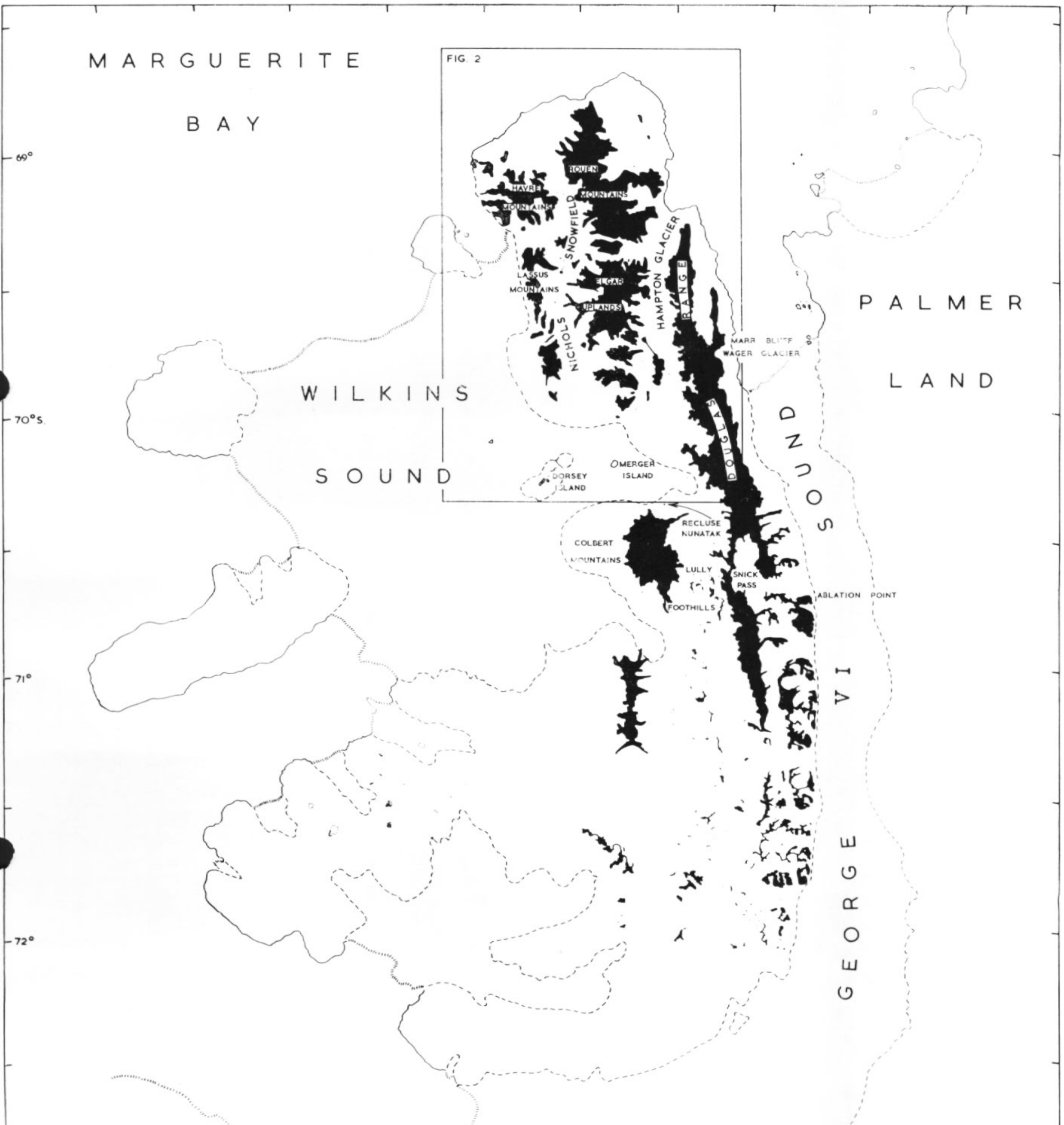

Fig. 1. Sketch map of Alexander Island showing the location of the area discussed in this paper.

