DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

SOME REMARKS ON THE CORE OF BUTE DIAMOND DRILL HOLE No. 2

by

W.V. PREISS
PALAEONTOLOGIST
PALAEONTOLOGY SECTION

Rept.Bk.No. 72/235
G.S. No. 5000
Pal.Rept.No. 16/72
D.M. No. 136/71

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ABSTRACT

Two major sedimentary sequences are represented in the core of Bute DDH2. The younger sequence consists of crystalline dolomite with relict oolites and stromatolites in places, and with basal sandstones, grits and conglomerate. The sandstones contain probable worm burrows. This sequence is probably best equated with the Lower Cambrian Kulpara Limestone and Mount Terrible Formation exposed nearby.

The older sequence is a thinly bedded black shale - dolomite sequence with affinities with the lower parts of the Tapley Hill Formation. No fossils were found in it. It also closely resembles parts of the Woocalla Dolomite known from outcrop and drilling on the TORRENS map sheet area.

INTRODUCTION

A series of diamond drill holes was drilled in 1970 in the Bute area, northern Yorke Peninsula, in order to determine the thickness of Cambrian sedimentary rocks, identify the rocks lying beneath the Cambrian cover, and to test for stratigraphic mineralization in the Cambrian and underlying units. Mr. B.P. Thomson, Supervising Geologist, Regional Surveys Division,

requested an examination of core from one of these holes, Bute DDH No. 2 in an attempt to find palaeontological evidence of the age of the sedimentary rocks penetrated. He had considered that these included beds of Cambrian and Sturtian age (pers. comm., 1972).

DESCRIPTION OF STRATA INTERSECTED

Beneath Quaternary sand and clay cover, 34ft (10.4 m) thick, three major rock units were noted: at the top a flat-lying carbonate sequence with basal clastics, overlying a flat-lying black shale - dolomite sequence, which rests on basement amphibolites.

A more detailed log of the strata intersected is as follows:

34' (10.4 m) to 41' (12.5 m):- Fractured highly weathered dolomite rock.

41' (12.5 m) to 71' (21.6 m):- Dark grey finely crystalline dolomite, partly mottled due to weathering.

71' (21.6 m) to 86' (26.2 m):- Highly weathered zone.

86' (26.2 m) to 100' (30.4 m):- Pale grey massive dolomite, partly banded or buff mottled. Equigranular, medium grained, crystalline.

100' (30.4 m) to 117' (35.6 m):- Pale brownish-grey massive crystalline dolomite, partly buff mottled, with a white chert nodule at 106' (32.2 m).

117' (35. m) to 122' (38.1 m):- Massive crystalline dolomite, partly vaguely bedded and partly with brecciated appearance.

122' (37.1 m) to 136' (41.4 m):- Dark grey finely crystalline dolomite with occasional stylolites, near which dolomite is discoloured to a pinkish grey. Possible intraformational breccia at 132' (40.2 m). Some buff mottling.

136' (41.4 m) to 139'(42.3 m):- Dark brown dolomite, partly micaceous.

139' (42.3 m) to 145'6" (44.2 m):- Medium grey massive dolomite with buff mottling, partly fractured, with 1-2 mm thick laminations in lower part. Stylolite at base.

145'6" (44.2 m) to 170' (51.7 m):- Dark and pale grey crystalline dolomite, partly mottled, partly laminated, with pale grey chert nodules which cut across the laminae. Stylolites in places at ½ metre intervals. Fractured near base, with solution cavities filled with coarsely crystalline dolomite.

170' (51.7 m) to 182'6" (55.5 m):- Pale buff-grey dolomite with dark grey interbeds. Scattered subrounded quartz grit at 174' (56.0 m). Occasional solution cavities filled with coarse pink sparry dolomite. Some bands have an erosional base.

182'6" (55.5 m) to 212' (64.0 m):- Pale grey finely crystalline dolomite, partly saccharoidal, vaguely banded. Some bands are disrupted to form intraclasts between 195' (59.4 m) and 208' (63.2 m). Large white chert nodule at 208' (63.2 m). Weathered zone at base.

212' (64.0 m) to 217'6" (66.1 m):- Sedimentary dolomite breccia, in upper part coarse, disorientated clasts of dolom te

... in even grained crystalline dolomite similar to lithologies above. Smaller, angular clasts in lower part; gradation into underlying lithology.

