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TERTIARY DEEP LEAD DEPOSITS IN THE MOINA AREA

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with a Petrographic Note on Grey Billy by Dr. Germaine A. Joplin.

(With two plates and six text figures.)

ABSTRACT

Tertiary deep lead deposits in the Iris-Lea River Valley and the Basalt-Bell Creek Valley are described. Sediments total 280′ in thickness, have an upper layer of grey billy, and are capped by basalt and basaltic breccia. The bottom of the leads lies at up to 150′ below the level of the present drainage and a reversal of drainage direction may have taken place.

INTRODUCTION

The following information is the result of investigation of the Wilmot Power Scheme, a proposal to divert water from the Wilmot River to the River Forth as part of the Mersey-Forth Power Development.

The Tertiary deposits examined lie in the Iris-Lea River Valley and the Basalt-Bell Creek Valley, both of which lie in the trough of a broad, faulted basin folded in Ordovician rocks. The area forms part of the Department of Mines Sheffield Geological Sheet, which was published in 1959.

PHYSIOGRAPHY AND PHYSIOGRAPHIC HISTORY

The basin has strong topographic expression with the altitude of the rim, which is formed of Ordovician sandstones and quartzites, ranging from 2000′ to 3000′, whereas the trough, which contains Ordovician limestone, lies at about 1460′.

Both the Wilmot and Forth Rivers are actively degrading superimposed rivers that in general flow transverse to the structural trend. The River Forth is more deeply incised than the Wilmot River and at Cethana Damsite the bed of the River Forth lies at an altitude of 415′, whereas the bed of the Wilmot River lies at 1460′ at Wilmot Damsite.

Both river systems were affected by faulting and volcanic activity during the Tertiary. The probable course of the "Lorinna Lead" (Figure 2), the Tertiary ancestor of the River Forth, has been determined by Spry (1958) and by Burns and Gee (1962) from studies of the base of the Tertiary basalt. The basalt is thought to have flowed into the old valley system and displaced the drainage. Locally, as in the vicinity of Cethana Damsite, the present river occupies a similar position to the Tertiary stream, for Tertiary river gravels and lake sediments occur on both sides of the valley down to about 250′ above present river level. Also basalt tongues run into the Forth Valley and boulders of relic grey billy indicate the former presence of basalt.

The Wilmot River was similarly affected, but in this case a reversal of drainage direction seems likely. The probable course of the Tertiary stream (Figure 2) that was ancestral to the Wilmot River, the "Moina Lead", was determined by Burns and Gee (1962) by a study of the base of the basalt, and observations made during the investigation of the Wilmot Power Scheme are in agreement with their conclusions. Drilling on the spur adjacent to the left abutment of Wilmot Damsite (Plate 1) revealed the presence of a buried river channel (Figures 3 & 4) filled with Tertiary lake sediments capped by grey billy, and the course of the channel has been outlined by a resistivity survey. Similar sediments overlain by volcanic breccia were found by drilling above the proposed tunnel line in the Basalt Creek Valley (Figures 1 & 5), which lies between the Wilmot River and the Cradle Mountain Road. The extent of this deposit has been outlined by further drilling and by seismic refraction surveys.

At Wilmot Damsite the lowest point so far located on the channel bottom is at an altitude of 1330′, which is 130′ below the bed of the present Wilmot River. In the Basalt Creek Valley the lowest point located on the lake bed is at an altitude of 1550′, which is 150′ below the present creek bed.

The Wilmot River crosses a branch of the Tertiary river system immediately below the damsite, and the presence of soft sediment in the river bed and banks is the reason for the wide deep pond at this location. This buried channel, however, does not rejoin the Wilmot River further downstream, for a continuous exposure of bedrock occurs in the river bed for some miles downstream at a level well above the base of the Tertiary stream. A search was made along the northern rim of the basin for an outlet, but again continuous quartzite and sandstone outcrop precludes drainage in this direction. No outlet to the north was found from the Basalt and Bell Creek Valleys. Late Tertiary faulting may have elevated the divide, but when considered in conjunction with Burns and Gee's reconstruction of the "Moina Lead" it is reasonable to conclude that the buried channels flowed to the south before turning east to join the "Lorinna Lead".

