# BRITISH ANTARCTIC SURVEY SCIENTIFIC REPORTS

**No. 49.** A. ALLEN. A magnetic survey of north-east Trinity Peninsula, Graham Land: II. Mount Bransfield and Duse Bay to Victory Glacier. 1966. 32 pp. 26*s.* 0*d.*

THIS report gives an account of a magnetic survey of approximately 1,600 sq. miles (4,140 km.$^2$) of north-east Trinity Peninsula. The work was carried out between 1959 and 1962 as a continuation of a routine magnetic survey of Duse Bay and Tabarin Peninsula, which was completed by J. Ashley in 1959. An Askania vertical magnetic field torsion (Gfz) magnetometer was used in the field, whilst the diurnal variation of the Earth's vertical magnetic field was recorded by an Askania Gf6 magnetometer with photocell head attachment in conjunction with a Hartmann-Braun dotted line recorder.

The commonest rock group exposed in Trinity Peninsula is a succession of greywackes and shales, known as the Trinity Peninsula Series. These sediments are intruded in several areas by granites, diorites and gabbros of late Cretaceous to early Tertiary age, which are known as the Andean Intrusive Suite. Other rocks exposed in Trinity Peninsula are Middle Jurassic sediments and Upper Jurassic volcanic rocks, Miocene basaltic tuff-agglomerates of the James Ross Island Volcanic Group and (?) Cretaceous andesitic flow lavas. In the Prince Gustav Channel area the most important formation is the James Ross Island Volcanic Group.

Orientated rock samples were collected widely over the area of the magnetic survey. Particular attention was given to the collection of rocks with high intensities of magnetization, and all the accessible exposures of the Andean Intrusive Suite on Trinity Peninsula were sampled. The greywackes and shales of the Trinity Peninsula Series are effectively non-magnetic, whilst the rocks of the James Ross Island Volcanic Group have widely variable intensities of magnetization.

A fundamental assumption of the widespread existence of a batholith of the Andean Intrusive Suite beneath north-east Trinity Peninsula has been used for much of the interpretation of the magnetic survey of this area. It is suggested that the similarities between the intrusive rocks of Graham Land and those of the South American Andes, the size of the magnetic anomalies associated with these intrusive rocks, and the consistency between the results of different methods of the interpretation of different anomalies all substantiate this assumption.

Interpretation of the magnetic anomalies associated with the James Ross Island Volcanic Group has been largely restricted to qualitative observations on the occurrence of these rocks and to the postulate of a ring-dyke system on Tail Island.

The magnetic anomalies associated with the rocks of the Andean Intrusive Suite on Trinity Peninsula have been interpreted in terms of variation in the topography of the assumed batholith's roof. The results of the magnetic survey indicate the existence of a north-west to south-east set of structural trends across Trinity Peninsula, but a combination of geophysical and geological information suggests more general south-west to north-east structural trends parallel to the length of Trinity Peninsula.

**No. 54.** P. H. H. NELSON. The James Ross Island Volcanic Group of north-east Graham Land. 1966. 62 pp. 41*s.* 6*d.*

THE Middle to Upper Miocene basalts of the James Ross Island Volcanic Group were first studied by J. G. Andersson, who was geologist to the Swedish South Polar Expedition, 1901–03. Although several other geologists have more recently described specific aspects of these volcanic rocks, the present report is the first attempt at a comprehensive description and evaluation of this volcanic group.

James Ross Island, the type locality of this volcanic group, is separated from north-east Graham Land by Prince Gustav Channel. The cliff, step and table-top topography, characteristic of James Ross Island and a dozen smaller nearby islands, is described. Several common step heights have been observed at intervals of approximately 500 ft. (152 m.) above sea-level. Although it is suggested that these steps have an erosional origin, it is also pointed out that the structure of the basalts lends itself to the formation and preservation of such features. With a

few exceptions, the cliff exposures display about 500 ft. (152 m.) of palagonite-breccias (dipping asymptotically from 35°) overlain by horizontally bedded olivine-basalt flow lavas. The flow lavas are often only a few tens of feet thick, but in one place they have a thickness of 750 ft. (229 m.). The macro- and micro-textures of the flow lavas clearly demonstrate that they cooled and crystallized subaerially. However, the basalt pillows, basalt glass and other quench features of the palagonite-breccias show equally clearly that drastic chilling, probably subaqueously, was involved in their formation. Cone structures in the palagonite-breccias have been interpreted as marking individual centres of eruption or positions where large lava streams, flowing from one dominant eruption centre, reached the surrounding sea.

