THE TOPOGRAPHICAL RESULTS OF ELLSWORTH'S TRANS-ANTARCTIC FLIGHT OF 1935

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THE TOPOGRAPHICAL RESULTS OF ELLSWORTH'S TRANS-ANTARCTIC FLIGHT OF 1935

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HEREWITH are presented the topographical results of Lincoln Ellsworth's Antarctic flights of November 21 and November 23–December 5, 1935. They are based on the original material generously placed at the American Geographical Society's disposal by Mr. Ellsworth, consisting of a complete set of the photographs taken by him and the observational and navigational records kept by him and his pilot, Mr. Herbert Hollick-Kenyon, on the two flights.

THE FLIGHT TRACKS

As described in the April, 1936, *Geographical Review* (pp. 329–332), the flight of November 21 proceeded from Dundee Island to and just beyond Stefansson Strait and then returned to its starting point, whereas the flight of November 23 to December 5 crossed the entire length of West Antarctica from Dundee Island to Little America (Fig. 1). The tracks of these two flights were plotted on the Society's map of the Antarctic on the scale of 1:4,000,000 from the courses, indicated air speeds, drift, and other data in the logs. It is likely that the track of the trans-Antarctic flight is nearly correct, since the astronomically determined position of the third landing,[1] on November 27 in 79° 58′ S. and 114° 15′ W., made it possible to tie it down at this point between its two known ends, and only minor adjustments had to be made in fitting the indicated courses and air speeds into the eastern segment and no adjustments had to be made in the western segment. Less confidence is held in the representation of the loops in the track of the November 21 flight in the Stefansson Strait region (top of Fig. 1), inasmuch as no courses or speeds were recorded after the second (westward) passing of Cape Eielson in this difficult flying terrain. It was only the recognition of identical features on photographs taken on both flights (Figs. 2, 3, 4) that gave some clue to the relation of the November 21 track to the relatively definite November 23 track. The plotting of both flights, however, in their southward approach to the mainland, agreed well in the resulting position of the important point Cape Eielson. Both tended to place it in about 70° S. and 64½° W. In latitude this agrees with Sir Hubert Wilkins' original reconnaissance position;[2] in longitude it is 2° to the west of that position, but this shift seems on the whole to fit better

[1] The astronomical positions of the first and second landings as published in the newspaper report and on p. 331 of the April *Geographical Review* were calculated back from the third landing, since it was later found out that the original determinations were incorrect owing to a loose screw on the sextant.

[2] *Geogr. Rev.*, Vol. 19, 1929, Pl. IV. See also note on Pl. IV and reference to reliability of latitudes and longitudes, p. 376.

the mountain structure revealed by the Ellsworth flight, as will appear.

The Photographs

The photographic material bearing on topography consisted of two series of Leica film, one of 25 exposures (each 24 x 37 millimeters) relating to the November 21 flight and the other of 41 exposures relating to the November 23 to December 5 flight. Neither series contained any photographs taken north of the Stefansson Strait region, and the last exposure in the second series (all were made on November 23) was made in about 77½° S. and 92° W. Of both series Mr. Ellsworth had made a list giving the time when each photograph was taken and whether from the right or the left side of the airplane. The flying height of the plane was as a rule available from the log.

Enlarged prints 4 by 6 inches in size were made: these were studied for coincident features, and the position and direction of each photograph were plotted along the time spacing on the routes according to the record on the list.[3] As a result, the photographs fell into groups naturally,[4] and this grouping and additional notes in the logs relating to features not shown on the photographs made it possible to reconstruct the major lineaments of the area traversed and classify them regionally.

