although direct comparison is difficult due to differences in preservation between Raasch's crushed material and the etched free specimens from Greenland.

The presence of the interpreted telson spine requires the rejection of the vertebrate hypothesis of Bockelie & Fortey (1976). However, until further material has been processed, it would be premature to attempt to reassign *Anatolepis* more specifically than to the Arthropoda, although affinity with the merostomes seems likely.

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Basement–cover relationships and metamorphic studies in the East Greenland Caledonides (72°–74°N)

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The reconnaissance work in the metamorphic complexes of northern East Greenland begun in 1975 (Friderichsen & Higgins, 1976) continued in 1976. Attention was concentrated on the relationships between Archaean basement gneiss complexes, middle Proterozoic medium- to high-grade metasediments, and the late Precambrian Eleonore Bay Group.

Gletscherland – southern Suess Land

Isotopic evidence from the Gletscherland complex which occupies all of Gletscherland and most of southern Suess Land (fig. 31), suggests it is largely of pre-Caledonian origin. Rex *et al.* (1976) have obtained two early Proterozoic isochron ages of 1740 m.y. and 1870 m.y. from Kap Hedlund at the east edge of the complex, and Rex *et al.* (this report) present a disturbed *c.* 2500 m.y. age from Tærskeldal in the southern part of the complex. Comparisons can be made with the Flyverfjord infracrustal complex of the Scoresby Sund region, which has yielded several Archaean ages between 2345 m.y. and 3000 m.y. (Steiger & Henriksen, 1972; Hansen *et al.*, 1973; Rex & Gledhill, 1974). The Gletscherland complex comprises biotite gneiss, hornblende gneiss, amphibolite bands and occasional dioritic bodies, all of which may be extensively veined or partially digested by granitic masses.

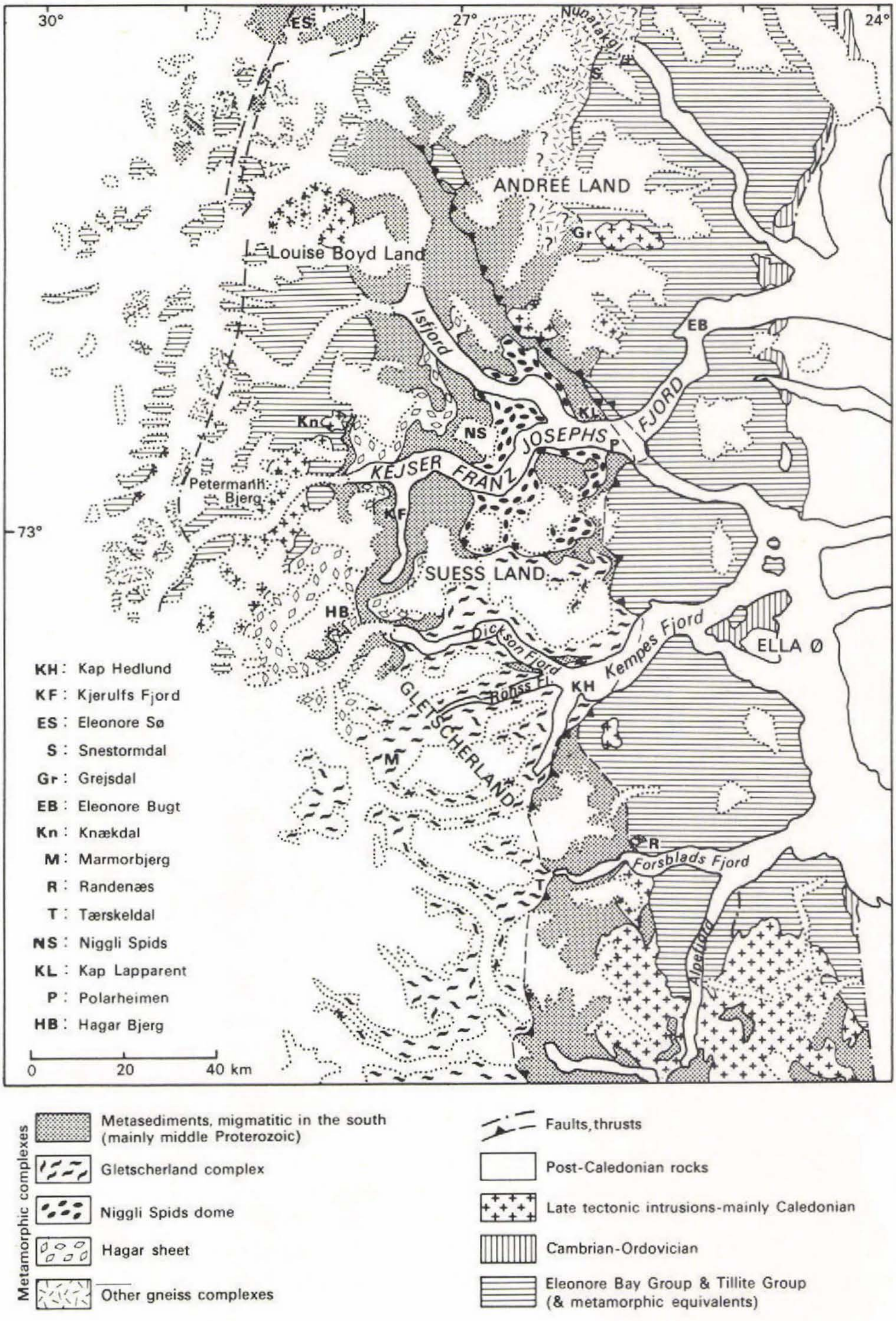

Fig. 31. Geological sketch map of northern East Greenland between latitudes 72° and 74°N.

