

IS ANTARCTICA A CONTINENT OR AN ARCHIPELAGO?

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It is known that during the I.G.Y. period, and earlier, several expeditions have found that over extensive areas the surface of the rock beneath the ice of the Antarctic Continent lies below sea level. Such evidence was obtained on Dronning Maud Land by Dr. G. de Q. Robin, a member of the 1949-52 Norwegian-British-Swedish Expedition, on Terre Adélie by French Polar Expeditions, on Queen Mary Land by a U.S.S.R. Expedition, and on Marie Byrd Land by an American Expedition. Most surprising was the fact that along nearly the whole route of the American Expedition between the Ross Sea and the Amundsen Sea, via Byrd Station, located almost in the centre of West Antarctica,* the bed of the ice sheet proved to be below sea level, sometimes to a depth of 1 to 2, and even of 2.6 km.

These findings gave rise to many surmises that, perhaps, Antarctica is not a continent, but an ice-capped group of islands, or that, if the Antarctic Continent does exist, it is in any case not nearly so big as had been supposed. To lovers of sensation "Terra Australis Incognita", lost in the eighteenth century and rediscovered in the nineteenth, seemed to be disappearing for the second time.

In fact, however, the answer to the question of whether Antarctica is a continent depends not only on the level of its surface. Geological survey of the East Antarctica coasts shows, beyond doubt, that it is a typical continental platform, and that its boundary with the surrounding oceanic depressions, the continental slope, has been contoured by depth soundings along all its shores.

The gravimetric investigations of the second U.S.S.R. Antarctic Expedition in 1956-58 showed that the thickness of the earth's crust in the area between "Mirnyy" and "Komsomol'skaya" ranges from 30 to 40 km.—a thickness characteristic only of a continent. A sharp decrease in crustal thickness begins only 100-150 km. north of "Mirnyy", near the continental slope.

The same data indicate that at least near the coasts East Antarctica is in a state of isostatic equilibrium. As the average density of bedrock is approximately 2.7 g.cm.^{-3} and that of ice 0.9 g.cm.^{-3} the isostatic equilibrium shows that, in comparison with its normal level, the Antarctic Continent is now submerged under the weight of its ice load to about one-third of the thickness of the ice sheet. If the ice were to melt, there would occur, with a certain lag in time, an isostatic rise of the continent to an average of one-third of the thickness of this ice sheet.

Cross-sections of the surface and bed of the ice sheet along the routes: "Mirnyy" (lat. $66^{\circ} 33' \text{ S.}$, long. $93^{\circ} 00' \text{ E.}$)—"Vostok" (lat. $78^{\circ} 27' \text{ S.}$, long. $106^{\circ} 53' \text{ E.}$) and "Komsomol'skaya" (lat. $74^{\circ} 05' \text{ S.}$, long. $97^{\circ} 29' \text{ E.}$)—the Pole of Relative Inaccessibility (lat. $82^{\circ} 06' \text{ S.}$, long. $54^{\circ} 58' \text{ E.}$) are given in Figs. 1 and 2. They are based on the preliminary results of seismic and gravimetric measurements made by the third U.S.S.R. Antarctic Expedition, 1957-59, and partly by the second U.S.S.R. Antarctic Expedition (the first 250 km. out of "Mirnyy" and details of relief on the "Komsomol'skaya"—"Vostok" stretch are based on gravimetric observations and 4 seismic stations of the third expedition).

* By the terms "East Antarctica" and "West Antarctica" the author is referring to portions of the continent lying either side of a line joining the Ross Ice Shelf and the Filchner Ice Shelf, "East Antarctica" being on the Atlantic Ocean-Indian Ocean side. These terms are not satisfactory for the reasons given in the *Polar Record*, Vol. 9, No. 61, 1959, p. 358-59, but alternatives are not suggested, since the structure of Antarctica is only now (through papers such as this one) beginning to become clearer.—Ed.

To a distance of 200 km. south of "Mirnyy" the surface of the continent lies between 480 m. below and 175 m. above sea level; between the 225th and 400th km. it rises to +760 m. Southward to the 950th km. in the direction of "Vostok" there stretches a lowland with altitudes from -350 m. to +500 m.; in the vicinity of the 505th km. it is intersected by a trough to a depth of 1,130 m. below sea level. The lowland is overlain by an ice sheet more than 3 km. thick. Over the trough its thickness reaches 4,060 m.

Further south and west the continental surface level is much higher. In the vicinity of "Vostok" Station its altitude reaches 1,660 m. A high mountainous country extends under the ice sheet more than 1,000 km. from 200 km. west of "Komsomol'skaya" to the Pole of Relative Inaccessibility. At the highest measured point in this region the rock bed rises to an altitude of 3,075 m. above sea level and is overlain by a glacier only 890 m. thick.

A comparison of these data with those of the British Trans-Continental, Australian, French and Norwegian-British-Swedish Antarctic Expeditions gives reason to presume that the main features of the terrain of East Antarctica are two high and approximately meridional horsts—the Great Antarctic Horst (South Victoria Land—Dronning Maud Land Mountains and on towards the Weddell Sea), and the second horst which runs nearly perpendicular to the former. This extends roughly along long. 65° - 75° E. from Lars Christensen Coast, between the Pole of Relative Inaccessibility and the "Sovetskaya" Station (lat. $78^{\circ} 24'$ S., long. $87^{\circ} 35'$ E.), towards King Edward Plateau. A vast lowland apparently lies in the north-eastern interhorst area. Between long. 75° - 105° E. the lowland is fenced off from the ocean by a coastal mountain range with some of the peaks towering above the ice sheet, while in the Wilkes Land area it comes right up to the seaboard. It is probable that there is a somewhat smaller depression in the north-western sector between the aforesaid horsts and the coastal mountains of Dronning Maud Land. The ice thickness in lowland areas, where this has been measured, is such that if the ice were to melt, after an isostatic readjustment the surface of the continent would rise, with but few exceptions, to altitudes higher than sea level.