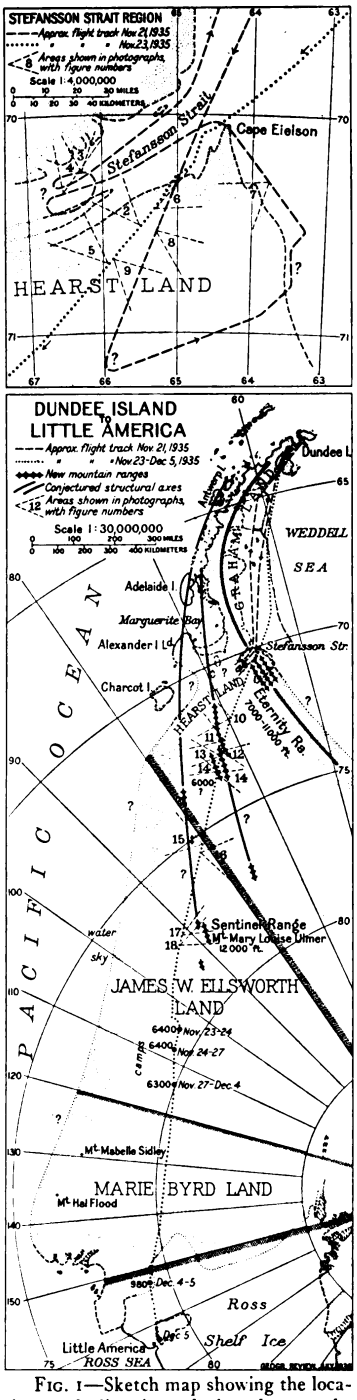


FIG. 1—Sketch map showing the location and direction of the photographs illustrating the article and the conjectured trend of the mountain axes of the Antarctandes. (For 6000? in 74° S. and 76° W. read 9000.)

[3] The photographs, consisting usually of individual exposures or, if in a consecutive series, of exposures made at one-minute intervals, did not as a rule lend themselves to the methods of cartographic reduction applied to the photographs of the first Byrd Antarctic expedition by O. M. Miller (*Geogr. Rev.*, Vol. 21, 1931, Pl. I and pp. 201–212) and H. E. Saunders (*ibid.*, Vol. 23, 1933, Pl. II and pp. 195–209).

[4] Of each of these groups at least one representative photograph is published herewith. Figures 2 to 18 hence encompass the whole range of topographical features observed on the flights.

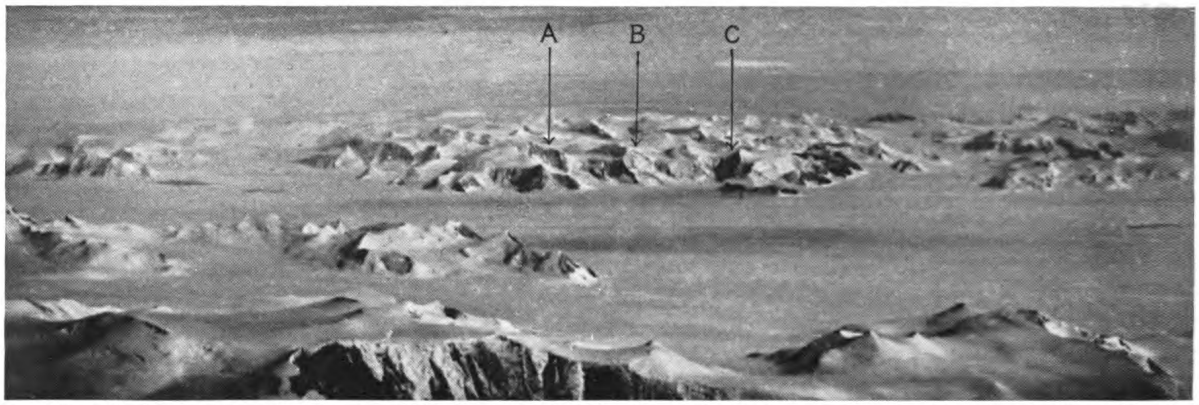


FIG. 2—Looking about northwest across the Stefansson Strait depression. Letters indicate identical features on Figs. 3 and 4. (13,000 feet; 12:45. Approximate altitude of airplane and Greenwich civil time on November 23, 1935, are given thus.)

