Proceedings of the Indiana Academy of Science
(1995) Volume 104 p. 85-92

THE EXPLORATION HISTORY OF THE LINDSEY ISLANDS, ANTARCTICA, 1928-1994

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ABSTRACT: The twelve islands and islets of the Lindsey Group (73°37′ S by 103°18′ W) were reached on 24 February 1940 by Admiral R.E. Byrd, while he navigated a flight from the *Bear* to the longest unknown coast of Antarctica. In 1968 and 1975, two topographic engineers of the U.S. Geological Survey worked on one or both of the two largest islands. In 1992, six geologists worked briefly on Island 1 of the northern subgroup, and some of them also worked on Island 2 and on the southwestern subgroup's main island. The base rock is pink megacrystic granite with many quartz diorite and gabbro dikes up to 15 m thick. Adelie penguins and skua gulls breed abundantly, and leopard seals are common. Many elephant seals, but neither Weddell nor crab-eater seals, were reported. The first large-scale map of this island group is published.

KEYWORDS: Antarctic coastal maps, antarctic exploration, antarctic fauna, antarctic ice tongues, antarctic islands, R.E. Byrd, geographic names, Hubert Wilkins.

INTRODUCTION

The last and least known part of the antarctic coast bounds the Amundsen Sea and Bellingshausen Sea divisions of the Pacific Ocean. Until 1940, this area was by far the longest continuous stretch of coast on earth to remain uncharted; it posed a particular challenge to Admiral Byrd during his mid-career. The Lindsey Islands lie off the Canisteo Peninsula within the central third of this coastal segment, where a conspicuous general trend of coastline runs north-south rather than east-west, leading in to Pine Island Glacier and Bay.

The Lindsey Islands (Figure 1) are significant disproportionately to their size. The largest is only 0.2 mile from the adjacent mainland peninsula on which helicopter pilots refused to land. In contrast to the peninsula, this island is extensively ice-free in summer with good landing and camping sites. It is strategically located and accessible in summer for its automatic weather station and permanent triangulation stations for mapping. Three experts in high-tech satellite positioning worked onshore in 1992 to fix the triangulation station locations precisely, tying into the Global Positioning System, a distinction accorded few antarctic locations. The exposed bedrock gives geologists access to the same formations which along the mainland coast are largely hidden under perennial ice. These low islands provide hauling-out spots and rookery sites for marine mammals and oceanic birds at or near the extreme southern limits of their breeding ranges.

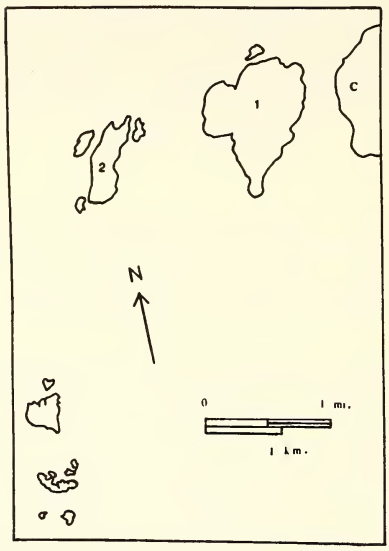

Figure 1. The two subgroups of the Lindsey Islands and the Canisteo Peninsula (C) of mainland Antarctica. Each subgroup, the northern and southwestern, has six islands and islets. The largest islands (1 and 2) are in the northern subgroup. Five of the twelve islands are 0.25 mile or more in length. From U.S. Navy airphotos of 23 January 1960.

