To compute the effects of gridded terrain models for accurate reduction of gravity and magnetic anomaly data, the modified procedure effectively determines an equivalent point-source model of the topography, where the point sources correspond to the zero nodes of the Legendre polynomials used to perform the Gaussian quadrature integration. Because point-source effects involve relatively simple mathematics, the method readily accommodates arbitrary physical property variations, geomagnetic field characteristics, and coordinate transformations in the terrain anomaly computations. Anomaly attributes including the potential, anomaly gradients, and vector components are also easily computed from the equivalent point-source terrain model. This modified procedure is being used to compute, in spherical coordinates, the regional geopotential anomaly fields of the Transantarctic Mountains to separate these effects from the anomalies of deeper lithospheric sources which are the focus of the investigation.

Preliminary results include magnetic and gravity analyses for a portion of the mountain range shown in figure 1, where the topography is gridded at a spacing of 0.02° latitude and 0.20° longitude from an antarctica series reconnaissance map (U.S. Geological Survey 1965). Gravity terrain corrections relative to the Bouguer slab reduction at each grid node of the topographic surface are given in figure 2A. Station A ($z = 2,287$ meters), which is 10–15 kilometers from any severe topography (figure 1), requires a terrain correction of 3.15 milligals. To emphasize the significant terrain elements of this gravity correction, figure 2B shows the percent contribution which each gridded terrain cell makes to the terrain correction of station A. Figures 3A and 3B illustrate, respectively, the gravitational and magnetic effects of the terrain computed at 5 kilometers elevation. These effects are for all mass between the lowest point ($z = 71$ meters) and the highest point ($z = 4,278$ meters) of the topographic grid. All calculations were made for a density of 2.67 grams per cubic centimeter or a magnetic susceptibility of 0.0015 in the entimeter-gram-second system, using a geomagnetic reference field model updated to 1980. No attempt was made in this preliminary study to account for the lower density of ice, but future work will model rock density variations and ice separately and also consider magnetic property variations of the topography of the Transantarctic Mountains.

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The Byrd Group of the Holyoake Range, central Transantarctic Mountains

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The Shackleton Limestone and Douglas Conglomerate are the principal units of the Byrd Group in the central Transantarctic Mountains. These and correlative formations were recognized in regional mapping projects during the mid-1960's (Grindley 1963; Laird 1963; Skinner 1964; Laird, Mansergh, and Chappell 1971). The Shackleton Limestone was thought to have a minimum thickness of 5,400 meters in the Holyoake Range where, on the basis of archaeocyathids, it was regarded as Lower Cambrian, possibly extending into the lower Middle Cambrian. The age of the Douglas Conglomerate is less well constrained, but the unit was considered to be Middle or possibly Late Cambrian (Laird 1981). Subsequent examination of the Byrd Group had been confined to the sector between the Byrd Glacier and the mouth of the Starshot Glacier (Burgess and Lammerink 1979; Stump et al. 1979).

The objectives of our study in the Holyoake Range during the 1984 – 1985 austral summer were to determine the tectonic and depositional setting that produced such great thicknesses of Shackleton Limestone and Douglas Conglomerate, to improve the biostratigraphic control within the Shackleton Limestone, and to ascertain the relationship between the two formations.

The field party consisted of two New Zealand mountaineers, Peter Braddock and Ray Waters; a Canadian geologist, Brian Pratt; and an American geologist, Margaret Rees. The party was put into the field by a LC-130 ski-equipped Hercules airplane on the Starshot Glacier on 27 November 1984. From this site, we used skidoos and Nansen sleds to establish three camps around the northern part of the Holyoake Range and to travel to collecting localities (figure 1). Due to remarkably fine weather, we had 23 working days in the area. Logistical problems prevented us from visiting the southern Holyoake Range.

Although it has long been known that the Shackleton Limestone has been folded and faulted (Laird, Mansergh, and Chappell 1971), our examination of small geopetal structures within it revealed that folding is much more intense than previously had been recognized. Two sets of mesoscopic folds are developed and are associated with two cleavages. This relationship is comparable to that reported in the area immediately south of the