217'6" (66.1 m) to 218' (66.3 m):- Dark greenish-grey fine clayey dolomite.

218' (66.3 m) to 219' (66.4 m):- Dolomitized ooid grainstone, banded with var... g degrees of alteration of ooids.

219' (66.4 m) to 240' (... m):- Pale and dark grey lenticular laminated dolomite, partly fractured and recemented. Possible altered oolites at 229' (69.6 m). Occasional irregular banding may be due to scouring. Finely laminated at base.

240' (73.2 m) to 255' (77.7 m):- Medium grey dolomite, vaguely banded, with alternating pale buff fine dolomite and granular bands. Intraformational breccia with angular intraclasts up to 3 cm long at 244' (74.2 m). Tabular intraclast breccia at 255' (77.7 m).

255' (77.7 m) to 263' (80.0 m): - Half metre thick cycles of dark grey dolomite, vaguely banded at the top, grading down to tabular intraclast breccia at base. Intraclasts rare at 262' (79.7 m).

263' (80.0 m) to 269' (81.8 m):- Medium grey dolomite with fine grained and granular interbeds. Intraformational conglomerate 10 cm thick at base.

269' (81.8 m) to 278' (84.6 m):- Medium to pale grey dolomite with thin shaly black leminae. Occasional detrital laminae or lenses.

278' (84.6 m) to 290' (88.4 m):- Massive grey dolomite with sandy lenses. Sparsely sandy pale grey intraformational breccia dolomite at 282' (85.8 m). Becoming dark grey, laminated at base, with thin granular and sandy lenses.

290' (88.4 m) to 296' (90.9 m):- Medium grey massive dolomite, slightly sandy, with alternating fine grained and granular layers. Clay-rich stylolites. Bands with intraformationally disrupted laminae, sometimes upturned in place. Sand is subrounded, medium grained.

296' (90.0 m) to 297' 6" (90.5 m):- Two cycles of medium grey dolomite passing down to pale grey dolomitic sandstone with convolute bedding and erosional basal contact.

297'6" (90.5 m) to 300' (91.4 m):- Sandy dolomitic ooid grainstone, partly wavy bedded.

300' (91.4 m) to 300'6" (91.6 m):- Dolomite intraformational breccia. Irregular clasts up to 4 cm in diameter of dolomicrite in dark grey slightly sandy dolomite matrix.

300'6" (91.6 m) to 302' (91.8 m):- Pale grey mottled dolomite, some black shale interlaminations. Some soft sediment deformation. Brecciated in lower part.

302' (91.8 m) to 304'6" (92.6 m):- Pale and dark grey mottled dolomite. Two stromatolitic horizons with vertical columns up to 10 cm long, 0.5 to 1.0 cm wide, very poorly preserved; the lamination is barely discernible. Interspaces are filled with sandy dolomite.

304'6" (92.6 m) to 307'6" (93.5 m):- Dark grey dolomite, possibly pelletal, lenticular bedded, grading down to homogeneous

pyritic dolomite at base.

307'6" (93.5 m) to 313' (95.2 m):- Fine to medium grained pale grey sandstone, medium scale cross-bedded, with very little dolomite cement. Irregular thin interbeds of dark dolomite, partly disrupted and incorporated as intraclasts. Mottling at 310'6" (94.4 m) could be due to bioturbation.

313' (95.2 m) to 321' (97.6 m):- Pale grey medium grained sandstone with thinly spaced black silty partings; cross-bedded on a finer scale. Irregular lenticular bedding, with gritty lenses. Possible vertical worm burrows at 315' (96.0 m). Very gritty beds at 318' (96.7 m) and at base.

321' (97.6 m) to 322'6" (98.1 m):- Conglomerate, subrounded, with clasts up to 2 cm diameter. Little dolomitic cement. Pebbles include black chert, a red igneous? rock, pale grey vein quartz and a pink quartzite.

\- Probable disconformity -

322'6" (98.1 m) to 323'6" (98.4 m):- Very soft dark grey shale.

323'6" (98.4 m) to 325' (99.1 m):- Extremely thinly laminated black and medium grey shale, non-calcareous, grading down into the underlying lithology.

325' (99.1 m) to 367' (111.6 m):- Interbedded ½-2 cm thinly laminated black shale and 1-5 cm grey dolomitic siltstone, pyritic in part.