EARLY APPROACHES, DISCOVERY, AND NAMING

Sir Hubert Wilkins was the first (1930) airborne explorer in Antarctica. He came closer to the Lindsey Islands than anyone else prior to Byrd's finding them in 1940. On 11 February 1930, Wilkins and two crewmen took off from the sea at the British research vessel *William Scoresby.* Weather conditions were execrable throughout; very little was seen, and Wilkins' navigation was highly inaccurate. His map incorrectly shows that they followed the meridian of 101° W. Long. in both directions and that they turned back at 73° S. Lat. The first was quite impossible, for all modern maps show that the 101° meridian would have taken them across the full width of the mountainous Thurston Island and many miles farther over the mountainous continent itself. The plane was flying less than 500 feet above the sea, which, together with icebergs, clouds, and snow, was all the men saw.

Wilkins (1930) wrote, "It is probable that in clear weather, from our farthest south, we could have seen land ahead; but we saw no definite indication of it." At the crucial turning point, "The gray, misty snowstorm had closed us in completely. To make a right turn and steady our compass was not an easy matter." He makes no comment on the hazards they survived, which were clearly horrendous.

Any close determination of where they were on this flight is clearly impossible, but it was somewhere in the northern part of Greater Pine Island Bay of Amundsen Sea, possibly as far south as the Lindseys but well to the west of them.

Later in the same year as Wilkins' flight, Admiral Richard E. Byrd flew to the South Pole, the last stop this side of the moon.

Byrd, on his second or 1933-35 antarctic expedition (Byrd, 1935) was planner and navigator for several flights from the flagship *Pacific Fir,* seeking the coasts of the Amundsen and Bellingshausen Seas. The present writer served on the Iceberg Watch and as the zoologist during this cruise. The coast was not seen, but the voyage erased vast extents of presumed land from contemporary maps. The ship had approached within 85 miles, we later learned, of the coast and 370 miles of the still unmapped and unnamed Lindsey group before turning back westward toward our Bay of Whales base for the winter.

Byrd's major personal effort during his next expedition (U.S. Antarctic Service) was concentrated on this long coast in a twin-engine Barkley-Grow seaplane carried by the *Bear.* He saw the Lindsey Islands from the air, along with crewmen Ashley Snow and Earl Perce, on 24 February 1940 (Hawthorne, 1945). The flights made about this time revealed 800 miles of new coastline and more than 100,000 square miles of new land.

The twelve Lindsey Islands, located at 73°37′ S by 103°18′ W were officially named in early 1960 (Bertrand, 1971) for Alton A. Lindsey of Byrd's second antarctic trip by the U.S. Board of Geographic Names on the recommendation by its Advisory Board on Antarctic Names. Various other features were also named for certain members of the Ice Parties of Byrd's first (1928-30) and second antarctic trips. In practically all cases, the individual has never seen the feature named for him. Lindsey (1983) first heard of the namings by chance in 1963.

Before assuming the vertebrate zoologist post for BAE II in 1933, Lindsey was a graduate teaching assistant at Cornell University with a Ph.D. Committee consisting of zoology professors Arthur A. Allen, James G. Needham, and A.H. Wright and botanist Arthur J. Eames. During summers, Lindsey was employed by the National Park Service at Mount Rainier as a ranger-naturalist, museum collector, taxidermist, and summit guide. On heading south in October 1933, he was 26, the average age of the 56 Ice Party members. The thirteen months of zoological work at Little America II, 1,010 miles west of the Lindsey Islands, resulted in five journal articles (Lindsey, 1937, 1938, 1939, 1940; Siple and Lindsey, 1937).

POST-DISCOVERY HISTORY

The information in this section was obtained in 1993-94 from interviews and correspondence with the persons credited herein.

The first humans to set foot on any of the Lindsey Islands were topographic engineers Karl Eissinger and the late Klaus Anderson, who landed on 7 December 1968. They constituted, that summer, one of the two surveying teams of the ongoing Pine Island Bay Project of the U.S. Geological Survey, with tactical support by the Navy. The two men and two assistants established Station Frieda (named for Eissinger's mother) at the highest point (123 feet) on Lindsey 1, sinking a bench-mark into the granite and erecting signal panels at several stations to guide aerial photography.

