During the coming field season we hope to investigate blue ice patches somewhat farther north along the interface zone between the polar ice plateau and the Transantarctic Mountains.

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Geologic studies in the South Orkney Islands: R/V *Hero* Cruise 77-1, January 1977

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R/V *Hero* departed Puerto Belgrano, Argentina, on 5 January 1977, bound for the South Orkney Islands. Geologic work was performed 12 through 31 January 1977 on Corona-

*Alphabetical order.

tion, Powell, Fredriksen, Michelsen, and Laurie Islands, as well as the Robertson, Saddle, Weddell, and Inaccessible Islands (figure 1). The ship returned to Ushuaia, Argentina, via Palmer Station on 10 February 1977.

The purposes of the voyage were (1) to conclude structural investigations of the so-called "basement" (i.e., probable pre-Jurassic) rocks of the South Shetland and South Orkney Islands initiated by Dalziel in 1968-1969 as part of the U.S. Scotia Arc Tectonics Project (see Dalziel, 1975, 1976, and Dalziel *et al.*, 1975); (2) to augment the collections of metamorphic and igneous rock from Coronation and other islands available for petrologic study (Thomson, 1971, 1973 and 1974); (3) to investigate the Mesozoic rocks of the South Orkneys as part of a program initiated by Elliot in 1974-1975 to study the late Mesozoic and Cenozoic evolution of the Antarctic Cordillera by means of sedimentary deposits of that age (Elliot *et al.*, 1975); and (4) to augment the somewhat meager collections of fossils from the South Orkney Islands (Thomson, 1975; Thomson and Willey, 1975).

"Basement" rocks. Two tectono-stratigraphic units of possible pre-Jurassic age are exposed along the Antarctic Peninsula and on the islands of the South Scotia Ridge, a metamorphic complex and a highly deformed but otherwise unmetamorphosed sedimentary complex consisting predominantly of greywacke and shale. The latter is known as the Trinity Peninsula "Series" in the Peninsula, the Miers Bluff Formation in the South Shetland Islands, and the Graywacke-Shale Formation in the South Orkney Islands (see Dalziel and Elliot, 1973). The graywacke and shale complex is here taken together with the metamorphic complex to constitute the geologic "basement" of the region. This is in keeping with usage in southern South America.

Prior to 1971, knowledge of the "basement" rocks of the South Orkneys was based on the extensive, but primarily lithologic, observations by members of the British Antarctic Survey on Signy, Coronation, Powell, and Fredriksen Islands (see Thomson, 1968, 1973, 1974). The present investigations, taken with work on Laurie, Fredriksen, Powell, and Signy Islands in the course of R/V *Hero* cruise 71-1 (Dalziel, 1971), enables the completion of a lithologic and structural map of the "basement" of the entire South Orkneys group. It is now clear that the South Orkney Islands, including the Inaccessible Islands, all have geologic affinities with Livingston, southern Elephant, and Gibbs Islands of the South Shetlands, rather than with the blueschist terrain of Smith, northern Elephant, and Clarence Islands (Dalziel, 1976; see figure 2). A major step forward in the understanding of Antarctic Peninsula-South Scotia Ridge geology was made during the present cruise with the recognition of a lithologic and structural transition along the west coast of Powell Island between the overlying Greywacke-Shale Formation of Laurie, Fredriksen, Powell, and the Saddle and Weddell Islands, and the underlying metamorphic complex of Coronation and Signy Islands.

Collections were made from the mafic dikes cutting the

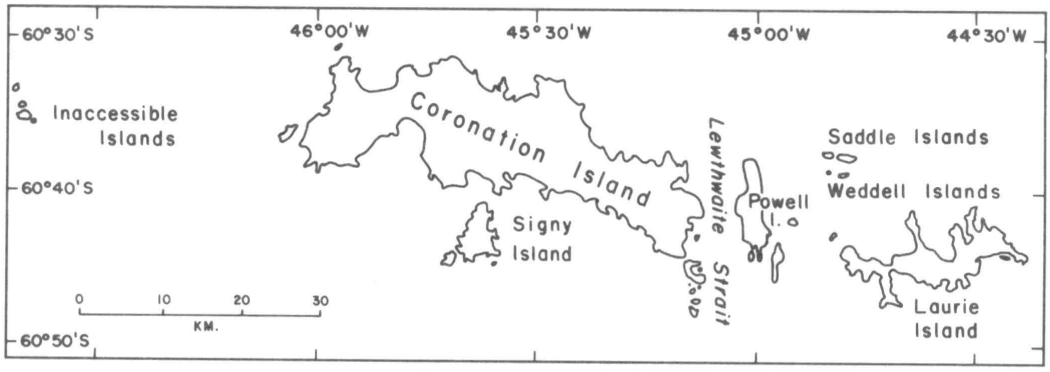

Figure 1. Location map of the South Orkney Islands.