367' (111.6 m) to 377' (114.7 m):- Pale grey dolomite, with very thin black shale partings, becoming thicker downwards.

Small scale cross-bedding in the basal 20 cm.

377' (114.7 m) to 406' (123.4 m):- Small scale cross-bedded thinly laminated grey dolomitic siltstones with black shale laminae. Some brecciation, possibly due to compaction. More homogeneous dolomite in lower part, with 1 mm laminations, often micro cross-bedded, with ?pelletal texture.

from 406' (123.4 m) to bottom of hole:- Amphibolite.

DISCUSSION

Palaeontology

No diagnostic fossils were found during the examination of this core. The upper sequence contains evidence of biologic activity in the form of probable stromatolites and worm burrows; no fossils were found in the lower sequence, although the black shales contain much organic matter.

Six samples from depths of 328.6' (100.1 m), 331.6' (101.6 m), 336.0' (102.4 m), 338.6' (103.2 m), 348.8' (106.3 m) and 367.0' (111.9 m) respectively, were prepared for palynological examination by maceration in firstly hydrochloric acid and then hydrofluoric acid. The residues, which were extremely carbonaceous, were oxidized with nitric acid to remove excess carbon. All samples contained numerous irregular carbonaceous fragments up to 20μ in diameter; in addition a few small spherical translucent bodies, 3-10μ in diameter and irregular strings of carbonaceous matter, up to 20μ long, are present. None of these bodies display consistent shape, size or internal structure. They are probably degraded and coalified fragments of organic tissue, but no definite organisms could be identified.

Timofeev (1966) claimed to have found "spherical lumps" (Protospheridium) and "angular fragments" (Laminarites), both considered to be characteristic of the Vendian of the Baltic Region, in samples of Tapley Hill Formation, S.A. Again, these fragments do not appear to be definite micro-organisms.

Lithostratigraphy

A number of lithostratigraphic comparisons may be made

with sequences known from elsewhere. The younger sequence is characterized by massive crystalline dolomites in which sedimentary structures are poorly preserved. The upper part of this sequence contains chert nodules, generally with concentric banding, which cut across the bedding of the carbonates. Chert nodules are known from the Lower Cambrian Kulpara Limestone (Daily, 1956) outcropping nearby in the Kulpara area. They are also recorded by Daily (1956) and Coats (1973, in press) from the Lower Cambrian Ajax Limestone of the Mount Scott Range, and by Wopfner (1969) from the Observatory Hill Beds of the Officer Basin, considered to be of Cambrian age. Daily (1956) described the Kulpara Limestone as consisting "dominantly of limestone but also contains dolomitic and siliceous limestones and at least one prominent band of yellow dolomite in the upper part. The siliceous limestones contain chalcedony nodules".

The lower part of the younger sequence has been less altered by the dolomitization, and occasional relicts of primary structures are preserved. Thus certain bands are oolitic, while others contain stromatolites. The preservation of the stromatolites is not adequate to allow identification (Fig. 3C), but in longitudinal section they are not unlike some specimens of Acaciella angepena Preiss (1972) which occur in Lower Cambrian limestone (frequently associated with oolites) in the Flinders Ranges. The Ajax Limestone was described by Daily (1956) as containing blue-grey siliceous limestones with chalcedony nodules, sometimes cross-bedded, oolitic limestones, pisolitic limestone, flaggy calcareous shale, ripple marks, sun cracks, intraformational

breccia and dolomite below the lowest fossils, 30ft. (9.1 m) above the base.

The base of the younger sequence at Bute is marked by sandstones and grits containing probable worm burrows in a few horizons. The burrows are vertical, up to 5 cm deep, and cut across the sedimentary lamination in the sandstones, although they are themselves cut by younger stylolites (Fig. 2). Worm burrows are very characteristic of basal Cambrian clastics in the Adelaide Geosyncline, the Parachilna and Mount Terrible Formations (Dalgarno and Johnson, 1964; Daily, 1963).

The evidence is consistent with but not definitive of a Lower Cambrian age for the younger sequence at Bute; the dolomites are probably dolomitized equivalents of the Kulpara Limestone and the basal clastics are probably to be correlated with the Mount Terrible Formation, as mapped nearby in the Kulpara area by Thomson (1969).