As well as the lava/palagonite-breccia volcanoes, in which cores of palagonite-tuff are often exposed, a few isolated ash cones composed entirely of fine-grained massive or laminated palagonite-tuffs are described. A sequence of five important phases of eruption has been observed. They are defined by five different lava/palagonite-breccia horizons and thus, it is believed, by five "fossil" sea-levels. The fifth level now stands about 2,500 ft. (762 m.) above the first, suggesting that the James Ross Island area subsided progressively during the formation of the volcanic group.

Subordinate intrusive rocks, which form part of the volcanic group, occur both in the volcanic rocks themselves and in the underlying Upper Cretaceous sediments. It is suggested that massive basalt dykes and olivine-dolerite plugs cutting the Upper Cretaceous sediments mark the sites of feeders to the eruptions. More vesicular dykes, which are often associated with palagonite-tuffs in the Prince Gustav Channel area, appear to have been injected at higher levels in the volcanoes. An analcite-bearing olivine-dolerite laccolith, which forms Palisade Nunatak near the west coast of James Ross Island, displays spectacular columnar jointing and has an interesting cooling history. Crystallization differentiation of high-temperature phases from an originally hydrous magma led eventually to the production of coarse-grained dolerite-pegmatites and, finally, highly felsitic alkali-rich veinlets. Zeolites were formed in abundance during the last stages of crystallization. From the geochemical and mineralogical peculiarities of the dolerite-pegmatites and the late-stage veinlets, it has been deduced that a dramatic increase in the water-vapour pressure of the last liquids to crystallize was responsible for the injection of the veinlets in the laccolith. Fourteen new chemical analyses of rocks from this laccolith and of extrusive basalts from several eruptive phases of the volcanic group outline a trend of initial iron enrichment relative to magnesium, culminating in the usual marked increase in alkalis relative to all other major cations. The alkali-basalt differentiation trend of the James Ross Island Volcanic Group is shown to be similar to the trends of other groups of alkaline volcanic rocks. It is also shown that this parental basalt type bears a closer resemblance to that of the olivine-basalts from Japan and Korea than to that of the Hawaiian volcanic suite. This is consistent with the geographical situation of the James Ross Island Volcanic Group in the circum-Pacific zone.

Zeolites are also described from the extrusive rocks of the group. It is shown that the zeolites which occur in the olivine-basalt lavas and palagonite-breccias have a diagenetic origin, although those in the intrusive rocks crystallized from hydrous partial magmas. Four grades of increasing intensity of zeolitization have been recognized in the extrusive rocks, and it has been found that the more intense the zeolite development the more complete is the conversion of the basalt glass to its hydrated form, palagonite. Chemical analysis suggests that sodium and potassium are leached during the palagonitization process, and that the resultant palagonite may contain 4·0 per cent of water compared with 1·5 per cent in unaltered basalt glass.

This report is illustrated with 15 text-figures and 11 plates of field photographs and photomicrographs. A coloured geological map, showing the distribution of the James Ross Island Volcanic Group, and a set of four break-down maps, showing the distribution of the rocks of the five volcanic phases, are included at the end of the report.

**No. 55.** A. ALLEN. Seismic refraction investigations in the Scotia Sea. 1966. 44 pp. 24*s*. 3*d*.

THIS report gives an account of the seismic refraction survey across the Scotia Sea between South Georgia and the South Orkney Islands, which was completed during 1959. One un-

reversed and nine reversed seismic lines were completed by the Department of Geology, University of Birmingham, in collaboration with the British Antarctic Survey and the Royal Navy.

Results on the northern part of the profile gave an almost typical mantle velocity of 8·0 km./sec., whereas a lower or sub-crustal velocity of 7·4–7·6 km./sec. was determined on the southern part. The interpretation of the survey results was hampered by some uncertainty in the velocity of the sea-bed sediments. The available methods for the determination of sea-bed sediment characteristics from reflection data are summarized and a new method, involving the ratio between the amplitudes of the first- and second-order sea-bottom reflections, has been devised.