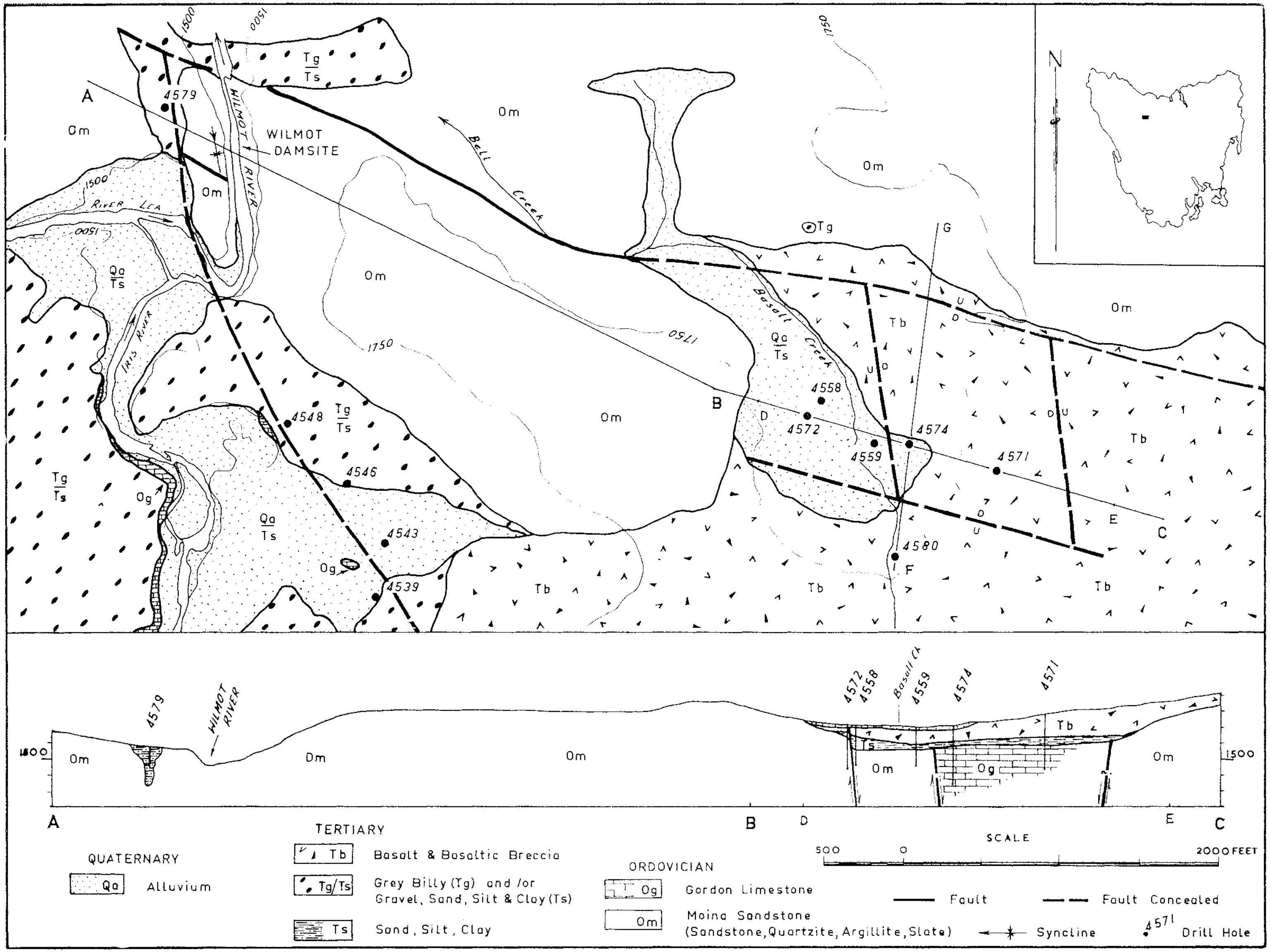

FIGURE 1.—Tertiary Deposits in the Moina Area.