The older sequence in bore hole No. 2 is more problematical. A search of numerous black shale partings revealed no fossils. If the above correlations are correct, this sequence must be of Precambrian age. I know of no precise lithological equivalent of this sequence in the Adelaide Geosyncline, but very thinly laminated pyritic black shales are widespread in the Tindelpina Member of the Tapley Hill Formation (Thomson et al., 1964). Significantly, thin-bedded dolomites are usually present in the basal parts of the Tapley Hill Formation (e.g. Binks, 1971). The Bute material (Fig. 3A, B) especially resembles the basal dolomites of the Tapley Hill Formation of the Depot Creek area, which are

flaggy and interbedded with black siltstones. The dolomites of both areas have laminations 1-2 mm thick, and are often of pelletal texture, although dolomites of other areas are frequently micritic (Preiss, 1973, in press).

Another instructive comparison may be made with the LD5 hole drilled south of Lake Dutton (TORRENS 1:250 000 map sheet). This drill hole penetrated a total thickness of 66'6" (20.3 m) of Woocalla Dolomite (Johns, 1968) below Whyalla Sandstone; the Woocalla Dolomite consists here chiefly of dolomitic shale with a 5ft. (1.5 m) thick massive dolomite at the base. A piece of core shown to me by Mr. R.K. Johns (Fig. 4) very closely resembles the black-shale dolomite sequence in the Bute hole; 0.5 cm laminated dolomite bands are interbedded with dolomitic black shale bands 1-2 cm thick.

Preiss (1971), in a discussion of environments of deposition in the Umberatana Group of the Adelaide Geosyncline, suggested that the Tapley Hill Formation records a widespread marine transgression, perhaps related to eustatic rises in sea level after the Sturtian glaciation. It was also suggested that this transgression could have spread further over the Stuart shelf than at later times (e.g. in Brighton Limestone time the basin margin was near the present western margin of the Flinders Ranges. Thus the Woocalla Dolomite on the Stuart shelf might represent a marginal facies of the Tapley Hill Formation. The discovery of thinly laminated black shales in the Woocalla Dolomite supports this suggestion. Preiss (1971) found that the stromatolites studied from the Woocalla Dolomite gave no indication of its age.

A correlation of both the Woocalla Dolomite and the older sequence in the Bute hole with the Tapley Hill Formation thus appears plausible in the light of available stratigraphic evidence.

