SUB-BASALTIC SEDIMENTS AND METASEDIMENTS OF THE MERSEY-FORTH AREA

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(With one text figure and three plates.)

ABSTRACT

Lacustrine sediments and silicified river gravels, slope deposits, *in situ* weathered material and joint fillings of Tertiary age in the Mersey-Forth area are described. An assessment is made of Tertiary drainage directions and the degree of post-basalt downcutting.

INTRODUCTION

Investigations for the Mersey-Forth Power Development Scheme have shown that Tertiary sub-basaltic sediments and metasediments are widespread. Evidence has been found for the silicification of river gravels, slope deposits, *in situ* weathered material and joint fillings. Such silicified deposits and the lacustrine sediments permit the elucidation of the Tertiary drainage pattern and the extent of post-Tertiary basalt downcutting in the Forth River.

Brief mention is made by David (1950) of Tertiary basalt covered gravels between 400′ and 500′ above the level of the present Forth River. He writes generally of gravels, sands, clays with lignite, locally cemented and basalt capped, being spread over the country at altitudes of 200′ to 500′ generally on the interfluve ridges. Such a description could well be applied to some of the basins of Tertiary sediments in the area under consideration.

LACUSTRINE SEDIMENTS

Sub-basaltic and intra-basaltic lacustrine sediments are common in the Mersey-Forth area and typically range from stiff black clays to fine grained sands as seen in drill holes on the Wilmot Tunnel Line (Paterson 1967). Lacustrine sediments exposed on the new Wilmot Road at 560′ S.L. (Fig. 1, locality 1) are composed of grey-brown sands and silts overlying river gravels and grading up into thick white clays (Plate I, a). Boulders of silicified scree cap the sequence. Similar lacustrine sediments with well preserved plant remains and thin seams of carbonaceous material are exposed on the opposite bank of the Forth River on the H.E.C. Works Area Access Road at 909′ S.L. (Fig. 1 locality 2). Both outcrops show dips towards the river and it seems likely that the Tertiary River Forth was dammed by faulting downstream of Cethana Damsite or possibly by a basalt flow.

SUB-BASALTIC METASEDIMENTS (GREY BILLY)

More widespread than the Tertiary lacustrine sediments are the silicified deposits which lie beneath the basalt, close to the margins of the present basalt outcrop or in widely dispersed areas showing the former location of basalt flows. Their diagnostic features have been described by Paterson (1967) from the Moina area and they can be recognized by the same characteristics further afield. Several authors (Spry 1958, Jennings 1958) have described silicified deposits but have not recognized their genetic affinity to the local basalt flows. As investigations in the Mersey-Forth area have proceeded it has been realised that such silicified deposits, the grey billy of David (1950) and other authors, are more widespread than formerly supposed and it is expected that further detailed work will provide more evidence of their existence.

The best example of *in situ* grey billy is found on Emu Plains (Fig. 1, locality 3) close to the margin of the basalt outcrop where silicified scree deposits or *in situ* weathered material lie as a mantle over Precambrian quartzite bedrock (Plate I, b). The grey billy is composed of angular to sub-angular pebbles and occasionally cobbles of grey quartzite of local origin cemented by a grey saccharoidal siliceous matrix. The siliceous cement is extremely hard and has allowed the grey billy to be preserved as a resistant capping to the bedrock. An extensive search has revealed the presence of boulders of similar material around the margins of the basalt although often the constituents include many well-rounded quartz and quartzite pebbles.

To the north of Lemonthyme Creek and close to the Dove schist/Fisher quartzite junction (Fig. 1, locality 4) large blocks of grey billy are found between the basalt outcrop and the Forth River. They are up to 5′ in diameter and are composed of angular to well rounded pebbles and cobbles of grey quartzite or schistose quartzite set in a siliceous matrix. It is considered that their present location may be due to transport by ice flowing down Lemonthyme Creek (Paterson 1965).

Numerous blocks of grey billy are found along the new Wilmot Road (Fig. 1, localities 5 and 6) which runs from the Forth River to the Cradle Mountain Road over scree slopes of Moina Sandstone quartzite. The blocks are up to 15′ in diameter (Plate II, a) and are generally composed of silicified quartzite scree although some rounded material may also be present. The grey billy rocks, some of which may not be *in situ*, have a dip component towards the Forth valley.

In the area a mile north of Cethana Village (Fig. 1, locality 7), where the basalt overlies Cambrian bedrock, numerous boulders and cobbles both of quartzite conglomerate and silicified wood are found. No *in situ* exposures have been seen but drilling in the area showed the presence of amygdales of agate and chalcedony in the basal flows.