The Tertiary stratigraphy indicates that disruption of the drainage system, probably by faulting, produced a system of lakes in which some 280′ (Buried Channel-Wilmot Damsite) of sand, clay and gravel accumulated. Lacustrine sedimentation was followed by volcanic activity which covered the area with basaltic breccia and basalt flows causing further disruption of the drainage system.

STRUCTURE

The major structure is a broad faulted basin that trends N.N.W. and is approximately 6 miles long by 4 miles wide. It is folded in Ordovician Roland Conglomerate, Moina Sandstone and Gordon Limestone. Within the basin the rocks are folded into tight minor folds of wave length varying from 100′ to 1000′. These folds are well exposed in the Lea and Wilmot River gorges, where they trend N.W. and plunge to the S.E. at between 5° and 25°. The synclinal ridge forming the left abutment of Wilmot Damsite is one of these folds.

Major faults trend in two directions. A N.N.W. trending fault controls the course of the buried channel on the western side of the damsite. A W.N.W. trending fault controls the buried channel that crosses the Wilmot River just downstream of the damsite. A W.N.W. trending normal cross-fault cuts the left abutment ridge just upstream of the damsite. A combination of these fault systems appears to define a fault trough in which the Ordovician limestone is preserved in the Basalt Creek Valley. The Tertiary lacustrine sediments are centered on and spill over from this trough.

STRATIGRAPHY

Ordovician

Moina Sandstone

The Moina Sandstone (Jennings, 1959) is the oldest formation exposed in the trough of the basin. It is correlated with the Caroline Creek Sandstone for which an Ordovician (Arenigian) age (Banks, 1961) has been established. The formation has been observed (Jennings, 1963) to conformably overlie the Roland Conglomerate on Mt. Roland.

In the Wilmot area the sequence consists of interbedded sandstones, quartzites, argillites, shales and slates. Spry (1963) examined specimens from drill holes on the damsite and penstock line and concluded that all appear to have been slightly thermally metamorphosed. This probably occurred during intrusion of the Devonian Dolcoath Granite, which outcrops on the River Forth just upstream of Cethana Damsite.

The sandstones are white, grey or pink and fine to medium-grained. Spry found them to be composed of angular to sub-rounded grains of quartz averaging 0.1 mm. in diameter surrounded by about 10% of matrix, which has been recrystallized to fine muscovite. The metamorphic mica is randomly arranged where it occurs with abundant quartz, but tends to be parallel to the bedding in the more pelitic types. Biotite, sericite and chlorite are present in the matrix of some specimens, and some are cut by sub-parallel to irregular fractures now filled with quartz. The sandstones grade into dense, white and saccharoidal quartzites. The argillaceous rocks grade from shales to argillites to slates.

At Wilmot Damsite a section totalling 170′ has been measured. This section contains an upper member (80′ thick) in which argillites, shales and slates are dominant and a lower member (90′ thick) dominated by sandstone and quartzite. The base of the section is not exposed. Tubicolor and brachiopod casts are abundant.

Gordon Limestone

Isolated outcrops of limestone occur in the Iris River Valley and limestone was encountered in Drill Holes 4571 and 4574 (Figure 5) in the Basalt Creek Valley. The limestone is lithologically similar to and occupies the same stratigraphic position as the Gordon Limestone, which Jennings (1963) observed to conformably overlie the Caroline Creek Sandstone south and east of Standard Hill.

The limestone is banded light to dark bluish-grey, compact, hard and grades from a calcilutite to a calcarenite. It contains some argillaceous beds. Drill Holes 4571 and 4574 in the Basalt Creek Valley were completed in limestone and the maximum stratigraphic thickness measured was 240′.

Tertiary

Lacustrine Sediments

Drill Holes 4558, 4559, 4571, 4572 and 4574 in the Basalt Creek Valley (Figure 5) revealed the presence of Tertiary lacustrine sediments, soft black clay containing bands of dark grey and white fine-grained sand, underlying basaltic breccia and resting unconformably on Moina Sandstone and Gordon Limestone. A maximum thickness of 85′ of sediment was found in Drill Hole 4558.