Thus, East Antarctica proves to be a typical continent submerged by the weight of a thick ice sheet to a depth of several hundred metres, and in some parts to below sea level. Only in West Antarctica is there the probability that a chain of mountainous islands is joined to the East-Antarctic Continent by the over-lying ice sheet.

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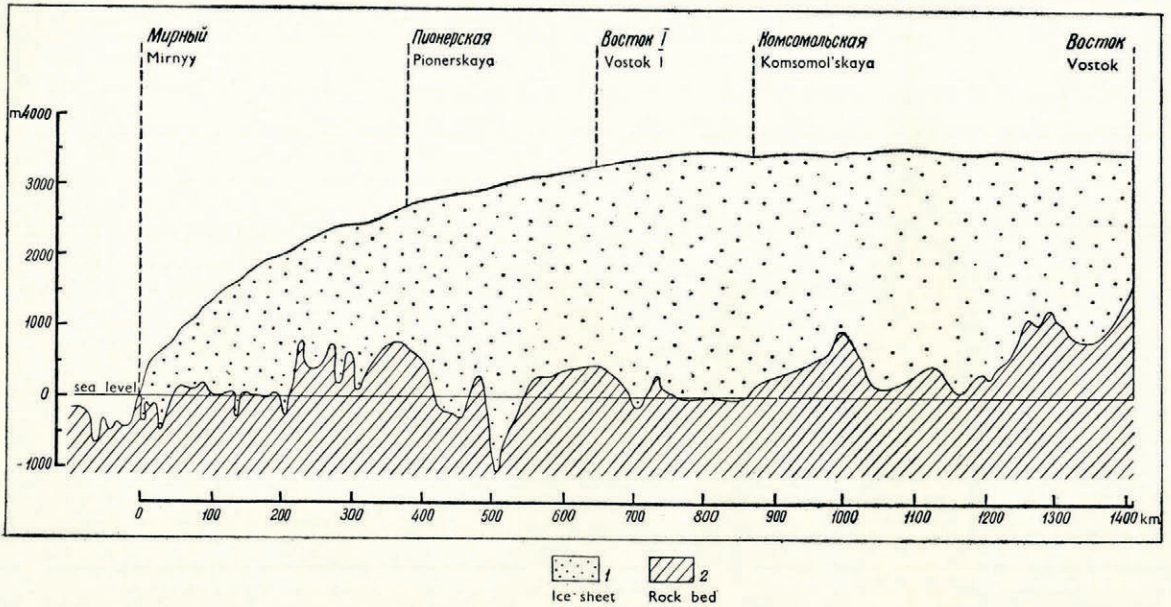


Fig. 1. Cross-section of the surface and base of the Antarctic Ice Sheet along the Mirnyy-Vostok route

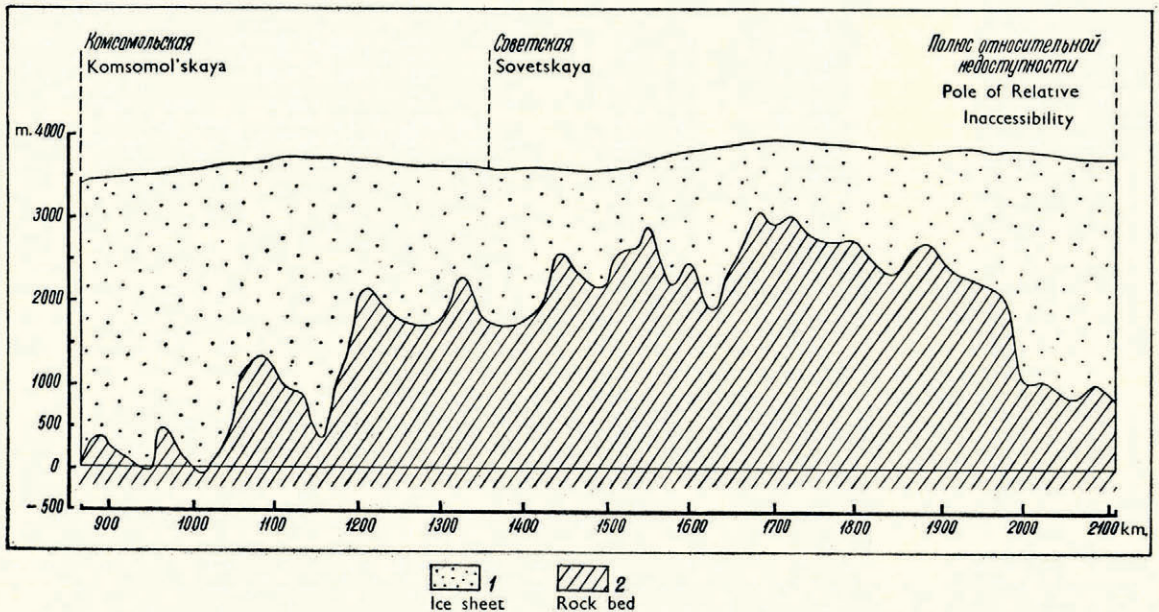


Fig. 2. Cross-section of the surface and base of the Antarctic Ice Sheet along the route: Komsomol'skaya-Pole of Relative Inaccessibility