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A few hours in the Seychelles with Alex du Toit in 1938

Alexander Logie du Toit (1878–1948) was South Africa's most famous geologist during his lifetime, having authored five books which brought him world renown. In December 1937 to January 1938, accompanied by his wife Evelyn, he visited India in order to attend the Jubilee Indian Science Congress in Calcutta and to do field work in coal and diamond mines. On the return journey to Africa by ship, they stopped for a few hours in Port Victoria on Mahé Island in the Seychelles archipelago. They also passed by Silhouette Island. Du Toit recorded his activities in a diary, and his geological observations in a notebook, where he also drew a sketch of Mahé, and recorded steep structures on the east coast of Silhouette. Although he had not visited the Seychelles before, his deep understanding of the problems of Seychelles geology resulted from his comprehensive research on Indian Ocean geology for his 1937 book *Our Wandering Continents*. He made remarkably accurate observations on the geomorphology and structure, some of which were only confirmed decades later when the Seychelles were mapped in the 1960s to 1990s. His bold and prescient ideas on the breakup of the Gondwana continent, and on the formation of the Indian Ocean, have been amply confirmed by modern studies, especially by those of Lewis D. Ashwal and his collaborators.

Significance:

- South African geologist Alexander Logie du Toit's impressions of the Seychelles in 1938 are recorded for the first time, based on entries in his diaries. His observations of structures on Mahé and Silhouette Islands were prescient. His deep understanding of Seychelles geology was the result of his research for his 1937 book *Our Wandering Continents*. His bold conjecture that the Mascerene Ridge, made of continental crust, was the nucleus of Mauritius, was finally proved in 2017.

Introduction

In 1938, the South African geologist Alexander Logie du Toit (1878–1948) attended the Jubilee Indian Science Congress, from 3 to 9 January, in Calcutta (now Kolkata), India. He was accompanied by his wife Evelyn. They arrived in India by boat on 11 December 1937. Du Toit was then in the employ of the De Beers corporation, as Consulting Geologist, so after the Indian Science Congress, he visited the Panna District of Madhya Pradesh, central India, to report on the diamond mines there, on behalf of his company.

Du Toit was at that time the most famous geologist in South Africa, having published books on the *Geology of Cape Colony* (with Arthur Rogers, 1909)[1], on *Physical Geography for South African Schools* (1912)[2], *Geology of South Africa* (1924)[3], *Geological Comparison of South America and South Africa* (1927)[4], and most recently his passionately argued and hugely controversial book *Our Wandering Continents* (1937)[5]. He was particularly interested in the fossil evidence supporting the concept of continental drift. Prior to the Indian Science Congress he had visited the Jharia coalfield (in the Satpura Gondwana Basin some 200 km northwest of Calcutta) as well as the fossil collections of the nearby Dhanbad School of Mines, and during the congress he went on a field excursion to the Ramgahr coalfield (also in the Satpura Basin), which overlies the Talchir glacial beds (and is thus the equivalent of the Ecca coalfield overlying the Dwyka conglomerate in South Africa). He also visited the palaeontological museum of the Geological Survey of India in Calcutta, with its rich collections of Gondwana *Glossopteris* fossil flora.

Seychelles

On the return sea journey following his lengthy and strenuous time in India, du Toit was able to relax. The du Toits had departed Bombay (now Mumbai) on 19 January on the 60 000-tonne ship S.S. *Karanja* (Figure 1), and after putting into Murmagao (Goa) the next day, they headed across the Indian Ocean for Africa. On 24 January 1938, du Toit recorded in his diary[6] that they had re-entered the southern hemisphere (i.e. had crossed the equator). There was 'an absolutely calm sea', and he spent his time 'reading novels all day'.[6] The weather was 'dull at times in the afternoon, with occasional showers'[6].