Similar clays and sands were encountered in the Iris River Valley in Drill Holes 4539, 4543, 4545 and 4548, and in Drill Holes 4565-68, 4577-79, 4581 and 4582 in the buried channel (Figure 3) on the western side of the left abutment of Wilmot Damsite. The lower part of the channel deposit is composed of light to dark grey, fine to medium-grained sand containing a few bands of dark grey clay up to 3′ thick. The upper part of the deposit is composed of black clay containing bands of dark grey to black fine-grained sand from 3′ to 20′ thick. These sands and clays underlie grey billy, and the total thickness of the channel filling is about 280′. The sediments in both valleys are considered to have been deposited in the same lake system, which was later overrun by basalt or filled with basaltic breccia.

Wayne K. Harris of the South Australian Department of Mines has examined cores for spores and pollen from the buried channel adjacent to Wilmot Damsite and from the Basalt Creek Valley. His results are to be incorporated in a paper on Tasmanian Tertiary microfloras, but he has supplied the following personal communication. Drill Hole 4578 at the Wilmot Damsite failed to yield any spores or pollen. In the core from Drill Hole 4574, from the Basalt Creek Valley, 87′ of basaltic breccia overlie 38′ of indurated carbonaceous clay, and well preserved assemblages were obtained from the top 13′, but the remainder of the deposit was barren. Good assemblages were obtained from near the breccia boundary and fragments of breccia appear in the clay indicating a close relationship in time. The assemblages are similar to those in