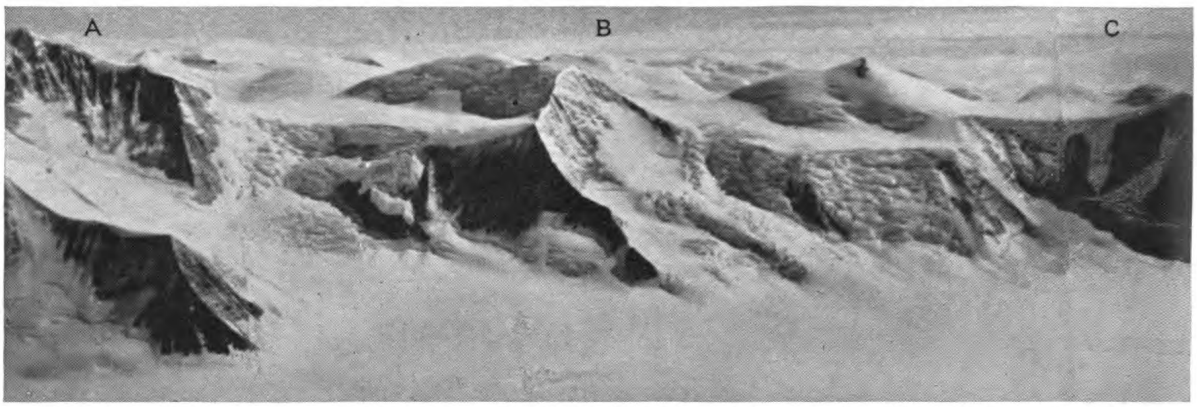


FIG. 3—Close view of the cirques, truncated spurs, and hanging glaciers of the northern mountain wall of the Stefansson Strait depression shown on Fig. 2. (Altitude and time not given—probably 5500 feet; Nov. 21, about 15:15.)

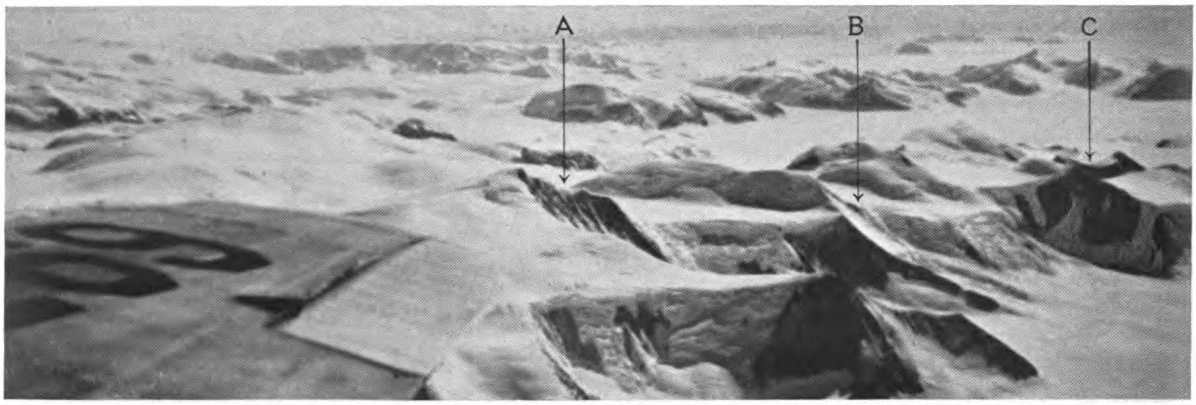


FIG. 4—Looking about northeast along the northern coast of the Stefansson Strait depression. The embayment in the right middle distance may also be identified on Fig. 2. (Altitude not given—probably 7000 feet; Nov. 21, 14:52.)

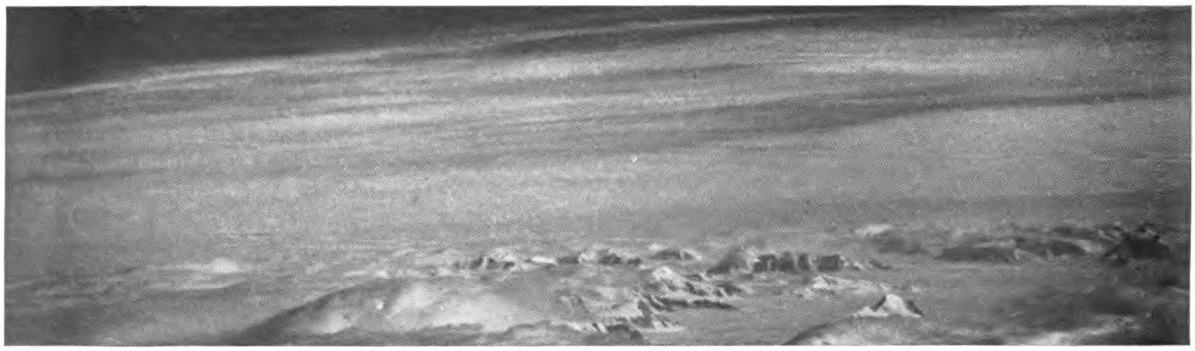


FIG. 5—Cloud-filled western part of the Stefansson Strait depression (probably slightly overlapping and continuous with left end of Fig. 2). (13,000 feet; 12:59.) This may be toward the head of the depression, if the non-existence of a through strait is confirmed that Rymill's flight of March 13, 1936, seems to disclose (see text).

