the rock of the mantle. However, away from its source which is a hotspot, an aseismic ridge is progressively lowered as it is also part of the lithosphere that (for 60 million years) progressively thickens by cooling away from the ridge where it originates.[9]

Guyots are individual seamounts, built above sealevel, gone extinct, eroded, and now sunk by their own weight and by ocean-floor subsidence away from a ridge. In 1960, Harry Stephen Ladd suggested that these, in addition to known islands, could have been stepping stones for trans-ocean dispersal of fauna and flora.[10] That could be so, especially in the Pacific where there are fields of guyots, but in the Atlantic ocean, guyots are few. Nevertheless, a "few islands" become enough to

make a "land bridge" explanation reasonable given geologic time by which measure cyclones and currents become incessant urgings. However, by such directional (wind and current borne flotsums of pumice and vegetation) mechanisms, diasporas would be one way and not back and forth.

Some life cannot reasonably island hop. Earthworms studied by Michaelson have a distribution of descendants evolved from primitive forms in other continents (***Figure i13.1***). For du Toit, this and many other such studies made continental drift the only plausible explanation. One he glossed over, but now a prime example given in textbooks (making trust in these dubious), was the distribution cited by Suess of an Early Permian, lagoon dwelling, small (<1m long), reptile called *Mesosaurus*.[11]

Mesosaurus fossils are found in what today are coastal areas of Namibia (formerly South West Africa) and southern Brazil. In these areas, the *Mesosaurus*-containing fossiliferous sediments are shales ("White Band") in Early Permian formations: the Upper Dwyka in southern Africa and the Upper Iratí in Brazil. *Mesosaurus* fossiliferous sediments contain shrimplike crustaceans but no shells of open-sea dwelling organisms. The bones of *Mesosaurus* have growth rings. Its teeth were comblike. Regionally, the *Mesosaurus* fossiliferous bed is an uncommon organic sulfureted mud that becomes calcareous to the north. The reconstructed environment in which *Mesosaurus* lived was a fresh, or brackish, cold-water lagoon with, possibly, an estuarine opening to the north. The comblike dentition of the small *Mesosaurus* suggests that it strained the water for its food. Its teeth are enamel-sheathed dentine and not epidermally derived sieving structures as in Baleen whales and filter-feeding birds. It could have survived the winters, as do snapping turtles today, by burrowing into the bottom mud and hibernating. By fitting together the coasts of South America and Africa, the habitat of *Mesosaurus* is reunited. Its fossils are found nowhere else, even though the same environment they occupied has been. Any notion that these small, specialized, creatures could have swum the Atlantic, as it now is, to populate both sides seems misinformed. For one thing, the strong Benguela ocean current that flows up along the west coast of Africa would have dispersed to the north any that attempted such a crossing. The implication is that there was no Atlantic.

Could there have been a land bridge? Du Toit de-emphasized *Mesosaurus* when he wrote about it because he had been told that *Mesosaurus* species in Southern Brazil were different from those in Namibia. A land bridge could account for this. A common small area could not.

We know that the Atlantic did open after the existence of *Mesosaurus.* With the luxury of hindsight we know that whatever is learned of *Mesosaurus* must fit that fact. Ignorant of du Toit's real worry that *Mesosaurus* negated his hypothesis of Gondwana, its fossils on either side of the Atlantic are anachronistically cited as *the* best early paleontological evidence for continental drift. ❑

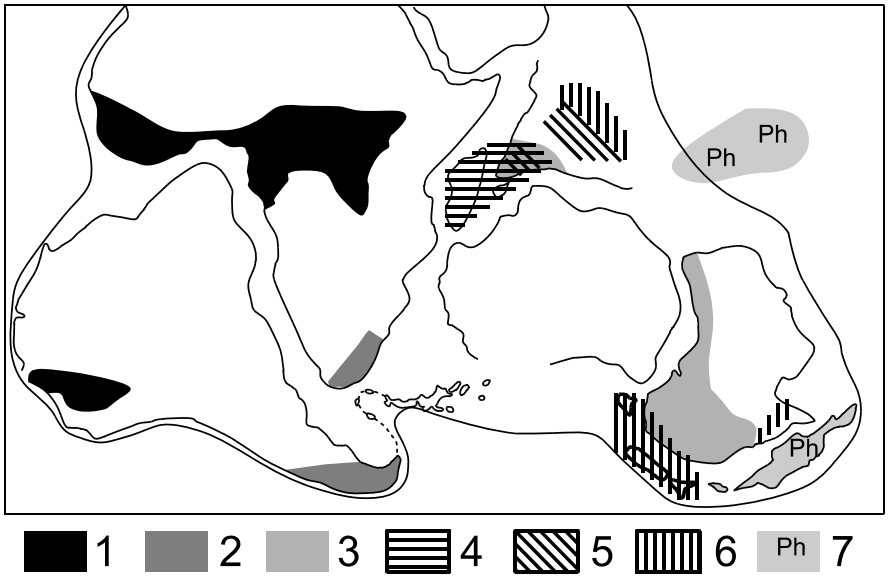

Figure i13.1 [12] The distribution of seven genera of living rain-worms (family Megascolecina) documented by W. Michaelson (1922) and plotted by du Toit (1927) on his reconstructed Gondwana.

Numbered in order of increasing specialization (with 7 being the most):

1. *Dichogaster*
2. *Chilota*
3. *Megascolex*
4. *Howascolex*
5. *Octocheetus*
6. *Perionyx*
7. *Pheretima*