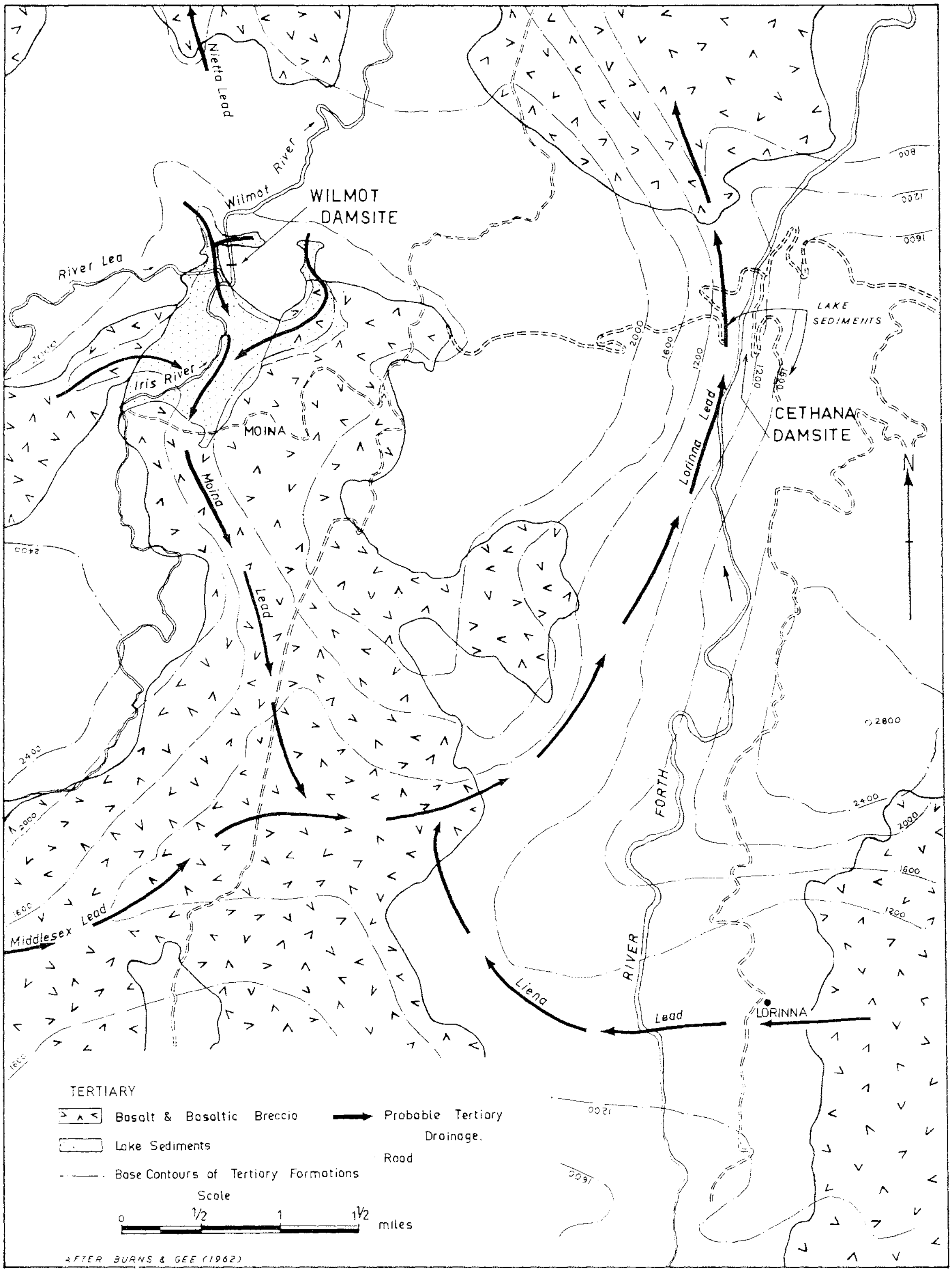

FIGURE 2.—Probable Tertiary Deep Lead Systems in the Moina-Cethana Area.

the Fossil Bluff Sandstone of N.W. Tasmania and Harris refers them to the Lower Miocene.

Bell Creek and its tributaries Mosquito, Poverty and Basalt Creeks were the site of a small alluvial gold field around 1900, and it is estimated (Twelvetrees, 1913) that some 4,000 ozs. of gold were won. The gold was obtained from alluvial gravels that bottomed in part on limestone and slate. Frequently the gold was obtained from immediately above a black clay pug, which the present writer considers to be part of the Tertiary sequence. The source of the gold was not found, but the gold probably originated close by to the north in the Ordovician sandstones and conglomerates on the southern flank of Bell Mount. As Twelvetrees pointed out it is unlikely to have come from the south for in this case it would be mixed with tin and wolfram ore from the Moina Area. The gold bearing gravels were probably reworked gravels of the Tertiary Drainage System.

Grey Billy

Grey billy caps prominent terraces on both sides of the Iris River and occurs as isolated remnants along the banks of the Lea River and along the buried channel west of Wilmot Damsite.

Grey billy occurs as blocks of siliceous conglomerate up to 15′ square on the Iris River Terrace (Plate 2, Figures 1 & 2). The conglomerates contain bands of sub-horizontal and cross-bedded, fine to coarse-grained siliceous sandstone, and these rock types resemble the Ordovician Roland Conglomerate. The conglomeratic grey billy is composed of rounded pebbles, cobbles and boulders of pink and white quartzite and white quartz, together with sub-angular to sub-rounded grains of quartz and feldspar set in a siliceous cement of chalcedony and/or quartz. The boulders are only sparsely jointed and quartz veins are absent. Under the microscope the quartz grains show expansion of the borders or diffuse borders with undulose extinction as a result of recrystallization. The framework varies from closed to open and the chalcedonic cement ranges from 5% to 25%. The fine-grained grey billy is composed of about 80% quartz grains and some grains of feldspar, with an average grainsize of 0.3 mm. 15% iron ore and 5% chalcedony. The framework varies from open to closed, and the cement is formed of chalcedony and recrystallized quartz. The quartz grains commonly contain inclusions of black opaque material which has been overgrown by optically continuous quartz. A description of some slides of the grey billy by Dr. Germaine A. Joplin is given as an appendix.

Under the microscope the conglomeratic and fine-grained grey billies can generally be distinguished from Roland Conglomerate rocks by the presence of chalcedonic cement and by the absence of mineralization and quartz veins. At Cethana Damsite a typical Roland Conglomerate is composed of sub-rounded to rounded quartzite and quartz pebbles and cobbles cemented by a fine-grained quartzose cement that is often accompanied by hematite. Mineralization is common throughout and patches are rich in pyrite, hematite, chlorite, siderite, arsenopyrite and tourmaline. Clay minerals occasionally are present and quartz veins are abundant.