FIG. 6—Looking northeast across headlands of the ranges terminating on the southern side of the Stefansson Strait depression. Cape Eielson, the northernmost of these headlands, probably lies behind the ridges in the middle distance. (13,000 feet; 12:40.)

FIG. 7—View probably looking southwest from over the Weddell Sea coast about 20 miles southeast of Cape Eielson across one of the longitudinal valleys and ranges forming part of the same system as those on Fig. 6. (9600 feet; Nov. 21, 14:00.)

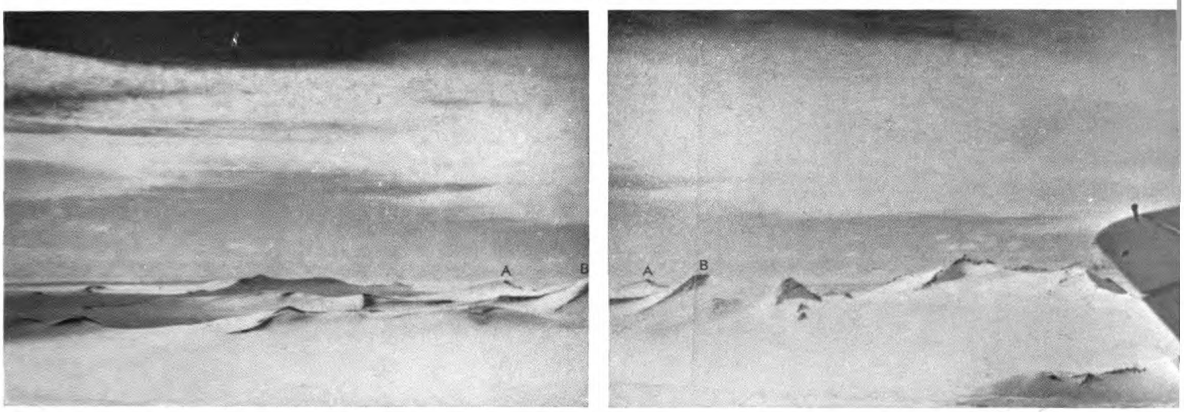


FIG. 8—Looking southeast over the summit peaks of the main axis of that system (termed Eternity Range by Mr. Ellsworth), about 40 miles southwest of Cape Eielson. Overlapping identical peaks indicated by letters. (8500 feet; Nov. 21, 12:20.)

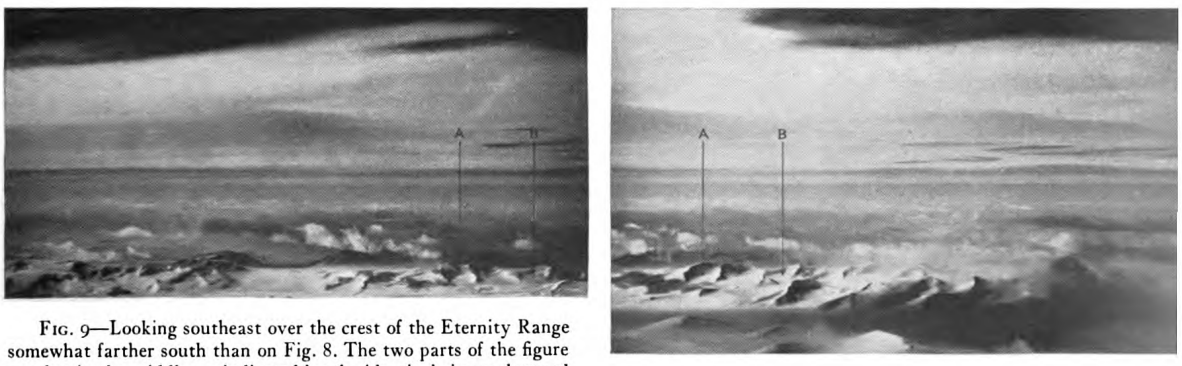


FIG. 9—Looking southeast over the crest of the Eternity Range somewhat farther south than on Fig. 8. The two parts of the figure overlap in the middle, as indicated by the identical cirques lettered A and B. (13,000 feet; 12:57.)