Jennings (1958) mapped 'conglomerate' on the north-east face of Cockatoo Ridge (Fig. 1, locality 8; Plate II, b) in the Round Mount area. It outcrops in a face 15′-20′ high and is composed of angular to rounded pebbles, cobbles and boulders of grey-pink quartz, quartzite, grit and conglomerate set in a granular siliceous matrix. It is structureless and boulders of Roland Conglomerate and Moina Sandstone up to 2′ diameter may be recognised. Jennings considers this is possibly a relic of a Permian till but due to its low elevation has tentatively interpreted it as being of Pleistocene age. The deposit bears all the characteristics of a sub-basaltic metasediment and is considered to be the result of silicification of river gravels and slope deposits by basalt flowing from Oliver Hill down Claude Creek valley towards the Forth River. Jennings' 'fluvioglacial deposits' lower on the same hillside are also considered to have the same origin although these are confused with recent slope deposits and possible outcrops of Roland Conglomerate.

Further up Cockatoo Road large blocks of Moina Sandstone are found between the road and Claude Creek (Fig. 1, locality 9). Some of these are believed to be *in situ* but many have tumbled from a terrace below the road. The upper surfaces and open joints of many of the *in situ* blocks show veneers or fillings of medium grained grey quartzite different in texture from the quartzite bedrock (Plate 3). The quartzite mantling the blocks is occasionally seen to run down into the open joints. It is considered that the quartzite mantling the blocks and filling the open joints has resulted from silicification by the basalt of sandy scree overlying the bedrock and infilling the major open joints.

Spry (1958) mapped 'fluviatile breccia' on the northern end of Magg's Mount at 2415′ S.L. (Fig. 1, locality 10). It occurs at the junction between the Precambrian quartzite and the Tertiary basalt and is composed of angular to well rounded pebbles and cobbles of light grey quartzite set in a sandy or dense siliceous matrix. It is poorly sorted. Although this out-crop is not well exposed it is considered to be a sub-basaltic metasediment similar to those described previously.

ORIGIN OF THE GREY BILLY

The occurrences of grey billy described in this paper bear out the hypothesis that silification occurred mainly as the result of silica-bearing solutions being introduced by the basalt and aided by the solvent action of heated pore water acting on silica already present in the sediments (Waterhouse and Browne), 1929; Raggatt, 1938). The presence of siliceous amygdales in the basal basalt flows near Cethana village and the general absence of grey billy except where the sediments are predominantly siliceous seem to support the hypothesis. Dr. G. A. Joplin has recognised a chalcedonic cement as being characteristic of finer-grained grey billy deposits and a quartz cement as being characteristic of the coarser-grained deposits (Paterson, 1967). It is possible that the cement may be related to the presence or absence of silica-bearing solutions accompanying the basalt but further investigation of grey billies in relation to their parent basalts is needed before any definite connection can be ascertained. Certainly permeability of the sediments must have been a strong factor in their susceptibility to silicification. G. Urquhart (pers. comm.) has mapped similar grey billies in the Savage River area where metasediments are intercalated with unsilicified deposits.

The original sediments seem to be variable and often heterogeneous in character. The silicified well sorted sands and gravels of the Moina area contrast strongly with the silicified scree deposits of Emu Plains and the new Wilmot Road. However the Lemonthyme, Magg's Mount and Cockatoo Ridge grey billies are characterized by the appearance of markedly angular and well rounded material in the same deposit. It is considered that much of the angular material must have been carried down the scree slopes into the valley bottoms by the flow of the basalt into the drainage channels.

CONCLUSIONS

Recognition of silicified sub-basaltic sediments permits further elucidation of the Tertiary drainage pattern. Flows into the Cethana Damsite area were towards the ancestral Forth River, which occupied a similar course to that of the present day, and are shown by the presence of grey billy outcrops along the new H.E.C. Wilmot Road at successively lower levels proceeding down to the edge of the present Forth Valley. The level of the river gravels underlying the lacustrine sediments to the west of the Forth River corresponds well with the level of the upper valley in the valley-in-valley structure of the Cethana Damsite area. This suggests that some 170′ of downcutting has occurred in pre-Tertiary rocks since the deposition of the lake sediments. Well compacted river gravels of probable Tertiary age which are found down to at least 710′ S.L. upstream of Cethana Damsite support this view.

Tertiary pre-basaltic relief in the Mersey-Forth area was probably of the order of 1000′ with deeply incised valleys separated by interfluves whose surfaces showed prominent though not rugged topography. The incision of the valleys is exemplified by the steep-sided buried channel recently located at Wilmot Damsite (Paterson 1967).