The blocks of grey billy on the Iris River Terraces (Plate 2, Figures 1 & 2) are shown as landslide debris on the Department of Mines Sheffield Geological Sheet, and were thus presumably mistaken for boulders of Roland Conglomerate. The sub-horizontal attitude of the bedding of individual blocks clearly indicates that they are not the product of slope movement or ice transport, and the presence of chalcedony as the cementing agent, the lack of jointing, and the absence of quartz veins suggest silicification in place. The material silicified was apparently the upper surface of the Tertiary lake deposit; an aggraded gravel and sand piedmont plain.

The grey billy found along the buried channel (Plate 2, Figures 3 & 4) is more readily recognised. It occurs in outcrops with a visible thickness of 20′ and up to 75′ by 50′ in area. It is a siliceous breccia composed of angular to sub-angular boulders, cobbles and pebbles of pink and white quartzite, tubicolar sandstone (Moina Sandstone) and quartzite conglomerate (Roland Conglomerate) together with quartz grains in an open chalcedonic matrix. It is obviously a silicified scree, younger than both the Roland Conglomerate and Moina Sandstone.

Basalt covers large areas within the Iris-Lea River Valley and it is thought that silification occurred at the base of the basalt. Occurrences in Australia for which such an origin has been postulated have been discussed by Waterhouse and Browne (1929), Raggatt (1938) and Williamson (1957). Waterhouse and Browne suggested that silicification was accomplished by siliceous solutions introduced by the basalt aided by the solvent action of heated pore water acting on silica already present in the sediments.. This hypothesis is favoured for the Wilmot occurrences.

Rawlings (in press) has recognised grey billy beneath basalt on the eastern slope of the Forth Valley near Lemonthyne Creek and below the basalt plateau ¾ mile north of the old Cethana Village. Some outcrops at both localities resemble Roland Conglomerate on casual inspection, but silicified scree was also found at Lemonthyne and silicified wood was found near Cethana. Drilling at the latter locality showed the presence of amygdales of agate and chalcedony in the basal basalt flows indicating that siliceous solutions accompanied some of the volcanic activity. Rawlings has examined a siliceous deposit on Cockatoo Road near Cethana that was tentatively interpreted as a Pleistocene tillite by Jennings (1958) and concludes that this is a Tertiary grey billy. He has also examined a siliceous breccia on Maggs Mount that was described by Spry (1958) as a Tertiary fluviatile breccia and concludes this also is a Tertiary grey billy. Thus it can be seen that grey billy is widespread in the Wilmot-Mersey-Forth area.

The problem of recognizing grey billy raises the question of whether mistakes in identification have been made in other areas. This question is pertinent to the distribution of Ordovician conglomerates, with which grey billy is easily confused, and to the extent of ice transport during the Pleistocene where this is based on the occurrence of large boulders of siliceous conglomerates, identified as Ordovician conglomerates, scattered over the landscape.