The 1973-74 summer was an ice-bound one, and a research ice-breaker failed to reach the Lindsey Islands, as did others in 1960, 1982, and 1994. However,

the 1974 aerial photography of the largest island resulted in the issuance that year of J.M. Metzgar's 1:5000 scale, 2-foot-contour U.S.G.S. map "Lindsey Island No. 1, Antarctica." The map shows the two unfrozen fresh-water ponds and associated stream systems evident on the airphotos.

In the summer of 1974-75, a helicopter from the Coast Guard ice-breaker *Burton Island* landed surveyors E. George Schirmacher and Tony Malva-Gomes on Lindseys 1 and 2. On 16 February 1975, they worked three hours ashore followed by nine hours the next day. They established, and tied together and with Station Frieda, three stations on Lindseys 1 and 2, which were adequate for photogrammetric compilation. Meanwhile, Coast Guardsmen were setting up on Lindsey 1 a Jamesway hut and an automatic weather station alongside the southern pond.

On 2 March 1992, the South Pacific Rim International Tectonic Expedition (SPRITE) reached the Lindsey Islands by the research vessel *Polar Sea* (SPRITE Group, *et al.,* 1992). Six geologists and a mountaineer studied the ground on Lindseys 1 and 2, and some of them became the first persons to go ashore on the southwestern subgroup. Geologist S.B. Mukasa of the University of Michigan has since studied his crushed rock specimens in the laboratory, paying special attention to the mineral zirconium silicate, $ZrSiO_4$.

In the early months of 1994, the 309-feet-long research icebreaker *Nathaniel B. Palmer* cruised for 50 days in support of strictly oceanographic studies in the Amundsen and Bellingshausen Seas. Stan Jacobs, aboard for work on icebergs and ocean currents, radioed this writer on 17 March as follows: "A few days ago we broke through a belt of sea ice northwest of Thurston Island and made a round trip to Pine Island Bay past the Lindsey Islands. This is typically a difficult region to get into — the large German icebreaker *Polarstern* was unsuccessful a few weeks ahead of us. The rough and shallow topography along that coast, with few previous soundings and ours obscured by the noise of breaking sea ice, made the going treacherous. I attempted some pictures as we approached your islands, but they were compromised by the ship's distance, the islands' low profile and the unfortunate all-hands muster at the critical time. It was...night when we returned past them...."

From an artist aboard, Alan Campbell, came this word-picture dated 13 March, also depicting conditions around the Lindsey Islands: "What a wonderland, cruising in a clear track between pack-ice to starboard and the glacier-covered King Peninsula to port. These are largely uncharted waters, and in addition to many of the landforms being misplaced by as much as 30 miles on the maps, the water's uncertain depth is also a concern.... We have already come close on several occasions earlier today. When I ask Harry for a fix on our position, he smiles and points to a spot, 'According to this chart, we are cruising across the top of the peninsula right now! What a ship!' The Captain has expressed his concern for proceeding into Pine Island Bay under these conditions, and the earlier comment by the second mate regarding a supply of food and fuel sufficient for a year should we get beset, well, let's just say it has aroused a lot of discussion. Ahead, mirages play across the horizon.... Incredible, absolutely incredible!"

At 6:00 a.m. on 14 March, the ship was finally in [Lesser] Pine Island Bay and completely surrounded by icebergs, many with ice caves and heavily crevassed.

GEOGRAPHY AND MAP CHANGES

The first useful airphotos showing the Lindsey Islands were taken by the U.S. Navy in 1946-47. Others followed in 1960 and in 1974-75 during the extensive Pine Island Bay Project. Mainly due to the latter effort, nine small-scale (1:250,000) maps were produced, which do not satisfactorily depict the small islands. Some icebergs were mapped as islets. The new sketch-map (Figure 1) corrects the number and shape of the islets in the two Lindsey subgroups.