The results of the seismic survey are discussed in terms of the origin and evolution of the Scotia Ridge, and it is suggested that this ridge was continuous with the Coast Cordillera of Chile in the north and the Antarctic Peninsula in the south until the beginning of the Cretaceous. The folding of the Sandebugten Series of South Georgia, the Greywacke-Shale Series of the South Orkney Islands and the Trinity Peninsula Series of the Antarctic Peninsula has been compared and it has been assigned an early Mesozoic age. It is suggested that an early Mesozoic cordillera stretched eastwards from Tierra del Fuego along the northern limb of the Scotia Ridge to South Georgia, the South Orkney Islands and the Antarctic Peninsula, and that the Jurassic and Lower Cretaceous rocks of these areas were deposited in shallow water on the Palaeozoic rocks of this cordillera.

During the fragmentation of the Gondwanaland supercontinent in the Cretaceous, South America and Antarctica drifted relatively south and westwards from Africa. The Falkland Ridge, which is an integral part of the South American continental block, and the part of the of the early Mesozoic cordillera, which now forms the northern limb of the Scotia Ridge, remained in the same positions relative to South America. The southern limb of the Scotia Ridge, at that time forming the eastern part of the early Mesozoic cordillera, drifted relatively farther west as a block with Antarctica and caused the rupture of this cordillera between South Georgia and the South Orkney Islands. The perpendicular trends of the foliation in the Basement Complex of the South Orkney Islands and the Elephant and Clarence Islands group are consistent with the further fragmentation of the early Mesozoic cordillera, which caused the South Orkney Islands to be separated from the Antarctic Peninsula as the latter drifted towards its present position. The observation of transcurrent faulting in the South Orkney Islands and the density of earthquake epicentres on the southern limb of the Scotia Ridge could substantiate the postulated rupturing of the eastern part of the early Mesozoic cordillera during continental drift.

Rocks of the Andean Intrusive Suite are exposed in South America, South Georgia and the Antarctic Peninsula; they were probably intruded into the early Mesozoic cordillera to form the northern limb of the Scotia Ridge between South Georgia and Tierra del Fuego. The fragmentation of the early Mesozoic cordillera between South Georgia and the South Orkney Islands caused a break in the late Palaeozoic geosynclinal belt in this area and it may be responsible for the absence of exposures of the Andean Intrusive Suite between South Georgia and Graham Land. The continuity of the "Andean orogenic belt" could be maintained by postulating the presence of a submarine volcanic arc trending between South Georgia and the South Orkney Islands to the west of the South Sandwich Islands group. The results of the seismic refraction survey in the southern parts of the eastern Scotia Sea and the postulated submarine volcanic arc are consistent with theories developed to explain similar seismic results in the Venezuelan Basin of the Caribbean Sea.

The volcanic rocks of the South Sandwich Islands are unlike those of the South American Andes. It is suggested that this group is not fundamentally related to the Scotia Ridge and that its position is best explained in terms of the zone of crustal weakness left by the fragmentation of the early Mesozoic cordillera between South Georgia and the South Orkney Islands.

**No. 58.** J. W. NEALE. An ostracod fauna from Halley Bay, Coats Land, British Antarctic Territory. 1967. 50 pp. 24*s.* 0*d.*

THIS report deals with the podocopid ostracod fauna recovered from a sample of pale grey silty sand collected from a depth of 113 fathoms (206 m.) at Halley Bay in the Weddell Sea.

Among 1,020 specimens of these tiny crustaceans obtained from the sample, 26 species were represented and three of them were new to science.

In the taxonomic section the two new genera *Antarcticythere* and *Myrena* are described and their affinities discussed. *Antarcticythere* is closely related to *Bythocythere* and the soft parts need fuller examination, the genus being based principally on the nature of the valves which cannot be fitted easily into any of the genera so far described in the subfamily Bythocytherinae. *Myrena* is a new genus allied to *Loxoconcha* and it is based entirely on the hard parts, the hinge structure and ornament differing from the latter genus. This genus is also found in the Lower Miocene and looks as though it may prove of considerable use to Tertiary stratigraphers engaged in working out the phylogeny of the large group of loxoconchids. It is to be hoped that the author will find material on which to study and describe the soft parts of this genus in the near future.

All the 26 species of ostracod encountered are fully examined and figured, and the new species *Loxocythere frigida*, *Cativella bensoni* and *Robertsonites antarcticus* are established. The fairly full comparisons and discussion of affinities and differences are perhaps the most valuable part of this section of the report and should be of considerable value to other workers in this field. Typical austral genera such as *Bythoceratina* and *Loxocythere*, which are well known from the New Zealand area, are found to be present, as well as northern genera such as *Robertsonites*, a genus based on an Arctic species from the Quaternary of Alaska. Among the three species of *Cytheropteron* is *C. antarcticum* Chapman. The two specimens of this rare form validate Chapman's recognition of this as a separate species and enable it to be compared and interpreted in relation to the other species. A search failed to reveal the whereabouts of Scott's specimens from the South Orkney Islands but an attempt is made to interpret some of them. It is shown that Scott's *Cytherura ornata* is the same as *Hemicytherura anomala* (Müller), the apparent differences being due to the fact that when drawn Scott's specimen must have been tilted slightly away from the artist. The author is obviously less happy about the interpretation of most of Scott's other new species.