FIG. 10 (across spread of pages)—View northwest toward north-south trending range probably lying about 71° W. between 71½° and 73¼° S. The range, whose northern end is seen in the distance in the middle of the right picture, sweeps toward the observer in the left

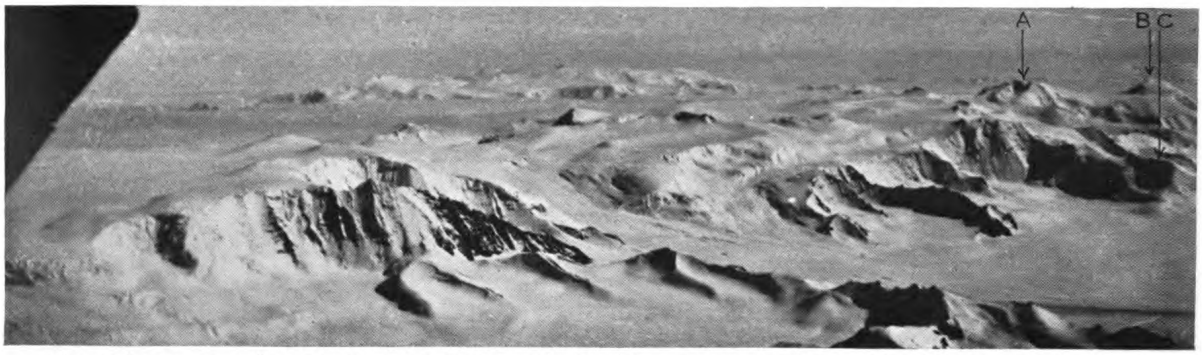


FIG. 11 (across spread of pages)—Near view, looking northwest, of the range shown in Fig. 10, as the airplane was crossing it in about 71½° W. and 72 2/3° S. Identical features on the overlapping sections are lettered to correspond. The wide, open glacial valley in the

FIG. 12—View southeast probably showing, in the distant left, the southern end of the range shown in Figs. 10 and 11. The foreground range (note stratification) probably ends in the ice-buried ridge appearing in background of Fig. 14 (left). (10,000 feet; 15:05.)

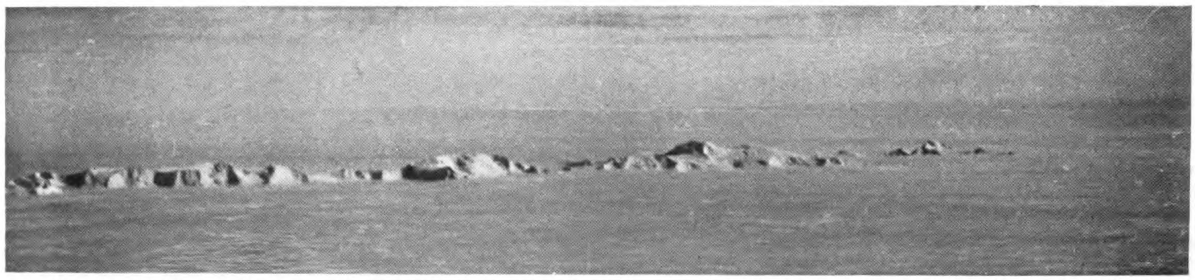


FIG. 13—Looking northwest toward the northern end, protruding from a cloud bank, of a range that probably lies in about 73½° W. and between 72¾° and 73¾° S. (10,000 feet; 15:12.)