W.V. Preiss

WVP:AM
6.12.72

W.V. PREISS
PALAEONTOLOGIST
PALAEONTOLOGY SECTION

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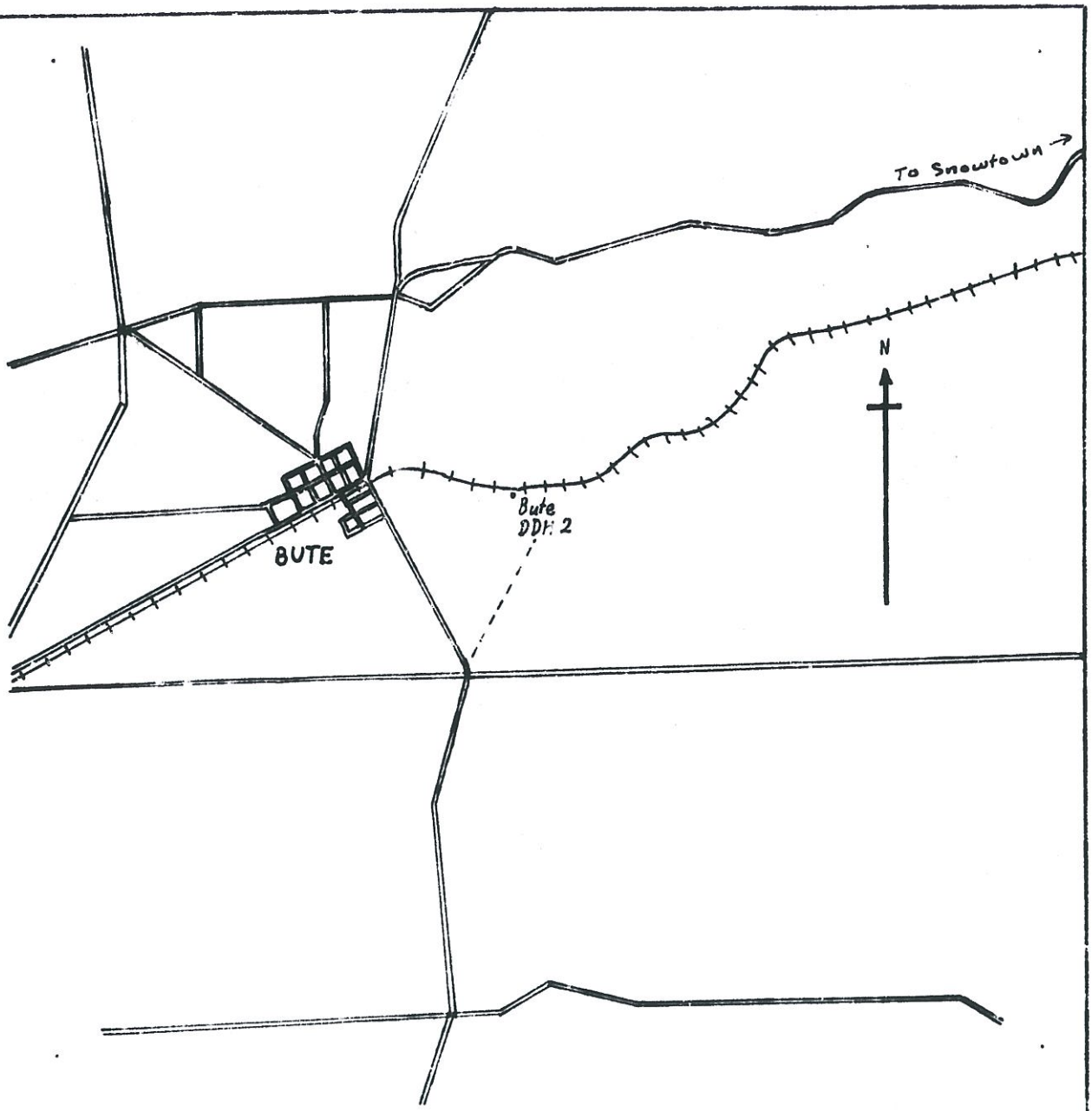

Blyth, Run 3, Svy. 232, Photo No 1307.

FIG. 1.	**DEPARTMENT OF MINES – SOUTH AUSTRALIA**	Scale: 1:48,000
Compiled: W.V.P.	LOCATION OF BUTE DDH 2.	Date: Nov. 1972.
Drn. W.V.P. Ckd.	(N.W. Corner Section 22, Hd. Wiltunga.)	Drg. No. S 10 029 Gc 5

Fig. 2. (Neg. No. 22861) sectioned core from 315' (96.0 m) Coarse grained sandstones with shaly laminae and approximately vertical tubular structures, probably worm burrows. Probable Mount Terrible Formation equivalent.

Fig. 3. (Neg. No. 22860) A: 358' (109.1 m) Very thinly laminated black shale and siltstone with pale grey dolomitic siltstone bands. Probable Tapley Hill Formation equivalent. B: Small scale cross-bedded laminated dolomite at 378' (125.2 m), possibly equivalent to dolomite of the Tindelpina Shale Member of the Tapley Hill Formation. C: Altered stromatolites in a dark grey crystalline dolomite, at 302' (92.1 m), probably Kulpara Limestone of Lower Cambrian age.

Fig. 4. Sectioned core of thinly laminated interbedded dolomite and black shale, Woocalla Dolomite, from drill hole LD5, south of Lake Dutton. (Kindly supplied by Mr. R.K. Johns).