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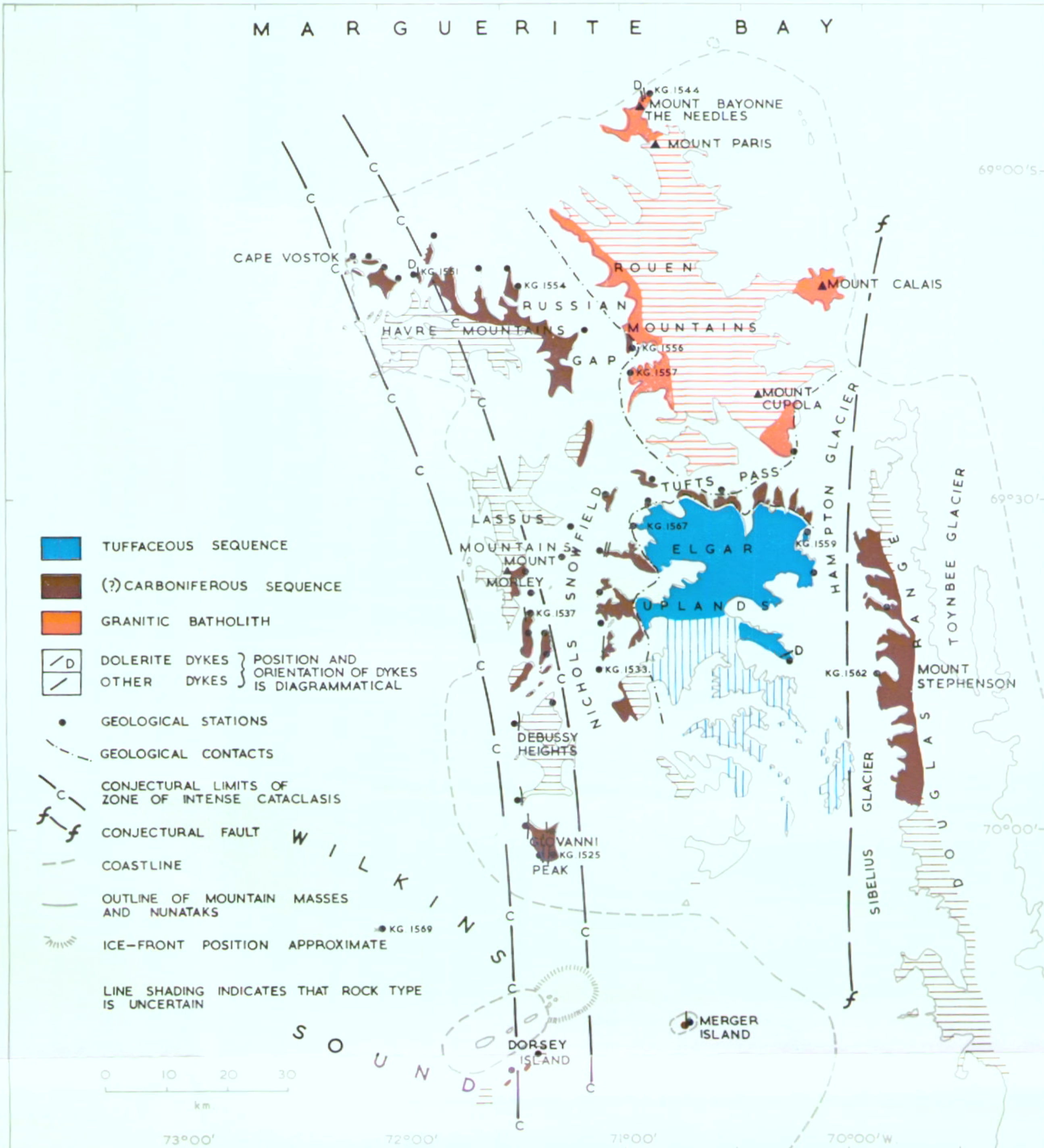


Fig. 2. Geological sketch map of northern Alexander Island.

GEOLOGICAL OBSERVATIONS IN NORTHERN ALEXANDER ISLAND

By C. M. Bell

ABSTRACT. The oldest rocks in northern Alexander Island are a sequence of tightly folded and cataclastically deformed sedimentary rocks of possible Carboniferous age. These rocks were intruded by dykes of adamellite and quartz-hornblende-porphyry, and a large batholith of granodiorite and granite. Unconformably overlying these older rocks is a sequence of relatively flat-lying tuffs and agglomerates of possible late Cretaceous age. The youngest rocks are thin vertical dolerite dykes of probable Tertiary age.

THE mountains of northern Alexander Island were first sighted by T. von Bellingshausen in 1821; in subsequent years broad belts of pack ice, high ice cliffs and steep glaciers thwarted attempts to visit all parts of the island except the eastern coast adjacent to George VI Sound. The north-eastern coast was first visited in 1947 by members of the Ronne Antarctic Research Expedition (Nichols, 1955) and in 1948 two localities north of Wager Glacier were visited by members of the Falkland Islands Dependencies Survey (Adie, 1954). The interior and north-western parts of Alexander Island remained virtually unknown, except for parts of the Colbert Mountains, Lully Foothills and western LeMay Range which were briefly visited by G. E. Grikurov in 1964–65. In 1969, geophysical investigations were begun in this area and during the summer of 1970–71 the author accompanied F. M. Burns and A. N. Bushell into northern Alexander Island. A reconnaissance geological study of parts of this large area was made. Some observations from the air have been used to extend the area mapped.