ACKNOWLEDGMENTS

The author is indebted to the Hydro-Electric Commission of Tasmania for permission to publish the information contained in this paper.

Grateful acknowledgment is made to S. J. Paterson for helpful discussion and to F. Ramshak for assistance in the preparation of Figure 1.

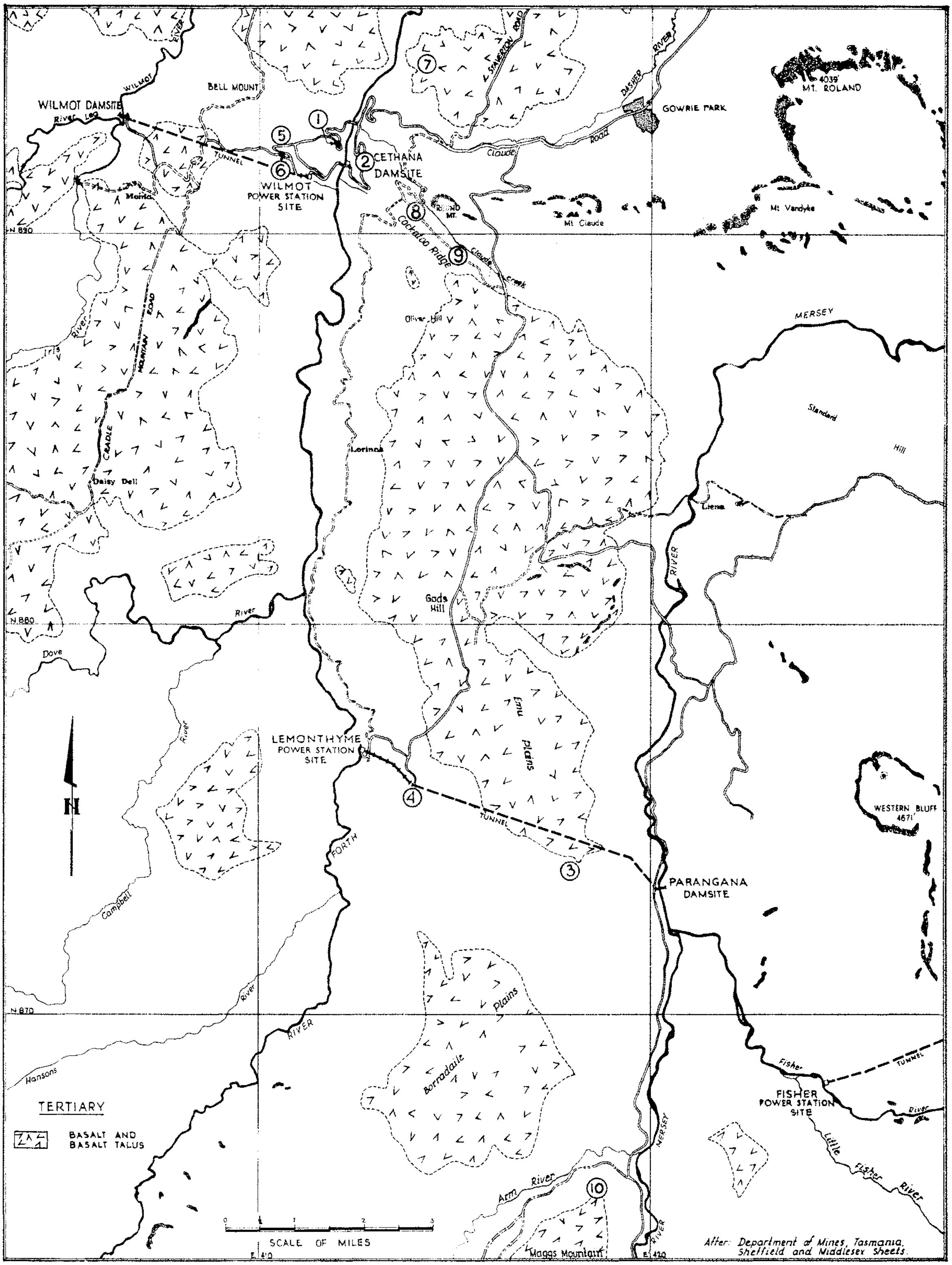

FIG. 1.—Location of Sub-basaltic Sediments and Metasediments.

