i11 du Toit < Gondwana, Samfrau >

> ... the really important point is not so much to disprove Wegener's particular views as to decide from the relevant evidence whether or not continental drift is a genuine variety of earth movement. —Holmes, 1944.[1]

In his book, *Our Wandering Continents* (1937)[2] is the statement: "from the mid-Palaeozoic onwards the lands must have crept northwards for thousands of kilometers to account for their deduced climatic vicissitudes. Such, indeed, constitutes the most telling demonstration of the reality of Continental Drift." However, no geological argument was persuasive to the American audience in the interval following a generally agreed to statement by Rollin Thomas Chamberlin (1881-1948, son of TCC) in the 1928 A.A.P.G. symposium: "If we are to believe Wegener's hypothesis we must forget everything which has been learned in the last 70 years and start all over again."[3] What was imperiled and what would indeed be forgotten by 1968 (and so now is at risk of not being taught) is identified by Naomi Oreskes (in *The Rejection of Continental Drift*, 1999) as the inductive and pluralistic method of geology that had been adopted to escape the Wernerian geognosy that had lingered. As that embarrassment became forgotten in the flush of sophisticated instrumented (geophysical) evidence for drift, the pendulum swung for geologist to again favor (for now) a theory-first (deductive) systems approach.[4]

A geologist who looked for geological evidence to test Wegener's hypothesis of continental drift was **Alexander Logie du Toit** (1878-1948). As a field geologist for the Geological Survey of South Africa he became familiar with the regional geology of that country. Curious to see firsthand how well, if at all, the geology either side of the Atlantic matched, he applied for and upon receiving a generous grant from the Carnegie Institution of Washington in 1923 he spent five months in South America familiarizing himself with the geology of Argentina, Paraguay and Brazil. His seminal paper, *A Geological Comparison of South America with South Africa*, was published in 1927. He wrote, "The concordance between the opposed shores, incidentally pointed out and discussed by others long before Wegener, has consistently been extended by each fresh geological observation until at present the amount of agreement is nothing short of marvellous."[5] Persuasive of a former proximity of the two continents are the discoverable linkages that "cross from coast to coast, not only directly but diagonally as well, and are furthermore of widely different ages." In the map to illustrate this tectonic and phasal (lateral variation in a formation) comparisons were delineated (***Figure i11.1***) by du Toit between South America and Africa when separated only by the 300-400 kilometer width of their shelf areas. This brought the two, now separate, continents closer than du Toit had proposed in some of his earlier reconstructions before he had learned that "the mid-Atlantic Rise is ... more probably a recent structure and not a relic of fractured Gondwana[land]." Rifting, which separated South America and Africa began in the Cretaceous. Salt deposits record the initial South Atlantic flooding of the rift zone with the ocean entering from north and south. Before, South America-to-be and Africa-to-be were a single area of once Gondwanaland.

Triassic fold trends exposed in the Sierra de la Venta of Argentina south of the River Plate, are the same age as those in the Cape Fold Belt of South Africa. Also, detailed correlations with the Falkland Islands can be made—"their stratigraphy and structure being almost identical with those of the Cape," noted du Toit. His reconstruction of the southern area of Pangea lines these up with Triassic fold trends in eastern Australia (***Figure i11.2***). For this Gonwanide mobile belt of Early Cretaceous climax, that in the Triassic had involved by right transpressional

deformations[6] foredeep strata that had begun to accumulate at its inception in the Silurian, du Toit coined the name *Samfrau* (an acronym for South America, Africa, and Australia).[2]

Eduard Sapper Suess
Born in London, but educated in Vienna and Prague. Of his works, which he published in German, his magnum opus, *Das Antlitz der Erde*, in three books 1883-1904; was competently translated by 1909 into English by Hertha Sollas as *The Face of the Earth*.

Du Toit excised for separate consideration the present southern continents (and India) from the northern continents. However, before they broke up into the present continents, his discussion of the northern and southern areas of Pangea as two *separate* continents can be misleading and requires some clarification. **Eduard S. Suess** (1831-1914) in his synthesis of world geology *Das Antlitz der Erde*, 1904,[7] had the continents, with their present distribution, as emergent upwarped sial linked by downwarped sea-flooded sial between and divisible geologically into a northern realm with North America and the Continent, and southern realm that he called "Gondwanaland." Wegener closed the present oceans to reconstruct the assemblage of continental blocks of a "primordial continent" that was in existence during the Late Carboniferous. Otherwise faithful to Suess, this primordial continent named "Pangea"(by others) had a northern realm that straddled the equator, and a southern realm, Gondwanaland, that contained the south pole. Between these, flooded the Tethys, an epeiric sea. In du Toit's scheme, the Tethys was a deep bight into the eastern side of Pangea and, faithful to Suess and Wegener, it was a sial-floored ocean. This was concurred because parts of the floor of Tethys emergent in Cenozoic fold mountains are sial crystallines and sediments. However, not known to du Toit, the deeper parts of Tethys were sima-floored as is so of its westernmost part that survives as Mediterranean deep-seafloor. Irregardless, du Toit postulated that Pangea was assembled from several "Urkontinente": an equatorially centered "Laurasian collection" and "Gondwana," which latter was his name for Gondwanaland and which realm of Pangea, retained much of the geological identity of the paleocontinent Gondwana that, *before* the Late Carboniferous, had been in existence since the mid-Cambrian.