Discordant amphibolite dykes previously known from Tærskeldal (Friderichsen & Higgins, 1976), were recorded in 1976 from several localities near Marmorbjerg, central Röhss Fjord and at Kap Hedlund. Such dykes are a very characteristic feature of the Flyverfjord infracrustal complex.

The dominant E–W structural pattern of the Gletscherland complex, which deviates so strikingly from the N–S Caledonian trend, is presumed to be a feature of Archaean or early Proterozoic orogenesis, and not an "inheritance of the internal structure of the old basement" (Haller, 1971, p. 180) developed during the course of Caledonian orogenesis.

The east margin of the Gletscherland complex in central Suess Land is a thrust contact, some hundreds of metres of dense greenish mylonite and crushed quartzites separating strongly E–W lineated augen gneisses from the concordantly overlying almost non-metamorphic Eleonore Bay Group. In inner Forsblads Fjord the southern continuation of this same thrust line separates Archaean banded gneisses, also with a strong E–W lineation, from middle Proterozoic high-grade, migmatitic metasediments which have dominantly N–S trends of lineations and fold axes.

Randenæs

Sillimanite-bearing migmatitic metasediments and migmatite granites make up most of Forsblads Fjord, and a transition into the sediments of the Lower Eleonore Bay Group has been claimed by Caby (1976) who supports the earlier views of Haller (1958). The middle Proterozoic 'errochron' age on gneissic quartzites from the west end of the fjord (*c.* 1270 m.y.: Rex *et al.*, this report) is at variance with this view, and the transition zone at Randenæs was therefore briefly revisited.

At Randenæs there is a gradual increase in the metamorphic state of the Eleonore Bay Group, from slightly micaceous quartzites, through spotted phyllites to interlayered garnet-mica schists and quartzitic schists. Granite dykes and sills become increasingly prominent as the contact with the migmatitic rocks is approached, and partially obscure the relationships. There does appear to be a conformable passage into sillimanite-bearing schists and migmatitic rocks, but the transition is rapid and could be apparent rather than real. Granitic bands in the migmatites are coarser grained and less regular than the granite dykes and sills at higher levels, and there is a distinct change in the lineation pattern from E–W mica lineations in the gently inclined Eleonore Bay Group to N–S sillimanite and biotite lineations in the migmatites, parallel to the axes of tight and isoclinal minor folds. These are perhaps significant differences between the two levels. On the other hand the metasediment paleosome remnants within the migmatites, as Caby (1976) has emphasised, are identical in composition with, and have the same zoned calc-silicates, sedimentary structures and heavy mineral bands as the Lower Eleonore Bay Group.

Andrée Land

Apparent transitions between the Eleonore Bay Group and crystalline rocks to the west have been described by Haller (1953) in Andrée Land. In 1976 the transition was investigated in several valley sections, of which the most significant is that in northern Snestormdal beside Nunatakgletscher.

In the east of the Nunatakgletscher section the Eleonore Bay Group is a steeply inclined, well-banded, monotonous succession of quartzites and shaly quartzites cut by small granite plutons and granite sheets. Traced westwards dark spots develop in shaly interbeds, and a zone of spectacular, rather angular major folds is encountered. The folds have east dipping axial planes, and SSE-trending fold axes which are exactly parallel to a widespread linear feature throughout this part of the sequence. Thick semi-concordant granite sheets are slightly folded. Further westwards and downwards the dark, banded, still low grade, Eleonore Bay Group succession passes abruptly into a thin sequence of kyanite-garnet schists, which in turn overlies a complex of granitic gneisses, garnet amphibolites, foliated granites and augen gneiss.

There is little doubt in the minds of the writers that the gneiss and granite complex can be interpreted as a basement unit (? Archaean), and that the high-grade schists (? middle Proterozoic) have no connection with the conformably overlying Eleonore Bay Group. It may be that at this locality a relatively undisturbed contact between the base of the Eleonore Bay Group and its basement has been discovered. If this is such a contact, then it must be noted that a great deal of the Lower Eleonore Bay Group sequence is missing in northern Andrée Land and perhaps was never deposited.