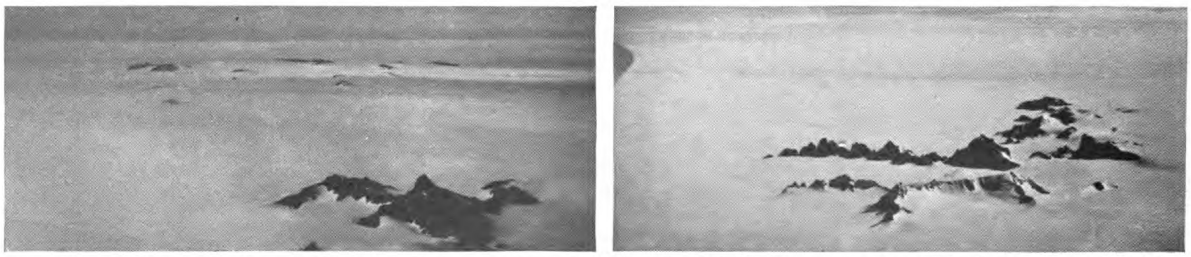
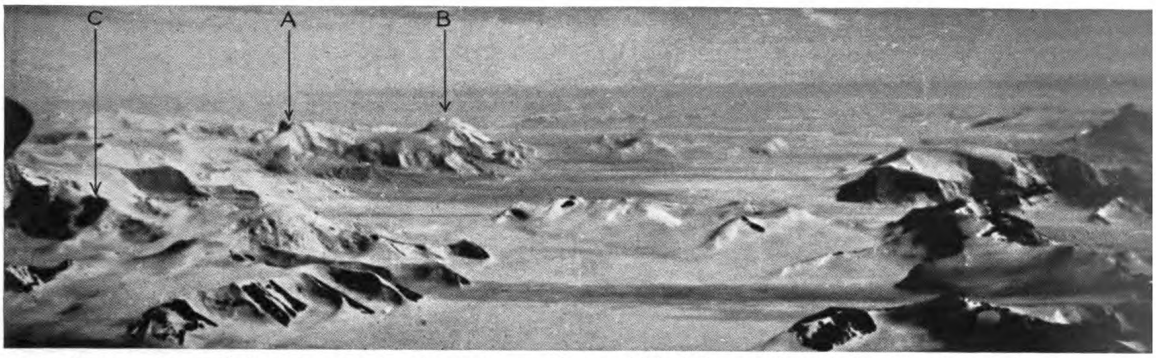


FIG. 14—Looking southeast (left) and northwest in about 73½° W. and 73½° S. along a range (probably the same as in Fig. 13), constituting the westernmost in the conjectured intermediate axis (see text). (9800 feet; 15:30.)

foreground of the left picture. The adjoining photograph to the left (not published) displays sedimentary rocks that dip about 10° to t southwest. (11,200 feet; 14:13 and 14:18.)



right picture is characteristic of the range (another appears on the unpublished photograph continuing Fig. 10 to the left). (10,000 fe about 14:50.)

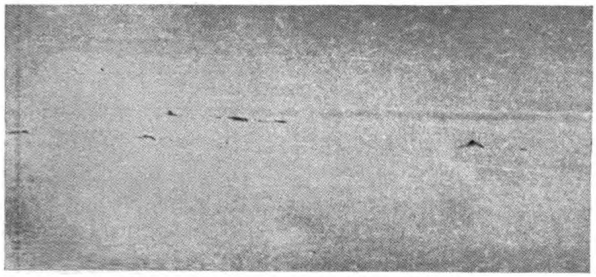


FIG. 15—Icecap with nunataks, typical outside of the mountain belts. Looking NW from 80° W. and 75¼° S. (10,000 feet; 17:18.)

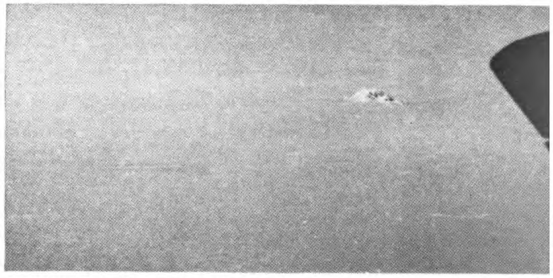


FIG. 16—Isolated nunatak seen southeast from about 81° W and 75½° S. (9,600 feet; 17:32.)