The SPRITE Group, *et al.* (1992) wrote, "The main drainage glacier [Pine Island Glacier] of the Pacific margin of Antarctica flows into Pine Island Bay." These names, and those of some other coastal features including Canisteo Peninsula, were given to honor support ships. Pine Island Bay as originally named is of the same order of magnitude as the next two bays to the north, Cranton Bay and, just north of the Lindsey Islands, Ferrero Bay. The SPRITE Group, *et al.* (1992) stated: "Strictly speaking, the name 'Pine Island Bay' applies only to the small bay at the mouth of Pine Island Glacier. The name is widely used, however, for the major indentation in the coastline of West Antarctica at the eastern end of the Amundsen Sea." The Lindsey Islands border the latter inclusive embayment, which is here informally called (Figure 2) "Greater Pine Island Bay," until an official naming agency clears up this confusion.

Comparing various small-scale maps, including whole-continent satellite image maps, brings out the difficulties that beset interpretation of the coast in the Pine Island Bay region. A 1978 map (1:250,000 scale), based on 1966 tricamera airphotos and revised from 1972-73 NASA satellite imagery, shows a prominent "Thwaites Iceberg Tongue" (sic) forming the western edge of Greater Pine Island Bay (Figure 2). The Ice Tongue is shown as a large island instead of as a peninsula (but it is given the same name) on a 1987 whole-continent map prepared by the National Geographic Society. The same feature is shown (indistinguishably from land) on a 1988 U.S. government satellite image Antarctica map (reproduced in the journal *Odyssey* for January 1994) as a prominent peninsula 160 miles long (Figure 2, dashed line).

On the 1989 Oblique Maps of Antarctica by Tau Rho Alpha, Thwaites Ice Tongue is replaced by a short stub without commitment whether land or ice. But the protrusion is entirely omitted (Figure 2, solid line) from the magnificent Satellite Image Map of Antarctica (1991, 1-2284), although the far smaller Demas Ice Tongue is shown. Stan Jacobs states, "The 150 mile peninsula . . . is mostly sea ice and icebergs, at the former site of Thwaites Glacier tongue. It broke off in the late 1960s but most of it is grounded nearby as Iceberg B-10." Whether island, peninsula, or neither or whether it consists, above sea level, only of ice or of both ice and land, it is not navigable by ship. Thus, for practical purposes, the Thwaites Ice Tongue determines the size and form of Greater Pine Island Bay (one of the few major indentations of the antarctic coastline), facts lost by omitting the barricade from maps.