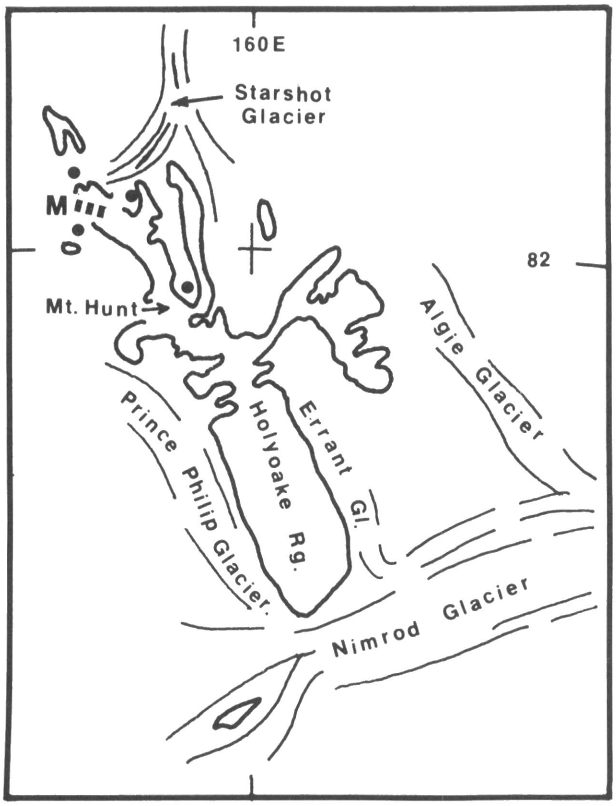

Figure 1. Holyoake Range in the central Transantarctic Mountains. Dots are locations of field camps occupied during 1984 – 1985 season. Broken line (M) is location of measured section that crossed the contact between the Shackleton Limestone and Douglas Conglomerate.

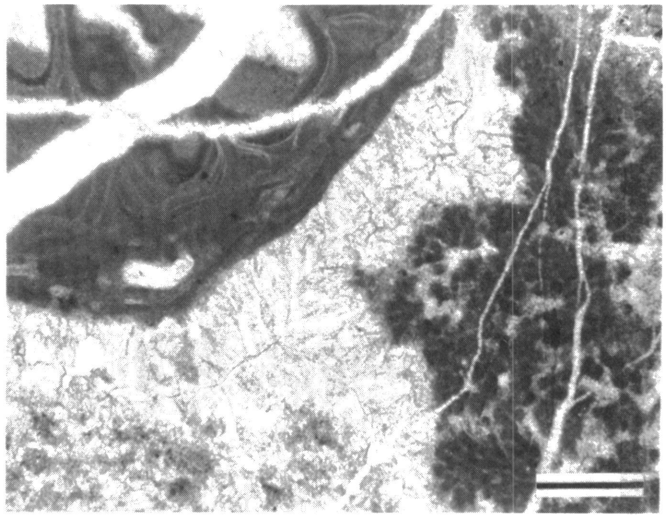

Figure 2. Redlichiid trilobite (cranidium) from locality H-84-25 closely related to species of *Wutingaspis* Kobayashi described from the Lower Cambrian of China by Zhang et al. (1980).

Byrd Glacier (Burgess and Lammerink 1979). Locally, within broad, well defined zones, however, strong deformation has produced a chaotic fold style that we consider to be of structural rather than syndepositional origin. This intense deformation precludes accurate estimate of thickness of the Shackleton Limestone, but we consider it to be much less than 5,000 meters and probably closer to 2,000 meters.

The Shackleton Limestone is composed of lithofacies that accumulated in numerous depositional environments varying from intertidal to near storm-wave base on a carbonate shelf. Rare intertidal deposits are characterized by cryptalgal laminites, thin intraformational conglomerates, and fenestral fabric. There are hundreds of meters of rock representing fairly high-energy, shoal-water complexes of archaeocyathid-alga reefs and ooid-peloidal shoals. These shoal-water rocks interfinger with a deeper water sequence of interbedded oolitic grainstone and mottled peloidal wackestone enclosing small isolated mounds of archaeocyathid-alga boundstone. An even deeper water and typically lower energy environment is represented by thin-bedded peloidal wackestone. These beds commonly have tracks and trails on their upper surfaces and are internally burrow mottled. The thin-bedded units contain rare thin, fining-upward sequences each with a basal skeletal or intraclastic grainstone. These sequences probably represent storm deposition on the part of the shelf that lay below fair-weather wave-base.

In addition to the archaeocyathids, the alga *Renalcis* occurs and *Epiphyton* (figure 2) is abundant. Shelly fossils are moderately common at several horizons. These include helicionellid molluscs, kutorginacean, and rare acrotretacean brachiopods, together with redlichacean (figure 3) and ptychopariacean trilobites. Preliminary examination of trilobites and brachiopods from the thin-bedded units indicates an entirely Early Cambrian age for all the formation.