Distant observations from near Marr Bluff (east of the Douglas Range) suggested to Nichols (1955) that the country rock consisted of diorite, intruded both by thin white dykes of granite and granodiorite and numerous vertical black dykes. Nearby, layered probable sedimentary rocks with steep dips were believed to be older than the intrusive rocks. Approximately 30 km. to the north, Nichols observed a faulted sequence of unfossiliferous sandstones and conglomerates.

Highly sheared tuffaceous andesite with variable dips and strikes was observed at two localities north of Wager Glacier by Adie (1954), who also described a quartz-muscovite-schist from glacial detritus in an ice cliff in the north-eastern part of the island. Adie (1964) later suggested that the greater part of northern Alexander Island was composed of "basement" schists and that the high Douglas Range was a massive intrusion, probably of Andean diorites and granites. Similarly, observations from the air suggested to King (1964) that rocks of the Andean plutonic suite formed the western Douglas Range and that "basement" gneisses cropped out in the northern parts of the Rouen Mountains. King also observed probable volcanic rocks in the "western massifs" [Elgar Uplands].

PHYSIOGRAPHY

The area of northern Alexander Island described here lies between lat. 68°45′ and 70°15′S., and long. 70° and 72°15′W. (Fig. 1). It includes Dorsey and Merger Islands and parts of the Havre, Lassus and Rouen Mountains, Debussy Heights, Elgar Uplands and north-western Douglas Range. High linear mountain ranges fringed by extensive ice piedmonts are separated by relatively low glaciers and snowfields.

The first account of the geomorphology of Alexander Island (King, 1964) was based both on observations from the air and the reconnaissance topographical map prepared by Searle (1961). King described what he considered to be the remnants of a late Cenozoic denudational land surface in northern Alexander Island which had been tilted towards the south. Block faulting oblique to George VI Sound was believed to have caused much of the present-day morphology of the island.

Mountain ranges in the north of the island are divided by snowfields and glaciers, probably eroded along major north–south faults parallel to George VI Sound (Fig. 2). From west to east the ranges include:

i. The Havre and Lassus Mountains, Debussy Heights and Dorsey Island.

ii. The Rouen Mountains and Elgar Uplands.
iii. The Douglas Range.

Between these mountain ranges are the snow-filled valleys of Russian Gap–Nichols Snowfield and Hampton and Sibelius Glaciers. Another parallel gap, occupied by Toynbee Glacier, separates the Douglas Range from the mountains farther east.

The magnificent snow-covered mountains of the Douglas Range (Fig. 3) form a 15 km. wide chain which reaches its highest point at Mount Stephenson (2,990 m.). The northern parts of this range consist of tightly folded, resistant arkosic arenites and mudstones which have been eroded along steeply inclined bedding planes into unnumerable sharp ridges and gullies. The highest peaks have an accordant summit level with a gentle southward dip. This range is bounded on the west by a fault first described by King (1964), who observed different rock types on either side of Hampton Glacier. This near-vertical fault has a downthrow of at least 2,000 m. on the west.

Fig. 3. Aerial view of the west side of the Douglas Range. Note the accordant summit level.

The northernmost range on the island is formed by the great granite batholith of the Rouen Mountains, which includes Mount Paris (3,000 m.) and an easterly extension towards Mount Calais. The range has a relatively flat summit plateau but the flanks are deeply incised by glacial erosion and the northern and eastern spurs have been eroded into spectacular arêtes and pinnacles. A low gap named Tufts Pass separates the Rouen Mountains from the Elgar Uplands. The Elgar Uplands and associated ridges farther south have a summit plateau at about 2,000 m. resulting from the erosion of relatively flat-lying volcanic rocks.

Tightly folded, resistant sedimentary rocks form steep-sided ridges and isolated nunataks in the western and southern Elgar Uplands and Nichols Snowfield. The northern and eastern sides of the Havre and Lassus Mountains and Debussy Heights also consist of resistant, sheared and mylonitized sedimentary rocks intruded by small plutonic bodies. At Cape Vostok, marine erosion of the mylonite has formed sea stacks and small rocky islands. The north–south

alignment of valleys and ridges in the northern Havre and Lassus Mountains is probably controlled by strongly developed cleavage planes and minor faults.

General Stratigraphy

The stratigraphy of northern Alexander Island is given in Table I. The oldest rocks so far discovered in northern Alexander Island are arkosic and lithic arenites and mudstones of possible Carboniferous age and similar to those exposed in many other areas of Alexander Island (Grikurov and others, 1967; Bell, 1973). These rocks underwent polyphase deformation probably during a late Palaeozoic or early Mesozoic orogeny. They were later intruded by dykes of adamellite and quartz-hornblende-porphyry which are themselves cut by a large granitic batholith. The absolute ages of these plutonic rocks are not known but they clearly represent several distinct intrusive phases. More than 500 m. of gently folded bedded tuffs and agglomerates were deposited unconformably on a relatively flat erosional surface cut across the older sedimentary and plutonic rocks. Near the base of these volcanic rocks at the western Elgar Uplands are fine-grained carbonaceous tuffs which contain numerous but as yet unidentified plant fragments. Associated dykes of hornblende-porphyry were intruded into the underlying rocks. A specimen of tuff from a similar sequence in the Colbert Mountains was dated by Grikurov and others (1967) as 70 m. yr. old. The youngest rocks in northern Alexander Island are narrow vertical dykes of dolerite.