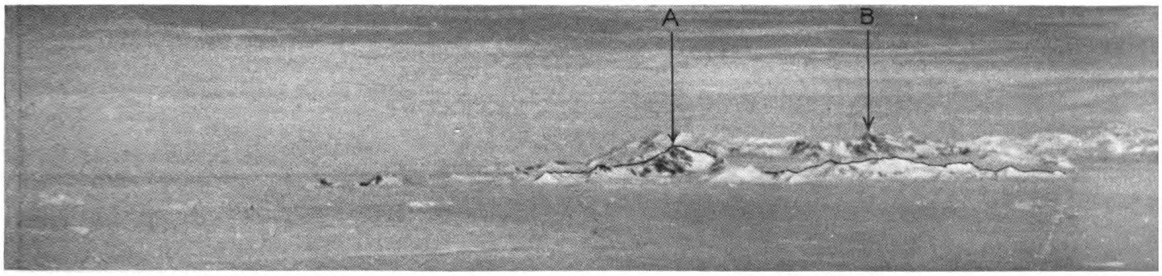


FIG. 17—The Sentinel Range, which lies in about 88° W. and between 77¼° and 78 1/3° S., looking southeast from about 91° W. a 77¼° S. A shorter range that lies in front of the left (northeastern) end has been silhouetted with a black line. (10,000 feet; 19:30.)

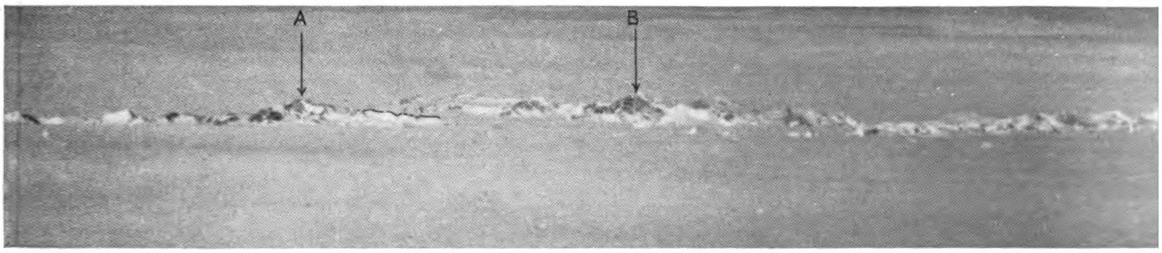


FIG. 18—The Sentinel Range from a point 25 miles southwest of the point whence Fig. 17 was taken. (10,000 feet; 19:44.) Mt. Ma Louise Ulmer is the highest peak in the main range.

Stefansson Strait Region

A general result of the flights seem to be to compress Stefansson Strait and shift it northward as compared with Wilkins' reconnaissance map. Its eastern entrance seems to lie mainly north of the 70th parallel, and the average width of the whole depression between Scripps Island and the mainland seems to be 20 to 25 miles, as compared with the 60 miles or more of the Wilkins map. From the Ellsworth photographs, of which Figure 2 is the most comprehensive, it is not possible to identify with certainty Lurabee Channel, the Finley Islands, and Stefansson Strait proper or to correlate them with Wilkins' photographs of these features.[5] The fact that toward the west the Stefansson Strait depression was filled with clouds on November 23 (Fig. 5) might point to the presence of higher land in that direction, as was first reported by Wilkins himself from his flight to Charcot Island on December 29, 1929, and as was recently confirmed by Rymill from his flight on March 13, 1936, to a point 75 miles southwest of his base on the east coast of Marguerite Bay in 68° S. Wilkins reported[6] two areas of high land that he interpreted as islands in about 70° S. and 68½° W. and 70⅓° S. and 69½° W. Rymill reports[7] Marguerite Bay as closed to the south by 7000-foot mountain massifs. These discoveries might indicate that Stefansson Strait is not a strait at all but merely one of the embayments—a major one, to be sure—into which the glaciers of the eastern side of Graham Land discharge.

The Antarctandes

South of the Stefansson Strait depression the results of the Ellsworth flights seem to confirm not only the conjectured southern continuation of the Antarctandes but also the virgation, or spreading, of their axes forecast by the Swiss geologist Staub.[8] The significance of this virgation would be that it represents the only one of the two blind ends in which the great world belt of young folded mountains frays out to the south that impinges directly on the old-land mass of Antarctica, since the other, the New Zealand–Auckland Islands–Campbell Island virgation, dies out before it reaches the southern continent.

Although all deductions must necessarily be tentative, it may be pointed out that the ranges discovered on November 21 and 23 south of Stefansson Strait seem, in orientation and position, to fit into the prolongation of the three axes recognizable north of the strait.