The zone of (? Archaean) basement rocks can be traced along the floor and west side of Snestormdal into Eremitdal, and in these areas comprises a splendid series of flaggy biotite gneisses, hornblende gneisses, amphibolites and extensive outcrops of a coarse-grained augen gneiss or augen granite. High-grade (? middle Proterozoic) schists occur locally. The contact with the Eleonore Bay Group is easily traceable as a marked feature, although rarely accessable, the Eleonore Bay Group above the contact characteristically containing numerous concordant granite sheets.

In Grejsdal in central Andrée Land steep cliff sections are exposed across the contact zone. West of the Grejsdal batholith, a major granite pluton cutting gently inclined Eleonore Bay Group sediments, several large-scale, N–S trending, asymmetric fold structures occur. They resemble in style and orientation the folds in the Nunatakgletscher section, but in Grejsdal an additional set of folds with steep west dipping axial planes occurs. Thin granite sheets are common, some pre-dating and some post-dating the folds.

From east to west metamorphic grade increases, biotite and garnet being noted successively. At the west end of Grejsdal some outcrops of probable (? Archaean) basement gneisses were noted, lying in the southward projection of the basement zone traceable from Snestormdal through Eremitdal, but the contact has not been precisely located.

Knækdal

The Knækdal section from the Petermann Series (= Eleonore Bay Group, fig. 1) downwards into crystalline rocks on the west side of the central metamorphic complex is well known from the work of Odell (1944) and Wenk & Haller (1953). Friderichsen & Higgins (1976) suggested that while there is an increase in grade towards the Hagar migmatite sheet, the contact seems in part at least to be a thrust, and they noted that the Hagar migmatite sheet usually has the characteristics of an old basement gneiss complex.

The section was re-examined in 1976, mainly to trace metamorphic variations. It is worthy of note that, as in the sections on the east side of the central metamorphic complex, the transition zone is remarkably conformable, granite sheets and dykes are common in the metasediments near the contact, and the major structures trend N–S and are of simple style. The lowest divisions of the Petermann Series, the Mystery Quartzite 'series' and Phyllite 'series', cannot be traced in the east end of the valley where they are considered to be cut out by the thrusts along the contact with the Hagar migmatite sheet, rather than transformed by Caledonian orogenesis into migmatites (Wenk & Haller, 1953).

Isfjord–Kejser Franz Josephs Fjord

Medium- to high-grade metasedimentary rocks are widespread in the region surrounding inner Kejser Franz Josephs Fjord and Isfjord. Isotopic evidence of their age is lacking at present, but in many respects they resemble the Krummedal sequence of the Scoresby Sund region which has given middle Proterozoic ages (Hansen *et al.,* 1974).

Nunatak zone

Koch & Haller's (1971) map of the nunatak region at a scale of 1:250 000 is based largely on aerial observations as only a very few traverses have been made on foot in this extremely difficult terrain (Haller, 1956). In 1975 and 1976 the hitherto limited ground control was considerably extended during six helicopter traverses, extensive sampling for metamorphic and geochronological studies being undertaken.

Studies are not yet completed, but in general many of the distinctions made on the published map have been confirmed with, naturally enough, some corrections and ammendments. Some associations of gneiss and amphibolites would be interpreted by the writers as likely (? Archaean) basement complexes (fig. 31). The presence of widespread, flat-lying, low-grade or non-metamorphic sedimentary sequences was confirmed, and their earlier interpretation as parts of the Eleonore Bay Group (Koch & Haller, 1971) seems very reasonable. However, the low-grade sediments and volcanics around Eleonore Sø are of uncertain age; volcanics are not known from any of the non-metamorphic Eleonore Bay Group successions.

Regional metamorphism

Regional and detailed metamorphic studies are at an early stage, and are aimed at distinguishing the Caledonian metamorphism from earlier metamorphic events, and establishing regional isogrades.

The Eleonore Bay Group shows an increase in metamorphic grade towards the metamorphic complexes in all the sections investigated. The most complete section is found in Knækdalen, where a metamorphic progression from an almost unmetamorphosed zone, through the biotite zone to the garnet zone can be followed. The highest grade encountered in known Eleonore Bay Group rocks is that of upper greenschist facies.

Most of the metamorphic complexes (fig. 31) are medium to high grade; in appropriate lithologies garnet is abundant and kyanite and sillimanite are common. Two major approximately N–S trending metamorphic zones may be distinguished. In a western zone (including much of Andrée Land) kyanite is the highest grade mineral. Kyanite occurs in stable associations in Louise Boyd Land and western Eremitdal, in altered associations at Nunatakgletscher and Knækdal, and has not yet been found around inner Kejser Franz Josefs Fjord and Kjerulfs Fjord although the high An-content of plagioclases clearly indicates amphibolite facies was reached. In an eastern zone kyanite and sillimanite coexist. Sillimanite is usually present as fine-grained fibrous aggregates, except at a locality near the head of Isfjord where it forms large crystals. Kyanite in stable associations was found at Niggli Spids and outer Dickson Fjord, and more or less replaced by muscovite was found at Kap Lapparent, Polarheimen and in Forsblads Fjord. At Polarheimen staurolite, sillimanite and kyanite were noted in association, the staurolite representing a late growth at the expense of sillimanite.

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