Table I. Stratigraphical succession in northern Alexander Island

Age	
(?) Tertiary	Dolerite
(?) Late Cretaceous	Hornblende-porphyry-tuff and agglomerate, (hornblende-porphyry dykes)
Erosional unconformity	
	Adamellite, quartz-hornblende-porphyry, granite and granodiorite
(?) Carboniferous	Arkosic and lithic arenites and mudstones

Sedimentary Sequence of (?) Carboniferous Age

Folded and cataclastically deformed sedimentary rocks are widely distributed in northern Alexander Island and in nearby Dorsey and Merger Islands and they crop out over an area of about 10,000 km.^{2}. A lithologically and structurally similar sequence in southern Alexander Island is possibly Carboniferous in age (Bell, 1973). Both of these groups of sedimentary rocks are equivalent to what has been referred to in Alexander Island as the "Trinity series" (Grikurov and others, 1967) or Trinity Peninsula Series (Grikurov, 1971), first described from the central parts of the island.

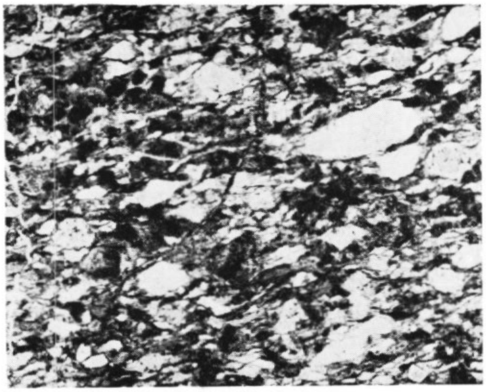
In northern Alexander Island, the sequence of tightly folded arkosic and lithic arenites and mudstones crops out in the Havre and Lassus Mountains, Debussy Heights, northern Douglas Range and in the lower outcrops of the Elgar Uplands. The same sedimentary sequence was also observed at Recluse Nunatak and Snick Pass.

A study of depositional structures and the petrology of these sedimentary rocks has been hindered by their intense tectonic deformation (Fig. 4) and extensive hydrothermal alteration. No fossils have yet been found, probably because of an unfavourable depositional environment and subsequent metamorphism. The beds are thin and of uniform lateral thickness; they seldom exhibit internal or bedding-plane structures. Rare intraformational conglomerates, consisting of small mudstone and fine-grained sandstone slabs in a sandy matrix, indicate penecontemporaneous erosion. Some thin beds of fine-grained sandstone exhibit small-scale cross laminations, and interference ripple marks probably caused by wave action were observed in sandstones at the western part of the Elgar Uplands.

Fig. 4. Crushed and sheared sandstone at Cape Vostok. The hammer shaft is 40 cm. long.

Angularity and irregular grain-size indicate that the sandstones are poorly sorted and a varied provenance is suggested by clasts of basic volcanic material and devitrified glass, together with less common fragments of quartz-muscovite-schist, quartzite, graphic granite, sandstone and mudstone. The commonest detrital minerals are quartz, plagioclase (mainly oligoclase), orthoclase, microcline, biotite, muscovite, hornblende, augite, sphene, zircon, apatite, pyrite and magnetite. Most of these minerals show hydrothermal alteration resulting in the formation of secondary sericite, epidote, penninite, calcite, prehnite, kaolinite and magnetite. Some euhedral sphene crystals are probably also authigenic.

Most of the mineral grains have been tectonically crushed and orientated (Fig. 5a). Quartz invariably shows an undulose extinction and frequently exhibits deformation lamellae; many plagioclase crystals are fractured and have bent twin planes. Elongated fragments of mica and mudstone are frequently orientated and bent between more resistant clasts. Arkosic arenites from the north-western Douglas Range (KG.1562.1) are characterized by a schistose texture, with parallel orientation and elongation of grains resulting from shearing and recrystallization in the plane of minimum stress. Sediments within a 10 km. aureole surrounding the granitic intrusions of the Rouen Mountains have been thermally metamorphosed; quartz-chlorite-schist from the western Rouen Mountains (KG.1556) consists of recrystallized quartz mosaics