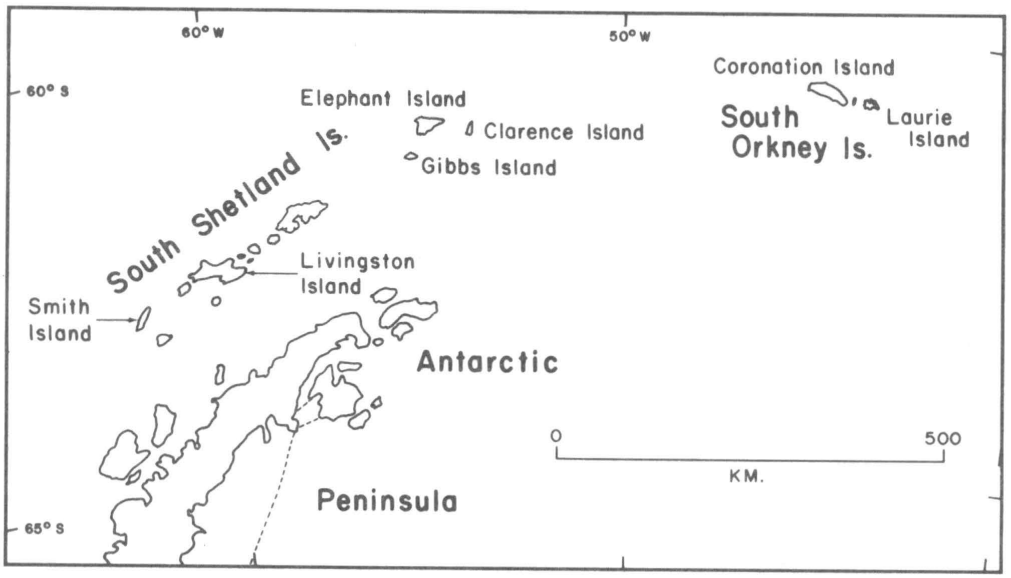

Figure 2. Location map of the northern Antarctic Peninsula, South Shetland Islands and South Orkney Islands.