The contact between the Shackleton Limestone and the Douglas Conglomerate is well exposed for 200 meters on the ridge of measured section M (figure 1). Here, the Douglas rests on an eroded, karst surface of deformed Shackleton Limestone, and the contact displays more than 20 meters of relief. Clasts belonging to the Douglas occur in fractures within the limestone and fill larger openings beneath overhangs of Shackleton. On this ridge, some 400 meters of Douglas are exposed but, although the beds are steeply dipping, locally mineralized, and carry one cleavage, neither faults nor fold axes were observed.

Clasts in the Douglas Conglomerate represent a variety of lithotypes, however, the majority were derived from the Shackleton Limestone. Along ridge M, the beds seemingly accumulated in the middle and outer parts of an alluvial fan. The lower two-thirds of the sequence is composed predominantly of lenticular- and parallel-stratified, boulder and cobble conglomerate. Typically, beds are poorly sorted and are both clast and matrix supported. Boulders are up to 1 meter across, and the matrix is predominantly sand- to pebble-size material with only a small percentage of clay. In the upper part of the sequence, boulder conglomerates are rare and cross-bedded, coarse to pebbly sandstones are common. Cross-bedding consistently indicates a northeast transport direction.

The relationship of the Douglas Conglomerate to the Shackleton Limestone in the northern part of the Holyoake Range strongly suggests that the Douglas Conglomerate is not a Cambrian formation. It postdates at least one phase of intense folding of the Shackleton and the subsequent uplift and development of a karst surface on the limestone. These pre-Douglas events are probably the result of the Cambro-Ordovician Ross Orogeny. The succeeding deformation and uplift of the Douglas, prior to deposition of the overlying Beacon Supergroup, must be attributed to yet another orogenic episode.

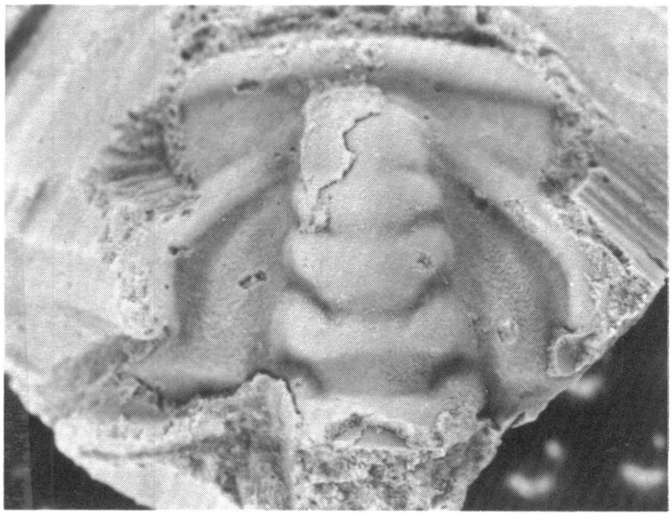

Figure 3. Photomicrograph of archaeocyathid-alga boundstone from Shackleton Limestone (sample number S-84-3D). Note archaeocyathid in upper left, *Epiphyton* alga on right, and intervening sediment and spar occluded cavity. (Scale 500 micron.)

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A new Triassic cycad from the Beardmore Glacier area of Antarctica

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The living Cycadales represent a relic group of gymnospermous plants that today include 10 genera that are restricted geographically to the tropics and subtropics. Fossil members of this order were widespread during the Mesozoic based on abundant foliage remains, and the group is believed to have originated from the late Paleozoic seed fern group Medullosales. Despite a wealth of information about the leaves of fossil cycads, details regarding the anatomy of the stems is limited to descriptions of a few small fragments. One of the most characteristic features of cycad stems is the so-called girdling configuration of the leaf traces, in which the traces to the laterals extend horizontally for some distance within the cortex before passing into the base of the petiole.

Several silicified stems which demonstrate typical cycad anatomy have been identified from plant material collected by members of the Institute of Polar Studies during the late 1960's from the Fremouw Peak locality in the Beardmore Glacier area of East Antarctica and are described in detail elsewhere (Smoot, Taylor, and Delevoryas in press). The Fremouw Formation fossils are regarded as being early-middle Triassic (Collinson, Stanley, and Vavra 1980). Because of the permineralized nature of the specimens, it has been possible to obtain a considerable amount of histologic information about these interesting plants and to consider aspects of their evolution.

The specimens range up to 3.7 centimeters in diameter and appear to represent more basal regions of the plant. The stem consists of an extensive, parenchymatous ground tissue that contains two zones of mucilage canals. The outer surface of the cortex is bounded by a periderm (figure 1). The vascular system consists of a ring of endarch vascular bundles separated by large rays (figure 2). Secondary tissue development is present in the Fremouw specimens and consists of a small amount of secondary xylem tracheids that exhibit circular bordered pits, cambium, and phloem zone containing sieve cells with elliptical