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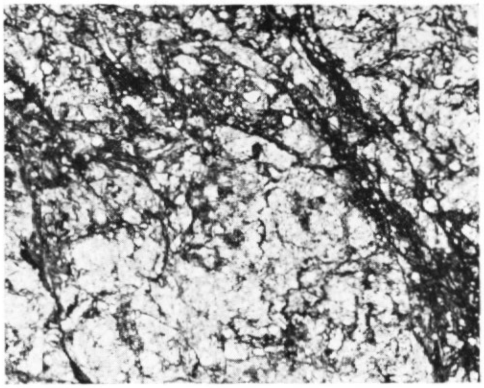

b

Fig. 5. a. Mylonite-schist with orientated mineral grains; western Douglas Range (KG.1562.1; ordinary light; ×8·5).
b. Cataclasite from the north-western Havre Mountains (KG.1551.3; ordinary light; ×10).

separated by thin bands of chlorite with scattered grains of sphene, hornblende, magnetite and epidote. Farther from the intrusions at the north-eastern Havre Mountains, thermal metamorphism of the arenites has formed a hornfels (KG.1554.1) consisting of recrystallized quartz and sericitized plagioclase with secondary tremolite, biotite and sphene.

Tuffaceous Sequence of the Elgar Uplands

A generally flat-lying volcanic sequence exceeding 500 m. in thickness was deposited unconformably on an eroded surface of the earlier (?) Carboniferous rocks in the central areas of northern Alexander Island. Deep weathering and rapid erosion have resulted in hillslopes thickly blanketed in scree and a characteristic brown iron-oxide staining. These tuffs and agglomerates together with subordinate lavas and sediments are exposed in the south-eastern part of the Rouen Mountains, the upper parts of the Elgar Uplands and west of Sibelius Glacier. The absolute age of these rocks is not known. However, Grikurov and others (1967) described a tuff with an age of 70 m. yr. from a similar ". . . horizontal, virtually tuffaceous formation, the thickness of which exceeds 1,000 m." in the Colbert Mountains.

Although the tuffaceous sequence unconformably overlies the (?) Carboniferous succession, and perhaps the adamellite and quartz-hornblende-porphyry intrusions, its exact stratigraphical relationship with the granite of the nearby Rouen Mountains is not known. The sequence is not metamorphosed and hence the tuffs are probably younger than the granite. Despite the K-Ar age determination of Grikurov and others (1967), it is possible that this tuffaceous sequence is equivalent to the Upper Jurassic volcanic rocks of Palmer Land, which also underlie a thick Upper Jurassic–Lower Cretaceous sedimentary sequence in the Ablation Point area of Alexander Island. Further geological mapping in central Alexander Island may clarify these relationships.

Near the base of a 100 m. thick sequence of bedded crystal and lithic tuffs and agglomerates at station KG.1567 are some fine-grained cherty beds rich in carbonaceous material and fragmentary plant remains. Fragments of carbonaceous wood and impressions of plant stems up to 2 m. long also occur in the coarser tuffs and agglomerates. The plant-rich strata are probably of a lacustrine origin. Cross laminations and other depositional structures are absent, except for slight irregularities in the bedding planes probably caused by ash showers. No invertebrates or trace fossils have been found.

The commonest rock types in this succession are coarsely bedded hornblende-rich tuffs and agglomerates of a probable subaerial origin. Hornblende-porphyry dykes, which intrude the tuffs, possibly formed feeders for contemporaneous subaerial eruptions. The petrology and mineralogy of the rocks are masked by extensive hydrothermal alteration. These rocks range

in grain-size from fine-grained cherty tuffs to coarse agglomerates. They are normally porphyritic with large euhedral phenocrysts of plagioclase and hornblende, together with small crystals of quartz, iron ore and zircon in a microcrystalline groundmass. Some slightly corroded hornblende phenocrysts enclose small zircons and unidentifiable alteration minerals. A porphyritic lava (KG.1559.2) from the eastern Elgar Uplands contains many quartz-rimmed amygdales, filled with calcite and a fibrous zeolite, and surrounded by concentrations of opaque iron ore microlites.

Intrusive Rocks

At least four phases of igneous intrusion have been recognized within the sedimentary rocks of northern Alexander Island:

i. Plutonic dykes and irregular bodies of adamellite and quartz-hornblende-porphyry.
ii. A batholith of granite and granodiorite.
iii. Hornblende-porphyry dykes (related to the tuffaceous sequence).
iv. Dolerite dykes.

The oldest of these are a suite of plutonic dykes of variable composition which intrude the previously folded (?) Carboniferous sedimentary rocks at Merger Island, Giovanni Peak, Debussy Heights, the western Elgar Uplands and the Lassus Mountains. They are probably unconformably overlain by the tuffaceous sequence of the Elgar Uplands. The absolute age of the plutonic intrusions is not known but they could be associated with late stages of the early Mesozoic orogeny, which probably caused the folding and cataclasis of the (?) Carboniferous succession. Vertical north–south orientated dykes of irregular size and shape consist of medium- to fine-grained rocks with porphyritic and granitic textures. Hornfelsed sedimentary xenoliths are abundant.