Du Toit's time for relaxation was short-lived, for the very next day, the ship sailed into the waters of the Seychelles archipelago. Du Toit recorded in his diary again[6]:

> *25th January 1938.*
>
> *Seychelles. Fine day but cloudy at times and a spot of rain. Arrived at Seychelles at 8 AM and with Eve went ashore. Some 1¾ hours on pier, then round about to Hotel des Palmes for morning tea and back to ship at 12:45 for lunch. More passengers left at 4:30 PM, and passed North Island at 6 PM. Excellent Day.*

The ship had sailed through the night, and by the next day, it was back to reading novels for du Toit. His full entry for 26 January 1938 reads: 'Fine fresh day. Nothing to record – remaining due west.'[6] For the remainder of the journey, du Toit spent his time working on and completing his report on the Panna diamond fields, and writing letters. On 29 January the ship reached Kilindini on the Kenyan Coast. Over the next week the ship put in at Zanzibar, Dar-es-Salaam and Beira, before finally arriving at its destination, Lourenço Marques in Portuguese East Africa (now Maputo, Mozambique), on 8 February. The du Toits then took an overnight train, arriving back home in Johannesburg on 9 February 1938.[6]

If du Toit's diary was all we had to go on, it would seem that he and his wife Evelyn had a pretty pleasant and uneventful few hours in the Seychelles, just enough to enjoy a stroll on shore and have tea at the Hotel des Palmes. But du Toit's mind was furiously engaged with trying to explain the great conundrum of the Seychelles: almost uniquely among coral-fringed oceanic islands, the Seychelles are made of granite, and not basalt – and therefore are made up of rocks characteristic of continental crust. How could that be explained?

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Figure 1: The passenger liner S.S. *Karanja*, which operated between India and the East Coast of Africa between 1931 and 1939. The du Toits travelled on this ship in January 1938 from Bombay to Zanzibar and Lourenço Marques, with a short stopover in Port Victoria on Mahé Island, Seychelles. This ship was later commandeered by the British Royal Navy in 1940, and was sunk in 1942 off the coast of Algeria during Operation Torch, the invasion of North Africa.

Aside from his calendar diary, in which it had been his habit to record his daily activities, always starting with the weather (more than four decades of his diaries are preserved in his Archives stored at the University of Cape Town), du Toit, when on field excursions, also kept an excursion diary. On this occasion, he noted the following in his excursion diary, concerning the few hours he spent in the Seychelles[7]:

> *Seychelles 25 January 1938.*
>
> *Fine group of islands made by bare crystalline rocks, often black through crust of lichens. At north end of Mahé, Port Victoria, there is a remarkably regular sheeting of the granite dipping SW at about 15° or so* [Figures 2 and 3]. *Granite without any marked gneissic structure or banding. In Silhouette Island to the NW there are indications of some structure standing at a high angle and trending rudely NNW. (Extraordinary is the small and large scale fluting of the solid granite, visible in Mahé Island, visible even in crags high up in the range, due to wetting caused by dripping of vegetation or guidance of rain down incipient fluting)* [Figure 4]. *Noticeable is the long axis of Mahé parallel to this same direction. The group of islands rises from a shelf with relatively shallow water which, at least on NW side (track to Mombasa) has an extremely sharp edge. Its north margin is outlined by shoals and islands.*

Although du Toit had spent only a few hours in the Seychelles, and made a few observations from on board ship concerning the geomorphology and structure of the islands he saw, he already knew more than just about anybody else on earth about the significance of this picturesque group of tropical islands. He was thus particularly concerned about the structure, because he believed that the granitic rocks of the Seychelles must have been part of a continent, from which they had been faulted away.

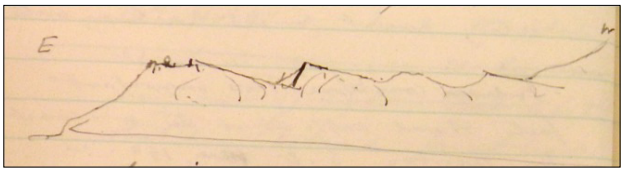

Figure 2: Du Toit's sketch of the outline of Mahé Island, Seychelles, 25 January 1938, looking towards the south.[7] Three shallow westward-dipping planes represent a former peneplain, which has been downfaulted and rotated by steeply eastward dipping faults, one of which is drawn with a prominent thick line (centre).

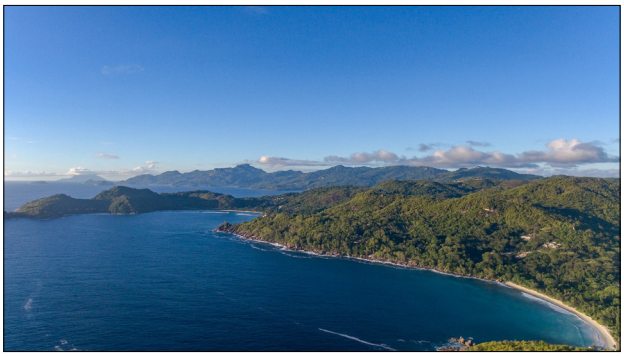

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Figure 3: Jagged skyline of Mahé Island, Seychelles, which was interpreted by du Toit[7] as having formed by block faulting of a peneplained continental granitic terrain.