Du Toit's, *Our Wandering Continents*, 1937, provided a comprehensive review of the geology of the continents relevant to testing the postulate of geographic closeness of lands now widely separated by deep oceans. Our present understanding is that the continent of North America is a fragment of Laurasia. Laurasia along with Gondwanaland were continents that existed briefly during the Jurassic and were the two fragments into which the supercontinent Pangea broke, ending its existence. During the Early Jurassic and Triassic, when Pangea did exist, the Gondwanaland continent-to-be was a realm in it and the Laurasia continent-to-be was the area of its Northern and Southern Laurasia realms. During the early Triassic, the Southern Laurasia realm had been the part of Pangea-to-be that had formed at the beginning of the Pennsylvanian by the joining of Gondwana and ORS (Old Red Sandstone) paleocontinents. The ORS had assembled in the Devonian from the joining of Paleobaltica and Laurentia paleocontinents. *Note*: Today, a large part this once Laurentia is North America, east of the mid-Rockies, *see* Topic *j18*.

In particular, the geology of Gondwanaland (a post-Pangean continent, formerly a realm in Pangea, and earlier a realm in Pangea-to-be) that was Gondwana (a paleocontinent before Pangea had begun to assemble), is easy to understand if one notes that the Gonwanide craton of these through the time of their existence (before the Jurassic and since the mid-Cambrian) remained undivided by deep oceans and, except for the Samfrau mobile belt in its margin, became progressively basined.

However, du Toit sang only to the local choir [8] as nearly all geologists in Europe who had no colonial ties and, in America (except for those few who, as David H. Krinsley,[9] later came to consider primary evidence) remained unmoved;[10] their convictions set or received since the British Geographical Society in 1923 and the American Association of Petroleum Geologists in 1926 conducted symposia at which Wegener's ideas were examined and rejected. "Utter damned rot!"

huffed octogenarian TCC (as Thomas Chrowder Chamberlin liked to be called) in 1923 and whose pet theory of vertical tectonics to explain mountains made him hostile.[11]

After Alexander Logie du Toit (1878-1948) in South Africa, and like minded John William Evans (1857-1930) in England who had geologized in India, Sinai, Bolivia and Brazil,[12] the most vocal (though poorly cited)[13] torchbearers for the geological reality of continental drift were geologist in the southern hemisphere: Samuel Warren Carey (1911-2002) in Tasmania,[14] Karl Buerlen (1901-1985)[15] and Reinhard Maack (1892-1969) who had geologized in Brazil,[16] Maharajpuram Sitaram Krishnan (1898-1970)[17] and **Darashaw Nosherwan Wadia** (1883-1969)[18] in India, and Lester Charles King (1907-1989) in South Africa.[19] ❑

Figure i11.1 After **du Toit's correlation maps** (A and B) which support the hypothesis that South America and Africa have drifted apart and before they did, no wide, deep, Atlantic ocean was between them. As Wegener had earlier written: "It is just as if we were to refit the torn pieces of a newspaper by matching their edges and then check whether the lines of print run smoothly across. If they do, there is nothing left but to conclude that the pieces were in fact joined this way." [5]

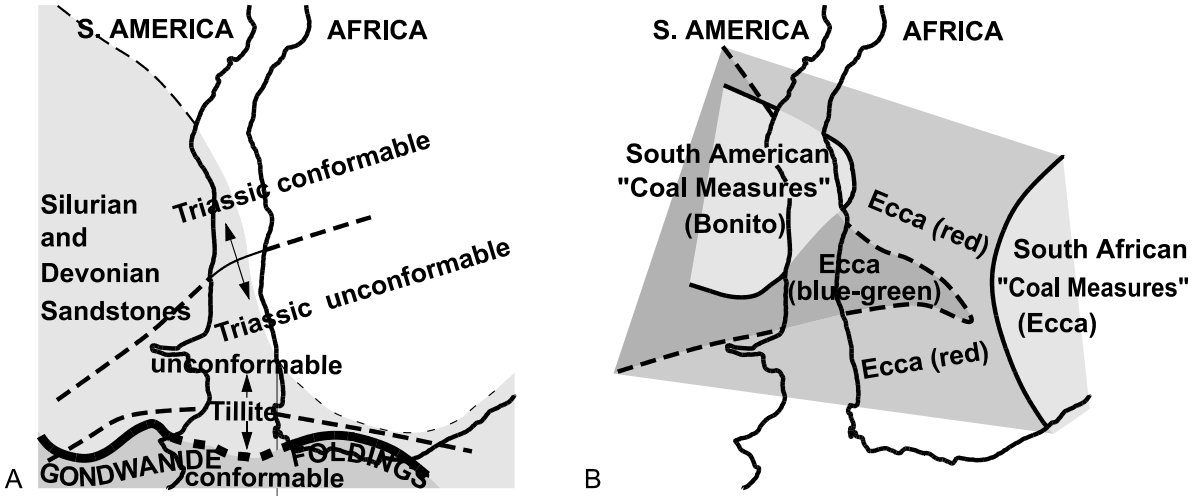

Figure i11.2 After **du Toit's reconstruction of Gondwana** centered over the south pole during the Paleozoic era. Outlines of the existing continents into which it has fragmented (beginning in the Late Jurassic) are shown. The thick dashed line is the front of fold mountains, created by compressions with an Early Cretaceous climax and Silurian inception. (The thin dashed outlines of India, Antarctica and Australia show how reversing seafloor spreading more accurately reconstructs their relative positions.) The Samfrau orogenic belt was the source of great volumes of clastic sediments (sandstones and shales) shed into the interior of Gondwanaland. In these sediments, fossils of mammallike reptiles and coals can be found.[7]