[5] *Geogr. Rev.*, Vol. 19, 1929, Figs. 29–34 on pp. 368–369.
[6] *Geogr. Rev.*, Vol. 20, 1930, Pl. III and pp. 373–374.
[7] *London Times*, April 17, 1936 (also weekly edition, April 23, 1936).
[8] Rudolf Staub: Der Bewegungsmechanismus der Erde, Berlin, 1928, pp. 117–118 and map in pocket. On the underlying concepts of geotectonics see Staub, pp. 7–21, and W. H. Bucher: The Deformation of the Earth's Crust, Princeton, N. J., 1933.

The main range discovered south of Stefansson Strait, named Eternity Range (Figs. 8 and 9), which reaches an elevation of 11,000 feet, forms a direct continuation of the main axis of Graham Land. It has a south-southeast trend and consists of a number of subranges whose northern ends and intervening longitudinal valleys are truncated by the Stefansson Strait depression (Fig. 6). Its eastern border, at least in the area observed, seems to form the western coast of Weddell Sea. The westward shift of Cape Eielson, at the northern end of this coast, mentioned above, brings the Weddell Sea coast into plausible alignment with the Graham Land coast north of the strait.

What may be termed the intermediate axis, defined by the islands west of Lallemand and Bourgeois Fiords (67½° W., between 67° and 68° S.) and by the mountain "islands" discovered by Wilkins and Rymill south of Marguerite Bay, seems continued to the south by three ranges trending north-south lying between about 71° and 74° W. and 71½° and 73½° S. (Figs. 10–11–12, 12–14, 13–14). Mountains seen to the south 120 to 140 miles from the November 23 track in about 81° W., and therefore lying in about 77° S. and 76° W., may also belong to this axis.

In the third, or western, axis, defined by the offshore islands Antwerp, Adelaide, and Alexander I (Charcot Island is off line), would lie the high Sentinel Range, discovered in about 88° W., between about 77° and 78° S., with its 12,000-foot peak Mt. Mary Louise Ulmer (Figs. 17 and 18),[9] and a range located in about 92° W. and 18½° S. Nearer the coast, in the same alignment, may lie the mountains seen to the right from 77° W. on the November 23 track, which would place them in about 79° W. and 73½° S.

Between the first and second and the second and third axes the plain of the icecap is interrupted only by occasional nunataks (Fig. 15).

Ice-Covered Plateau

Beyond the last mountains, in 92° W. and 78½° S., the icecap extends apparently without interruption to the Ross Shelf Ice. From 92° to 115° W. it maintains a level of more than 6000 feet. In 115° W. it begins to descend and decreases to 4500 feet at about the 127th meridian and to 1000 feet near its termination at the shelf ice in about 149° W. and 79 2/3° S., where the flight route crossed it.

Objectives for Future Exploration

From this brief account it will be seen that in one remarkable flight of 2200 miles, of which 1200 miles were over wholly unknown

[9] Owing to the smallness of the Leica exposures, which were the only prints available to the members of the expedition for identification at first, the range in 73° W. and 73° S. shown in Figure 14 was confused with the Sentinel Range. The one in 88° W. and 77½° S. shown in Figures 17 and 18 is the one to which Mr. Ellsworth gave the name and to which he wishes it to apply henceforth.

territory, a clue has been gained to the character of one of the earth's important structural areas. Enough has been seen to show that here, in this tapering projection of the continent between Weddell and Ross Seas, the interior of the icecap, unlike its counterpart of the same size in Greenland, does not completely mask the underlying topographical features. Further exploration is therefore likely to yield immediately tangible results: following the Eternity Range to the south will disclose the behavior of this major trend line and its relation to the probably shelf-ice-fringed west coast of Weddell Sea; following the other axes or crossing them farther south may throw light on their termination and their relation to the old mass of the rest of the continent; and tracing the coast on the Pacific Ocean side may confirm he inward sweep to the south (Fig. 1) suggested by the water sky observed by Hollick-Kenyon on November 23 in the conjectured position of 76° S. and 100° W. and also by the marginal location of Mt. Hal Flood and Mt. Mabelle Sidley surmised by Harold June on the flight eastward to 135° W. on the 78th parallel on November 18, 1934, during the second Byrd expedition.