Source: Hotel La Roussette; reproduced with permission

Figure 4: Strongly fluted outcrops of granite, due to wetting caused by dripping of vegetation or guidance of rain down incipient fluting, as observed by du Toit on Mahé Island.

He was quite alert to the possibility that the jagged outline of these rocks (Figures 2 and 3) could represent a formerly peneplained continental region which had been broken up by block faulting. His observations on the steep structures on Silhouette Island were confirmed many years later by Stephens[8] who showed that on the east coast of Silhouette there is a north to north-northwest trending trachytic breccia traversed by steep trachytic, microgranitic and microsyenitic dykes (which have been dated at between 64 Ma and 63 Ma)[9]. In 1937, in his magnum opus *Our Wandering Continents*[5], du Toit wrote, what we now know, in hindsight more than 80 years later, to be a breathtakingly daring, intricately detailed and presciently accurate account of the geological setting and palaeogeographic positions of Madagascar, the Seychelles, Mauritius and the Mascarene Plateau, and India, in relation to the breakup of the Gondwana continent and the formation of the Indian Ocean. This is what du Toit wrote, in part, about the Indian Ocean, based on his comprehensive and detailed researches[5(p.226–227)]:

> *THE INDIAN OCEAN*
>
> *Floor. – With area slightly less than the area of the Atlantic this basin has a mean depth of about -4000 m. with maximum of -7450 m. in the Sunda or Java foredeep.*

> *It is like the Atlantic through the presence of a medial rise that runs northwards from the Gauss Berg in Antarctica through Heard, Kerguelen, St. Paul, New Amsterdam, Chagos, Maldive, and Laccadive Islands to the Western side of India, which in similar fashion gives off branches to the Cape (via the Crozets and Agulhas Bank), Seychelles, Somaliland (via the Carlsberg Ridge and Socotra) and possibly Tasmania. The floor is thus divisible into an eastern and a western portion, and those again into subsidiary deeps.*
>
> *Madagascar stands on a deep shelf prolonged somewhat to the south, which is connected to the African mass, and has a crystalline basement. The curious curving Mascarene ridge to the east reaches above the sea in the granite of the Seychelles in the north, and the volcanic islands of Mauritius and Reunion in the south.*

About the Seychelles he had this to say[5(p.125)]:

> *...the Mozambique Channel was developed by the movement of Madagascar to the east of south, while the crystallines of the Seychelles – perhaps the nucleus of Mauritius also – are visualized as fragments left behind in the rear of India.*

Considering how little was known then about the sea floor, and about the ages of rocks, what du Toit said in 1937[5] presages the insights that were to be gained by the geological mapping of the Seychelles by Baker in 1963[10], and the more recent geochronological and palaeomagnetic studies of Tucker et al.[11] and Torsvik et al.[12], summarised most recently in the 35th Alex du Toit Memorial Lecture by Professor Lewis D. Ashwal[13]. Du Toit's remarkable conjecture, made in 1937, in visualising the crystalline rocks of the Seychelles, and 'perhaps the nucleus of Mauritius also' as being fragments left behind by the rifting away of India from Madagascar, was finally proven to be correct 80 years later. Ashwal et al.[14] showed that the island of Mauritius was underlain by crust of a much older continental fragment called 'Mauritia', which extended towards the Seychelles, and was originally situated between Madagascar and India, exactly as du Toit[5] had envisioned it.

Du Toit in the 1930s had been one of the very few crusaders (together with people like Reginald Daly and Arthur Holmes)[15-17] championing Alfred Wegener's ideas[18] of continental drift (the Displacement Hypothesis), while single-handedly opposing the ideas of isthmian and insular links between the continents (continental linking)[19], which had been invoked to explain the remarkable similarities in the fossil fauna and flora of the Gondwana continental fragments through a process of island-hopping. He ended his Chapter X, on 'The Oceans'[5], with this strongly worded, declamatory statement:

> *The Displacement Hypothesis is, on the contrary, competent to explain these and other puzzles of biological distribution, particularly in this great Austral region, in a simple and logical manner and without the violation of isostatic principles.* Current views of continental linking must therefore be firmly rejected.

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