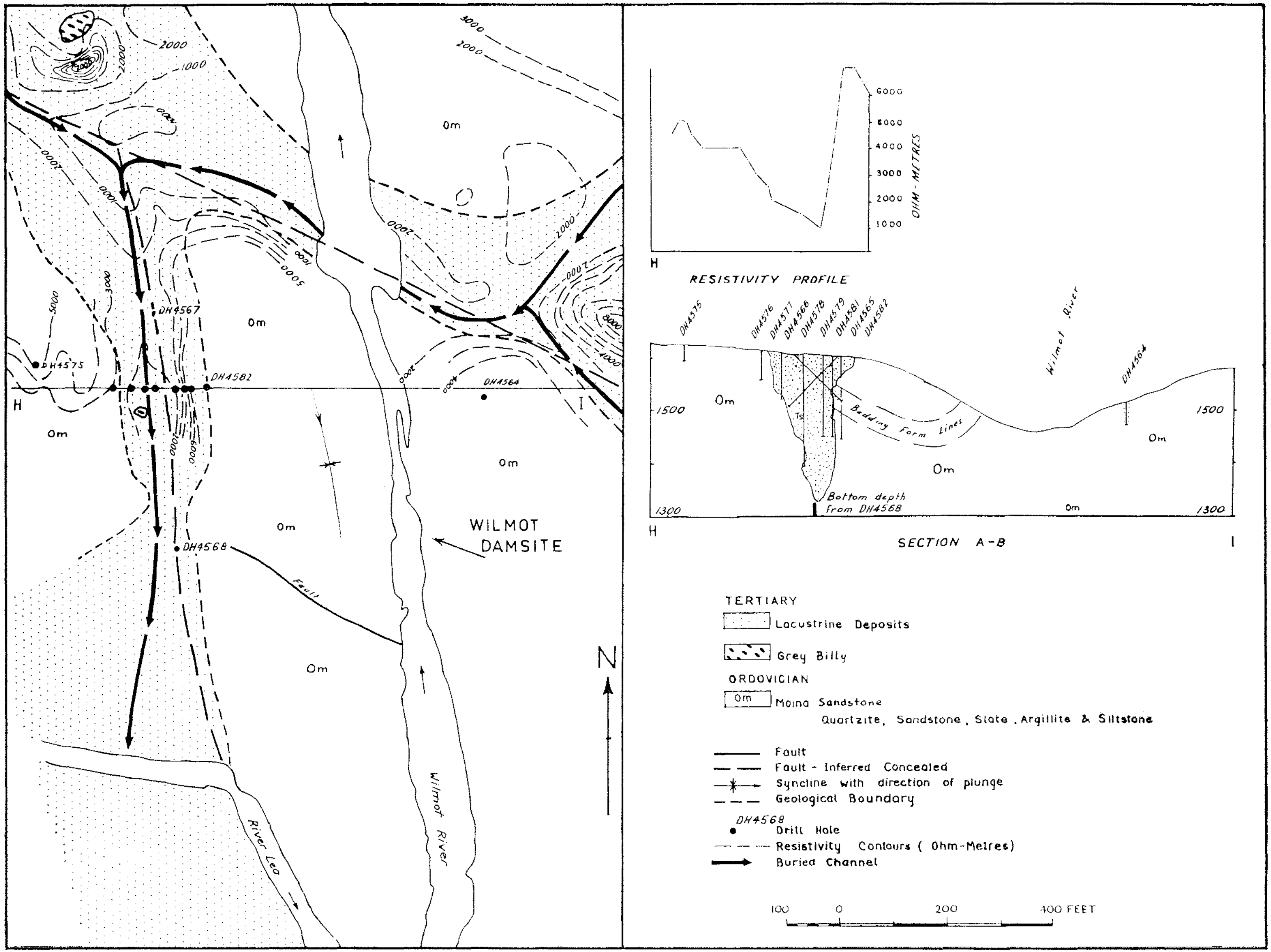

FIGURE 3.—Tertiary Deep Lead at Wilmot Damsite.

Basalt and Basaltic Breccia

Basalt and basaltic breccia blanket a large part of the Iris, Lea and Basalt Valleys. In the Basalt Valley Drill Hole 4571 passed through 139′ of weathered to partially weathered breccia, containing a number of bands of indurated black clay up to 11′ thick, before encountering the main lacustrine deposit. The rocks contain boulders of vesicular basalt up to 2′ diameter and fragments of volcanic glass in a basaltic matrix. The thick breccia sequence suggests the nearness of a centre of activity.

Petrographic Description of Grey Billy from the Moina Area by Dr. Germaine A. Joplin

The grey billy consists mainly of quartz grains and some grains of feldspar in a silica cement. Coarser types may also contain small pebbles of quartzite and some specimens contain an appreciable amount of a black opaque substance which may be graphite or an iron ore. This black material occurs in intergranular spaces and as a film around quartz and feldspar grains. Grains are rounded and are less commonly angular and range in size from about 6 mm. to less than 0.1 mm.

The silica cement may consist of quartz and/or chalcedony, the latter being present mainly in the finer grained parts of the rock, and in the quartzite pebbles of the coarser grained types. The finer grained rocks (e.g., Specimen 2) consists of small quartz and feldspar grains in a cryptocrystalline cement in which small spherules of radiating chalcedony may be distinguished. In some places a narrow rim of chalcedony surrounds the mineral grain.

Rocks containing a quartz cement are commonly coarser grained, because quartz grains have been overgrown by optically continuous quartz and thus enlarged. Where the original grain has been manteled with a film of black opaque material, this is enclosed by the quartz overgrowth.