Of particular interest is the examination of *Pseudocythere caudata* and identical or closely related forms from various regions ranging from the Arctic to the high Antarctic and the demonstration that on the hard parts alone the Antarctic specimens cannot be satisfactorily differentiated from those from the Arctic. Limbs and soft parts from the Antarctic were not available but a dissection of *P. caudata* from Norway casts doubt on differences that have so far been recognized in the nature of the copulatory appendage of the male. Another aspect of this study was that size measurements confirmed that, in general, this species increased in size with increase in latitude.

In the whole fauna, adults comprised 22 per cent of the total population, and simple length and height measurements were made on the valves of a number of the commoner species. These were plotted graphically and fell into well-defined clusters corresponding to the various moult stages, indicating that they were drawn from a single community. The addition of outlines of the various moult stages to the graphs gives a pictorial representation of the development of the species so treated.

Where the number of specimens was sufficient to allow conclusions to be drawn, it was found that the ratio of males to females was about one to two in the Trachyleberidinae, Hemicytherinae, Cytherurini and Loxoconchinae. On the other hand, in *Xestoleberis* males were not recognized and only females appeared to be present. Although the author does not develop this further, perhaps one might infer that in this community the genus *Xestoleberis* was reproducing parthenogenetically at this time.

In discussing the fauna attention is drawn to the fact that five species, namely *Australicythere polylyca* (39 per cent), *Xestoleberis rigusa* (12 per cent), *Patagonacythere devexa* (12 per cent), *Loxoreticulatum fallax* (9 per cent) and *Cativella bensoni* (7 per cent) account for 77 per cent of the individuals in this fauna. A similar predominance of a few species is seen in the other well-known podocopid faunas from the high Antarctic. The numerical abundance and percentage occurrence of the various species in the two best known of these are listed and compared. Small faunas described from elsewhere in the high Antarctic are also noted and discussed.

The significance of the Halley Bay fauna lies in the fact that only two other reasonably

representative podocopid ostracod faunas have been described from the High Antarctic Province. In the nearest of these, from the Ross Sea and McMurdo Sound 1,500 miles (2,415 km.) away, there were 13 species, of which 8 (62 per cent) were also found at Halley Bay, whilst the other faunas from "Gauss station", 2,000 miles (3,220 km.) away, had 38 species of which 16 (42 per cent) occurred in the Halley Bay sample. The existence of a distinct "High Antarctic Province" characterized by species such as *Bythoceratina dubia*, *Myrena meridionalis*, *Cytheropteron gaussi*, *Xestoleberis rigusa*, *Cativella bensoni*, *Robertsonites antarcticus* and *Australicythere polylyca* is confirmed by the ostracod evidence.

The report then goes on to compare faunas from other faunal regions. Comparisons are closest with the fauna of Iles de Kerguelen and Heard Island situated on the Antarctic Convergence and next with the abyssal fauna from below 1,500 fathoms (2,745 m.) listed by Brady in the *Challenger* report. Three of Brady's 17 species of Podocopida found in the abyssal region are also present at Halley Bay. There is only one species common to the Halley Bay fauna and that from South Georgia in the low Antarctic (the latter fauna admittedly only partially and poorly known), and anti-boreal South America also only has one species in common.

This remarkable lack of affinity between the Halley Bay fauna on the one hand, and the low Antarctic and South American faunas on the other, leads the author to conclude that the low temperature is the principal ecological control. He goes on to suggest that the distribution is controlled largely by the circum-polar East Wind Drift, the Antarctic Peninsula and the Scotia arc on the west side of the Weddell Sea acting as a barrier to its spread towards South America where the shelf waters and lower latitudes give higher temperatures which are inimical to this fauna.

The report is well illustrated with 14 figures drawn by the author and four plates of photographs taken by Mr. N. Bell. It forms a distinct addition to our knowledge of an area where much remains to be done, and as such it should prove of interest to both zoologists and palaeontologists working in this field.