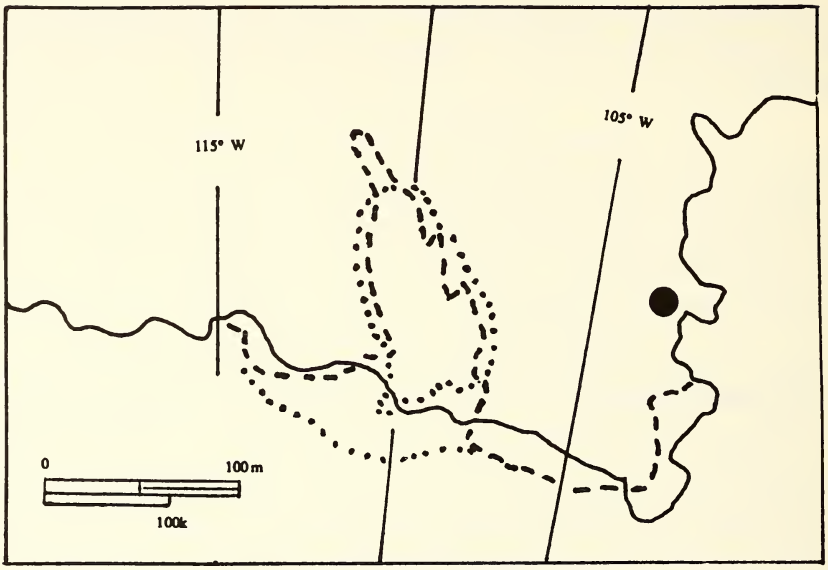

Figure 2. The Greater Pine Island Bay region of the Amundsen Sea and Walgreen Coast. The solid line represents the coastline as given on the 1991 Satellite Image Map of Antarctica. The dashed line depicts the Thwaites Ice Tongue on the preceding (1988) satellite image map of the whole continent. The dotted lines indicate the identically named feature drawn as an ice-island on the National Geographic Society whole continent map of 1987. Without this Thwaites mass, Greater Pine Island Bay appears much larger and indefinitely bounded westward. The original (Lesser) Pine Island Bay is shown differently (lower corner) on the two satellite image maps. The large dot is just seaward of the Lindsey Islands group (see Figure 1).

GEOLOGY

The Lindseys and nearby island groups are emergent portions of a shelf generally less than 600 feet deep. Farther seaward is a long trough more than 3,000 feet deep, believed to bound adjoining major blocks of the earth's crust which have existed since the Gondwana supercontinent broke apart in the Mesozoic. The geological information here is condensed from the report of the SPRITE Group, *et al.* (1992).

A pink megacrystic granite, locally rich in garnets, is the base rock of the Lindseys. These massive, coarse-grained biotite-hornblende granitoids contain pink feldspar. The northern subgroup is distinctive in containing conspicuous "black" strips and patches of dark gray granite as much as 15 feet across, clearly evident in airphotos from 4,000 feet.

Massive dikes of gabbro and quartz diorite 15-30 feet thick make up 30 per cent of the exposed rock. They dip very steeply to the north, striking east-west. These dikes weather and erode more readily than the base granite. Under a pocket stereoscope, through the vertical exaggeration of the technique, they give dramatic images of large ridges and troughs, which alternate quite regularly. The effect produced is like that of recurrent soft and hard sedimentary strata, tipped