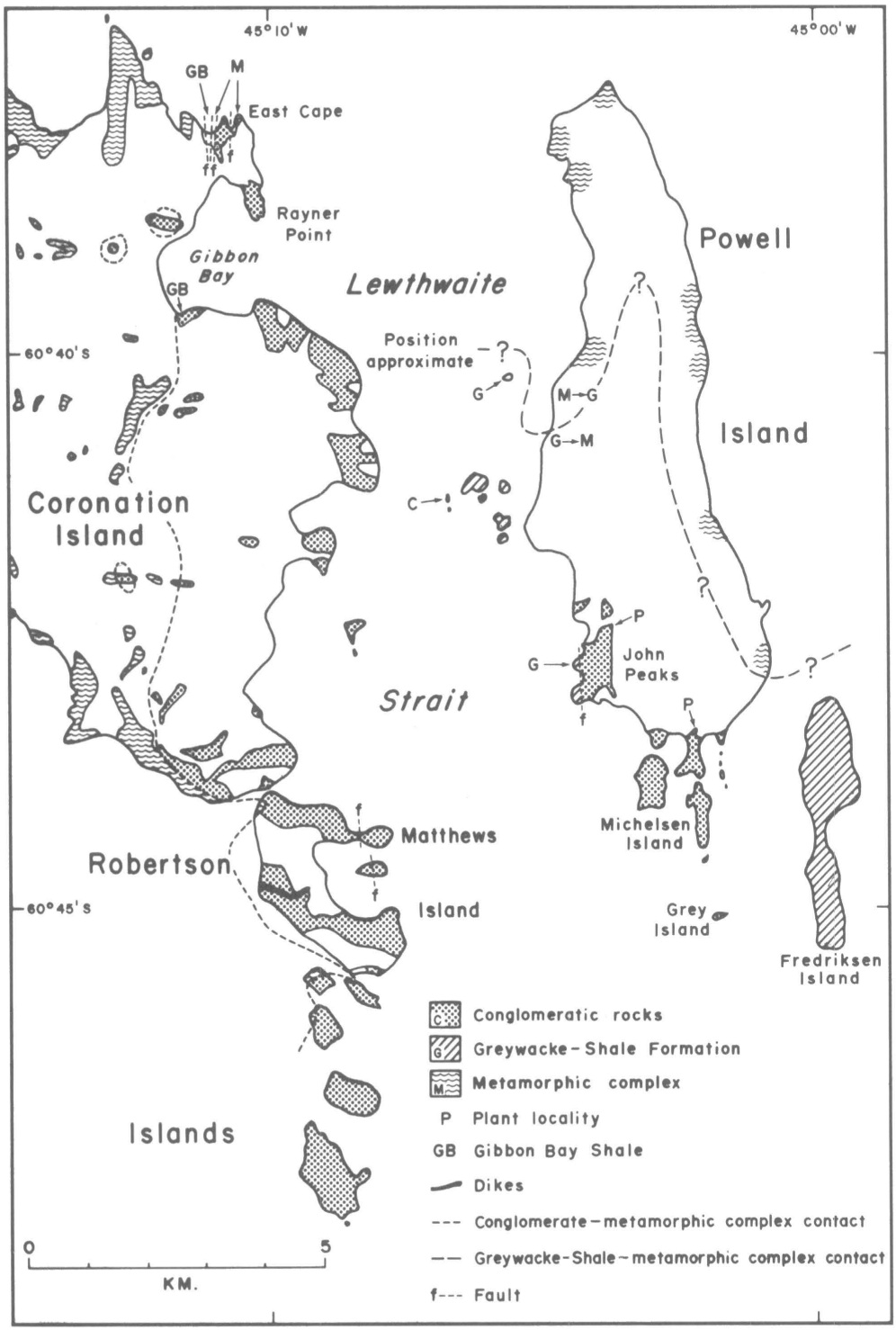

Figure 3. Geologic sketch map of the Lewthwaite Strait area, South Orkney Islands. On Powell Island the letter symbols M→G and G→M are used to represent rocks transitional from the metamorphic complex to the Graywacke-Shale Formation and vice versa; see text for explanation.

metamorphic rocks of Coronation Island for paleomagnetic study, as well as from the "basement" complexes as a whole for petrologic, structural, and radiometric work. Outcrops visited for the first time along the northern and western coasts of Coronation Island consist of metamorphic rocks comparable with those occurring elsewhere on the island (Thomson, 1974). At most of the new localities the typical rock-type is a grey micaceous schist. However, marbles and interlayered garnetiferous rocks were noted at three of the localities and hornblende-garnet schists at a fourth.

Mesozoic rocks. The primary objective was to establish the relations of the Mesozoic strata (see Thomson, 1971, 1973, 1974) which crop out adjacent to Lewthwaite Strait (figure 3) to the evolution of the Antarctic Codillera and its extension in the South Orkneys. Investigation of the sedimentology of the Mesozoic conglomeratic strata showed that at least five sedimentary facies are present and allows the recognition of the sequences as alluvial fan deposits. Those on Powell and adjacent islands were derived from the north and east, and in their composition reflect the occurrence of

the pre-late Mesozoic Greywacke-Shale Formation to the east. Those on the Robertson Islands and eastern Coronation Island were derived mainly from the metamorphic basement rocks to the west. The alluvial fans probably are related to Mesozoic fault block tectonics, in which inferred north-south trending graben faults would have been important.

Field observations have allowed some slight revision to the previously published geologic maps, and these changes are incorporated in figure 3. New localities at which the unconformity below the conglomeratic beds is exposed were observed on several islands south of Matthews Island and at East Cape. A new outcrop of the Gibbon Bay Shale was found just west of East Cape.

Dating of the sequences is important, but it is not possible from field observations alone to improve on the present rather imprecise age assignments based on limited fossil evidence (Thomson, 1975; Thomson and Willey, 1975). Laboratory studies of fossil plants from two localities on southern Powell Island (figure 3), and rare ammonites and belemnites from Matthews Island may clarify the ages of these rocks. In addition, new collections were made of fossiliferous "calcareous grit" boulders that occur in the conglomerates at Rayner Point, and of the invertebrates from the Gibbon Bay Shale which underlies the conglomerate. The discovery of ammonites and belemnites in the shale should, it is hoped, provide a more accurate age assessment than has hitherto been possible. Bulk samples were also taken for processing for microfossils.

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