A vertically jointed medium-grained adamellite (KG.1527.2) at north-west Giovanni Peak has intergranular masses and myrmekitic intergrowths of quartz and plagioclase (An_{50}). Flakes of biotite are partly altered to penninite, and hornblende is largely replaced by penninite, magnetite, calcite and epidote. A large irregular intrusion of medium- to fine-grained quartz-hornblende-porphyry (KG.1537.2) south of Mount Morley is possibly the same age as the adamellite. Although porphyritic, it is mineralogically similar to a fine-grained quartz-diorite. It consists of large zoned phenocrysts and small laths of plagioclase (An_{54}) together with intergranular quartz, phenocrysts of hornblende (up to 1·5 cm. in length), magnetite and zircon. Alteration minerals include actinolite (derived from the hornblende), penninite, calcite and sericite.

Rouen Mountains batholith

The Rouen Mountains are formed of a large batholith of xenolithic biotite-granite and granodiorite. Although only three outcrops have been visited, the rocks are easily recognizable from a distance by their massive appearance, strong vertical joints and pale pinkish grey colour. The batholith extends from Mount Bayonne in the north to Mount Cupola in the south and eastward to Mount Calais, an area of at least 1,500 km.^{2}. Biotite-granite also occurs south of Tufts Pass in the northern Elgar Uplands. North of Mount Paris, biotite-granite is intruded by granodiorite, and a coarse intrusion breccia, formed by magmatic stoping, consists of large angular blocks of dark-coloured country rock in paler granite and granodiorite which exhibit distinct flow structures.

Coarse-grained granodiorite (KG.1544.4) from the northernmost cape of the Rouen Mountains consists essentially of zoned plagioclase (An_{42}), intergranular quartz and perthite. A few crystals of hornblende and large irregular flakes of biotite are partly altered to penninite and calcite. Accessory magnetite, zircon and apatite occur together with a little secondary epidote and sericite. South-west of the Rouen Mountains (KG.1557), a massive coarse-grained biotite-granite is cut by small irregular intrusions of aplite and pegmatite. The granite consists of irregular masses of quartz enclosed in kaolinitized perthite, microperthite and albite. Some flakes of biotite are partly altered to chlorite and calcite. Rare accessory minerals include magnetite, apatite, zircon and tourmaline.

Hornblende-porphyry dykes

Dykes of hornblende-porphyry are widely distributed throughout northern Alexander Island; they occur on Merger Island, Giovanni Peak, Debussy Heights, the north-west Havre Mountains, northern Rouen Mountains and Elgar Uplands. The vertical dykes are between 1 and 10 m. wide and in the Elgar Uplands they are probably feeders for the overlying tuffs, agglomerates and lavas. At station KG.1533, a dyke with abundant sedimentary xenoliths is zoned parallel to its walls; its porphyritic texture and numerous amygdales suggest near-surface intrusion. Although the rocks are only slightly metamorphosed, most of the minerals are difficult to identify in thin section because of extensive hydrothermal alteration. The hornblende-porphyry commonly has euhedral phenocrysts of zoned plagioclase (An_{60}) some of which are flow orientated, together with large, euhedral zoned phenocrysts of hornblende. The hornblende crystals often have corroded margins and enclose laths of plagioclase. Small anhedral quartz crystals are scattered in a fine-grained or microcrystalline groundmass. Alteration minerals frequently pseudomorph the ferromagnesian minerals; they include penninite, calcite, epidote, sericite, prehnite and magnetite. In specimen KG.1533.4 embayed quartz crystals are surrounded by zones of radiating microlites formed by reaction with the groundmass.

Dolerite dykes

Narrow dolerite dykes of probable Tertiary age represent the latest phase of intrusion in northern Alexander Island. They intrude the (?) Carboniferous sedimentary rocks in the northern Havre Mountains, granite and granodiorite in the northern Rouen Mountains and the tuffaceous sequence in the south-east Elgar Uplands.

Porphyritic dolerite (KG.1544.1), which intrudes the granites of the northern Rouen Mountains, has undergone extensive hydrothermal alteration. Phenocrysts of sericitized plagioclase (An_{54}), augite (altered to hornblende and actinolite) and magnetite, together with patches of calcite, are enclosed in a cryptocrystalline groundmass. A 1 m. wide, east–west orientated dolerite dyke (KG.1551.4) intrudes mylonitized arenites at the northern Havre Mountains. It has a porphyritic intergranular texture of labradorite, pigeonite and magnetite together with secondary calcite and pale green antigorite. The amygdales are filled with calcite and rimmed with radiating antigorite.