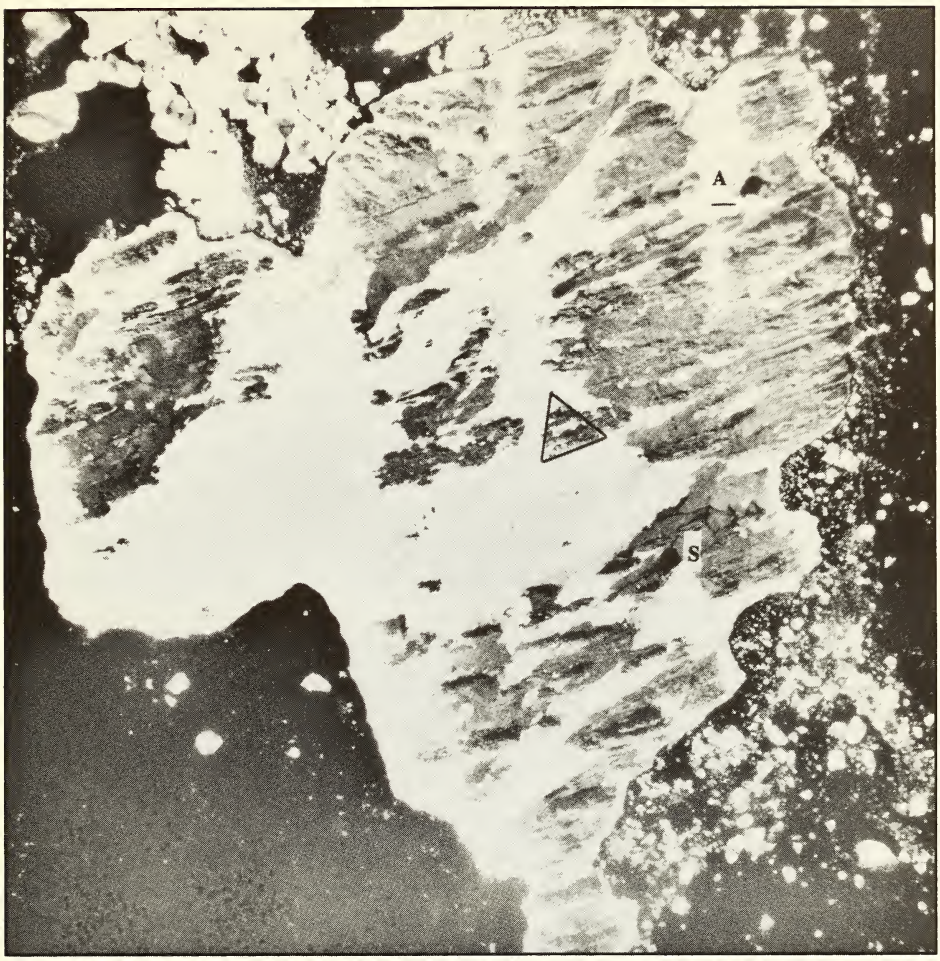

Figure 3. This U.S. Navy airphoto of Lindsey Island 1, taken on 14 January 1974 with minimal snow and ice cover, shows the ridged topography. The triangle pointing upward to the north encloses the major triangulation station "Frieda" and a point located precisely by the Global Positioning System. The letter "A" marks the northern fresh-water pond. The "S" marks the site of the second pond, where expeditions headquartered, placed an automatic weather station, and erected a Jamesway hut. Pine Island Bay Project airphoto TMA 2421,0115.

up to be seen edgewise, and differentially eroded (Figure 3). Their presence readily shows why the surveyors found hiking cross-country more feasible than driving the small machines carried in the helicopters.

In the southwestern subgroup, a 1.5 foot wide felsic porphyry cuts across both the granite and an east-west basalt dike, which are of equal thickness.

BIOLOGICAL OBSERVATIONS

The 1968 observations revealed the first breeding colony of any penguin species reported along the entire stretch of the Eights and Walgreen Coasts.

Adelie rookeries occupy the Lindseys and nearby island groups. The rookery on Lindsey 1 was photographed by Eissinger on 7 December and shows eggs being incubated. Access to the nests was favored by the scarcity of fixed sea-ice along the shore. In the absence of rounded pebbles, the Adelie nests were mounds of angular, walnut-sized fragments of dark granite, which had probably served for centuries. A flying oceanic bird, the South Polar Skua (*Catharacta maccormicki*), was breeding in a rookery adjacent to the penguins and preying on penguin eggs and chicks. On this summer day of scattered clouds, the air temperature was +22° F at Station Frieda, 123 feet above sea level.

The first three expeditions commonly observed leopard seals killing penguins offshore. The men were careful to give these agile carnivores a wide berth.

The 1975 survey team on Lindsey 1 saw a group of southern elephant seals (*Mirounga leonina* L.), and in 1992, the next party ashore (SPRITE Group, *et al.*, 1992) reported "thirteen females" with a well-developed wallow. None of these observers was a biologist. Stray individuals and small groups of young males are commonly reported, some as far south as the continental coast (Readers Digest of Australia, 1985). Females wander much less from the breeding colonies, and the group of thirteen was extraordinarily far south for females, if they were indeed such rather than subadult males.

Strangely, the two common antarctic pinniped species, the Weddell and crab-eater seals, were not reported in the Lindsey group. No plant life has been noted, and none appears in photographs, but in much worse climates on the mountains of Marie Byrd Land at 78° S Lat., foliose lichens up to 6 inches in diameter are found.

ACKNOWLEDGMENTS

Thanks are extended to the U.S. Department of the Interior, to Elizabeth, David, and Louise Lindsey, and Meredith F. Burrill, Stan Jacobs, Mark Rockmore, and Ruth J. Siple. The author is especially indebted to these members of the three expeditions which went ashore to study the Lindsey Islands: Ian Dalziel, Karl Eissinger, Charles Morrison, Samuel B. Mukasa, and E. George Schirmacher.

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