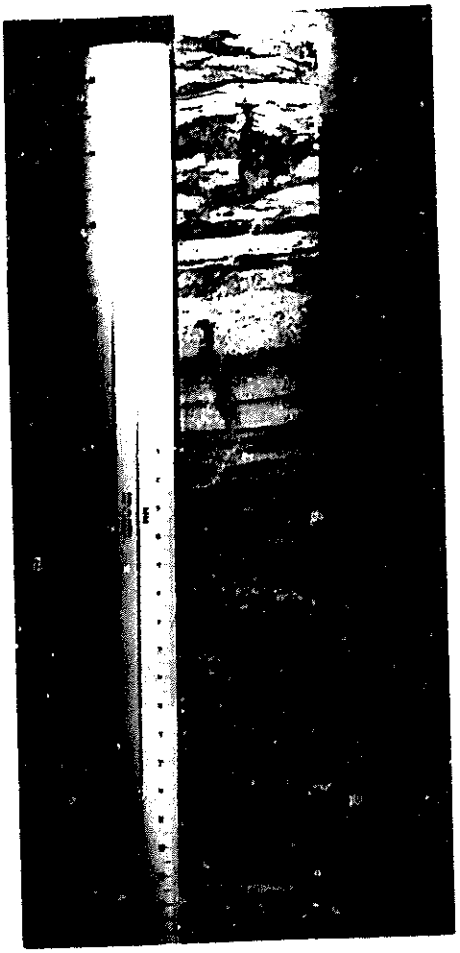

FIG. 2. Neg. No. 22861

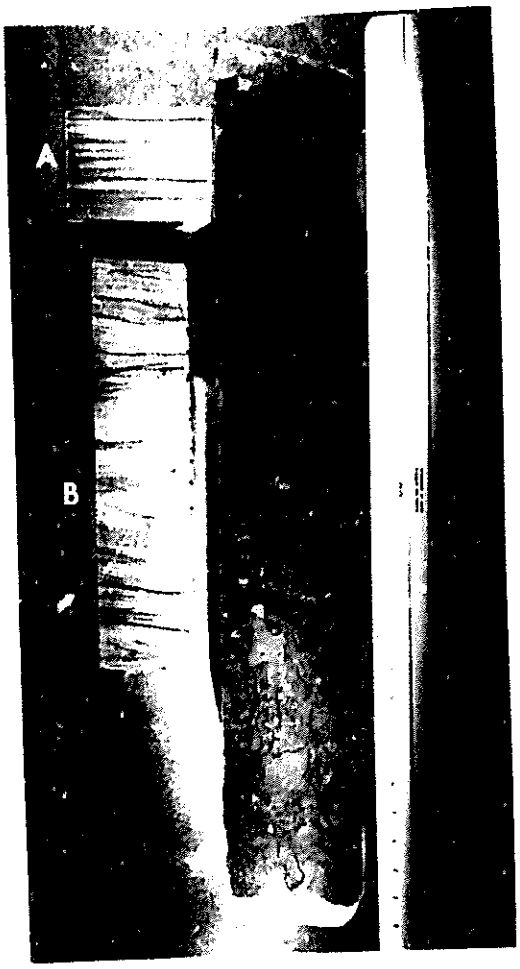

FIG. 3 Neg. No. 22860

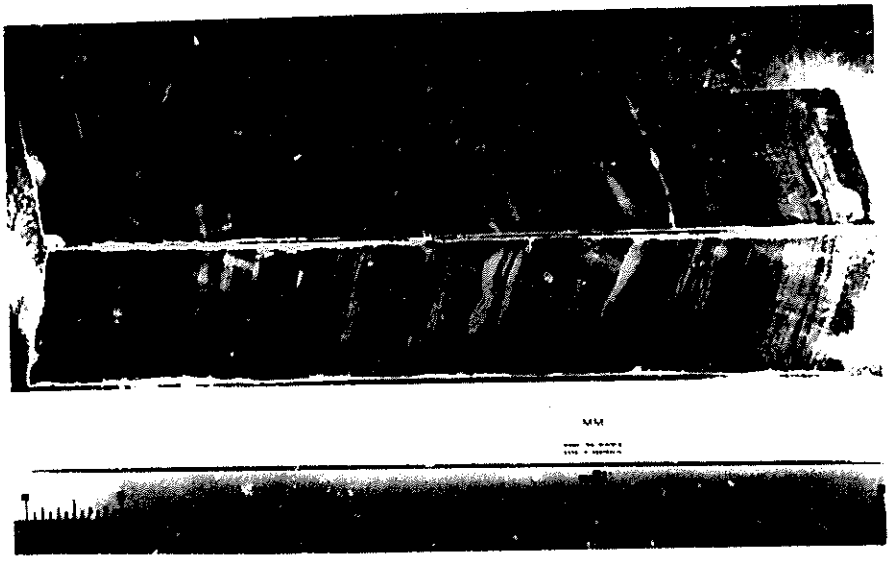

FIG. 4. Neg. No. 22842