A specimen of amygdaloidal augite-hornblende-porphyry (KG.1569.1) of unknown age and association was collected from a small island 25 km. north-west of Dorsey Island.

Structural Geology

The rocks of the (?) Carboniferous sedimentary succession in northern Alexander Island have been subjected to polyphase folding and extensive cataclastic deformation. The folding is probably related to an early Mesozoic orogeny which affected similar successions in the northern Antarctic Peninsula and South Shetland Islands (Horne, 1969; Dalziel, 1971). All occurrences of the sediments are tightly folded but the folds are generally too large for the orientations of their axes and axial planes to be easily measured. Bedding planes dip steeply towards the south-west (Fig. 6a) but in most areas intense cataclasis has destroyed the depositional structures. Re-folded fold axes and axial planes indicate at least two phases of folding, and irregularly orientated cleavage planes (Fig. 6b) frequently bent by small-scale kink zones suggest a third phase of deformation. The orientation of these phases of folding is not known due to the complicated fold pattern and sparse field observations.

A most significant feature of the (?) Carboniferous sedimentary rocks of Alexander Island is the extensive and intense cataclasis they have undergone (the cataclastic nomenclature used here is according to Higgins (1971)). As a result of this cataclasis, most of the sediments have been transformed into protomylonite–mylonite–utramylonite or microbreccia–cataclasite. Mylonite-schists occur in the western Douglas Range (Fig. 5a) and at Russian Gap but their higher grade of thermal metamorphism may be due, at least in part, to contact metamorphism associated with the intrusion of the Rouen Mountains batholith. Rocks in the elongated mountain range of Giovanni Peak, Debussy Heights and the Lassus Mountains were identified in the field as fine-grained basic lavas or tuffs, characterized by a massive flinty appearance and

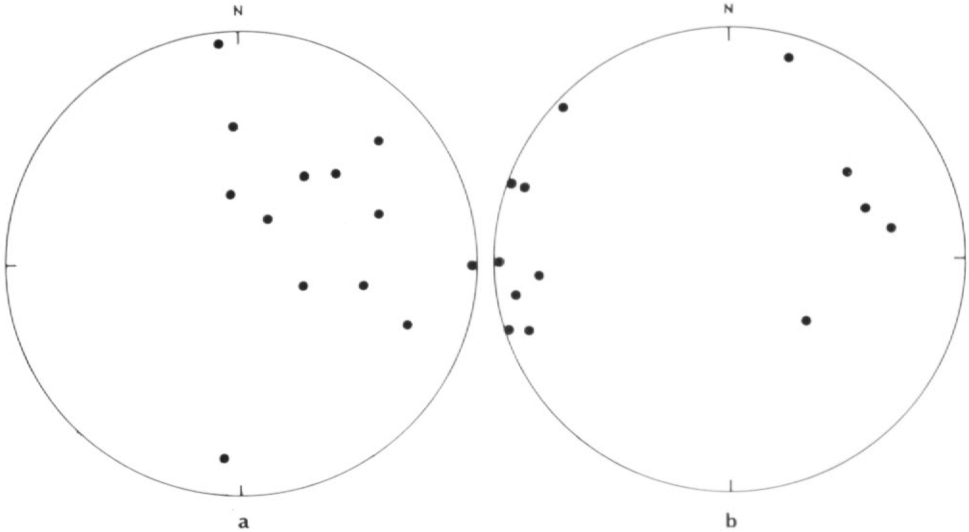

Fig. 6. a. Poles to bedding planes in sedimentary rocks of the (?) Carboniferous sequence in northern Alexander Island.
b. Poles to cleavage planes in sedimentary rocks of the (?) Carboniferous sequence in northern Alexander Island.

pale to dark grey colour. In places distinct colour laminations are reminiscent of bedded tuffs and some occurrences have abundant parallel masses of slickenside planes. In thin section, however, these unusual rocks consist of microbreccia and cataclasite formed by crushing of a sandstone rich in volcanic clasts. Specimens of microbrecciated cataclasite indicate a history of polycataclastic deformation. There are similar occurrences of microbreccia and cataclasite in the north-west Havre Mountains (near Cape Vostok) and at eastern Dorsey Island. This zone of microbreccia and cataclasite extending north–south through Giovanni Peak, Debussy Heights and the Lassus Mountains (and possibly including the north-west Havre Mountains and Dorsey Island) is at least 12 km. wide and 50 km. in length. There are too few observations for any firm conclusions to be drawn as to the extent and orientation of this zone, but similar occurrences of cataclastic rocks in southern Alexander Island (Bell, 1973) suggest that a great fault zone extends at least the length of Alexander Island and is up to 50 km. in width. Within this broad zone, however, there is a great variation in the degree of cataclasis; for example, at the northern Havre Mountains and east of Nichols Snowfield the sandstones are folded but not affected by intense crushing.