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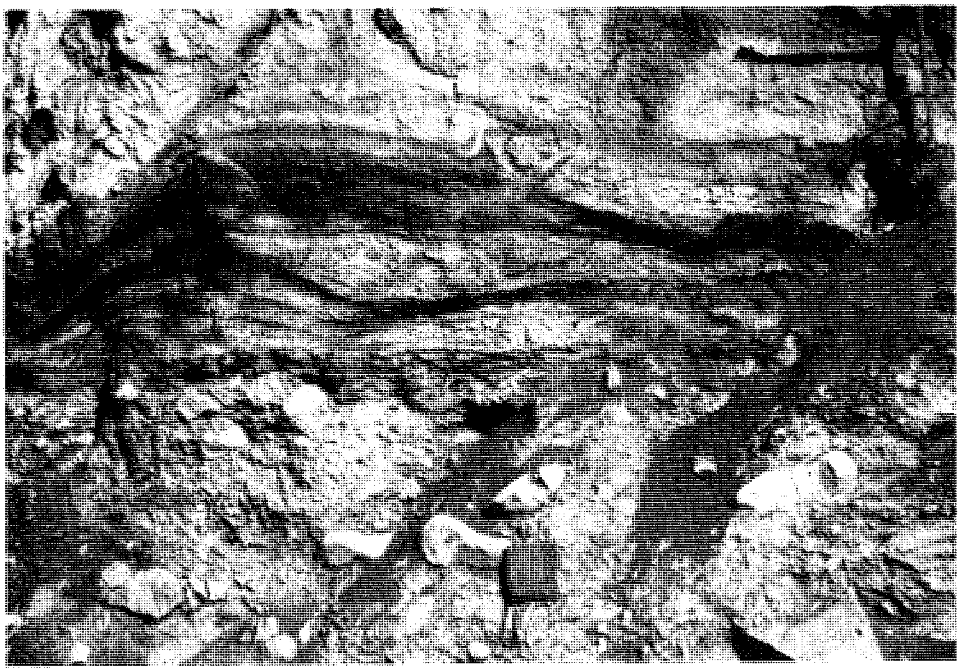

PLATE I (a)—Tertiary lacustrine sediments overlying river gravels. Strong leaching shown by banding. New Wilmot Road. (Fig. 1, Locality 1).

PLATE I (b)—Grey billy mantling Precambrian quartzite. Emu Plains (Fig. 1, Locality 3).

PLATE II (a)—Silicified quartzite scree. New Wilmot Road. (Fig. 1, Locality 6).

PLATE II (b)—Silicified river gravels and/or slope deposits. (Fig. 1, Locality 8).

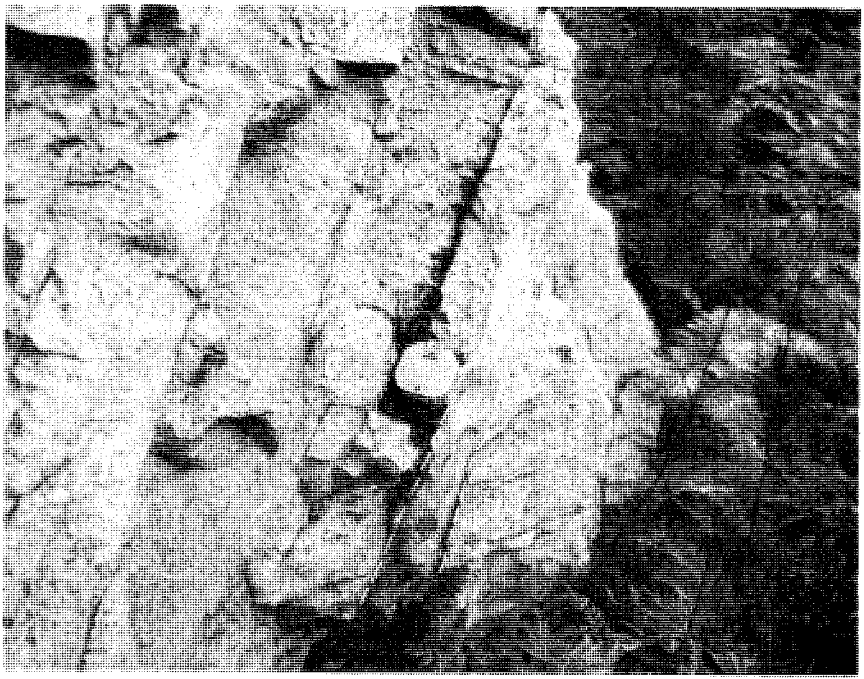

PLATE III.—Grey billy filling joint in Ordovician quartzite.