An important feature of these cataclastic rocks is the general absence of a directed penetrative texture or fluxion structure which could be useful in determining the direction and sense of movement. In some specimens of mylonite and ultramylonite, however, the orientation of the fluxion structure has been disturbed by later microbrecciation. Irregular veins of quartz, calcite, epidote and prehnite are extremely common in the cataclastic rocks; in places they comprise up to 20 per cent of the total volume of rock. Thin sections of microbrecciated cataclasite or mylonite show highly strained angular quartz and feldspar fragments in a dark grey crushed matrix with abundant euhedral grains of secondary pyrite. A dark grey cataclasite (Fig. 5b) from near Cape Vostok has numerous specks of pale green alteration minerals and a re-folded fluxion structure.

The only occurrence of cataclastic rocks on a comparable scale, known to the author, is that described by Higgins (1971) from the south-eastern United States of America. A series of parallel fault zones (the Towaliga, Goat Rock and Bartletts fault zones), totalling about 20 km. in width, extends for at least 250 km. and possibly as much as 600 km. These faults are best exposed near the southern margin of exposed Piedmont rocks in Georgia and Alabama (granites, gneisses and schists with some belts of marble and quartzite, probably mostly of

Palaeozoic age but in part of pre-Cambrian age) and all the zones are marked by thick assemblages of various types of cataclastic rocks. These fault zones were initially interpreted as thrust faults but recent interpretations suggest a polycataclastic history with three distinct periods of movement. The main mylonite zones were formed by strike-slip movement along steeply dipping planes and there is evidence that the movement on all these faults was right lateral but the amount of displacement is unknown.

The San Andreas fault zone of California ranges from a few metres to a few kilometres in width (Hill and Dibblee, 1953) with more than 1 km. of right lateral movement since Pleistocene times (Higgins, 1971). In New Zealand the Alpine fault, which could have a right lateral transcurrent movement of about 480 km., crops out as a belt of grossly sheared rocks up to 0·4 km. wide (Suggate, 1963). Sutton and Watson (1959) have also described shear belts up to 0·4 km. wide associated with relatively narrow mylonite belts in a metamorphic terrain in Tanganyika. They concluded that these belts indicated transcurrent movements deep within the crust.

This comparison with other fault zones, particularly those of the south-eastern United States, suggests that the cataclastic zones of Alexander Island represent major planes of strike-slip faulting related to large-scale crustal movements.

In striking contrast with the underlying tightly folded strata, the tuffs and agglomerates of the Elgar Uplands are gently folded with a poorly developed north–south cleavage. This cleavage is parallel to that of the Upper Jurassic–Lower Cretaceous sedimentary sequence in the Ablation Point area of eastern Alexander Island.

Major north–south faults parallel to George VI Sound are indicative of block faulting (King, 1964). These faults probably control the direction of Toynbee, Hampton and Sibelius Glaciers, Russian Gap and Nichols Snowfield, and are important factors in the morphological development of the present-day northern Alexander Island.

Regional Stratigraphical Comparisons

Both the physiography and stratigraphy of Alexander Island are distinct from those of nearby Palmer Land. Possibly the oldest rocks in Alexander Island are the highly sheared and altered andesites reported by Adie (1954, 1971) from the north-east coast. These volcanic rocks may be equivalent to the gneisses, schists and sheared volcanic rocks forming the "basement" of north-western Palmer Land (personal communication from T. G. Davies). No rocks in adjacent areas of Palmer Land are comparable with the widely distributed and abundant sedimentary and volcanic rocks of possible Carboniferous age in Alexander Island (Grikurov and others, 1967; Bell, 1973). However, some occurrences of a similar succession (the Trinity Peninsula Series) occur in the northern parts of central and eastern Palmer Land (Adie, 1969), and are abundant in north-east Graham Land (Adie, 1957; Aitkenhead, 1965; Elliot, 1966) and Livingston Island (Hobbs, 1968). Rocks of this formation were subjected to polyphase folding and metamorphism, probably during an early Mesozoic orogeny (Dalziel, 1971). A broad north–south belt of cataclastic sedimentary rocks in Alexander Island is believed to have formed in a zone of extensive transcurrent movement, which was possibly related to the late stages of this orogeny.

Intrusive rocks of a possible early Mesozoic age occur in the Antarctic Peninsula and Alexander Island. The batholith of the Rouen Mountains may represent a later Mesozoic intrusive phase. No eruptive rocks equivalent to the (?) late Cretaceous tuffaceous sequence of the Elgar Uplands have so far been described from other parts of the Antarctic Peninsula. Basic dykes of a Tertiary age, which occur in many parts of Antarctic Peninsula and in Alexander Island (Horne and Thomson, 1967; Bell, 1973), represent the final volcanic phase.

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