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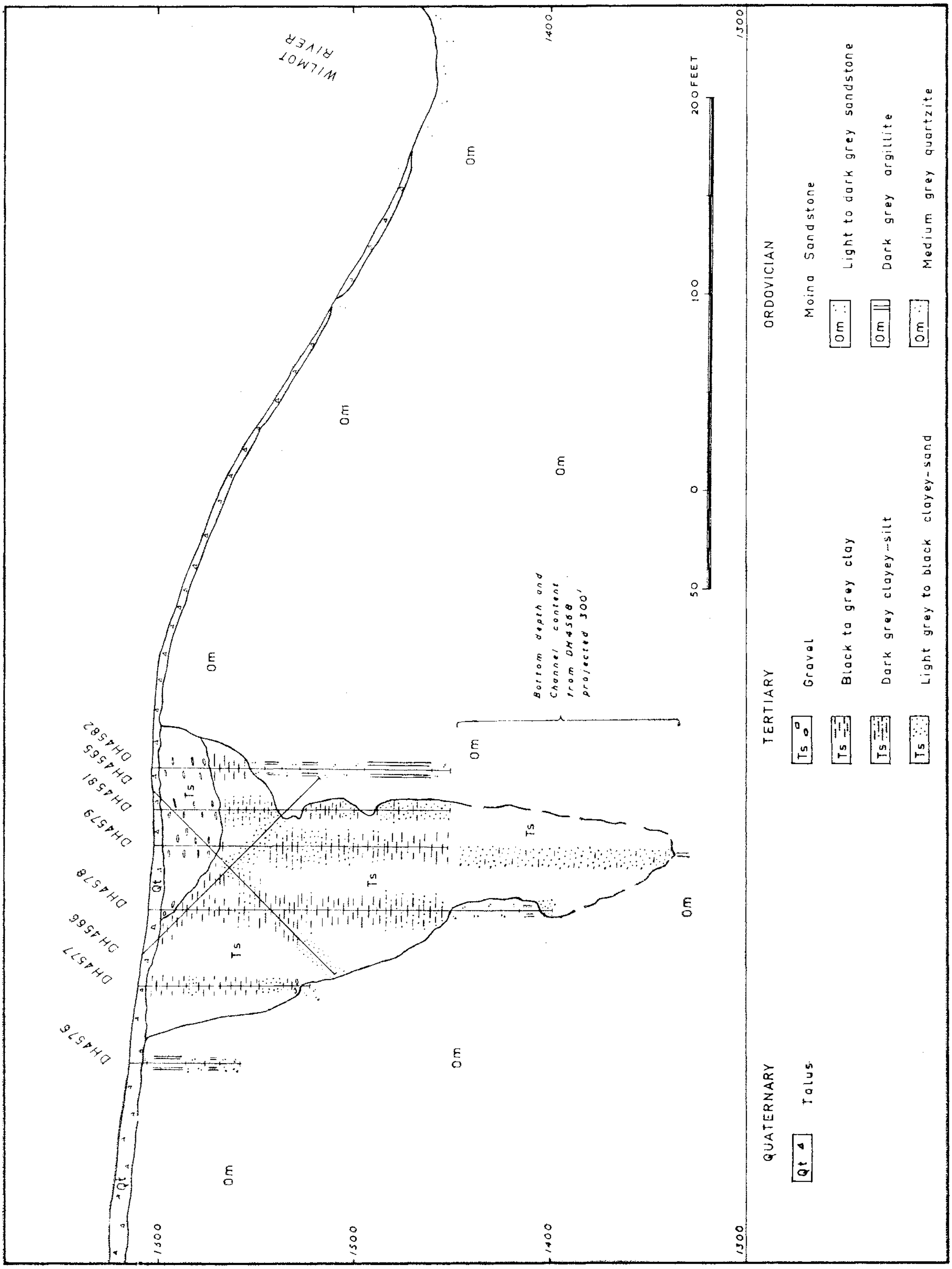


FIGURE 4.—Details of the Tertiary Deposits in the Deep Lead at Wilnot Damsite.

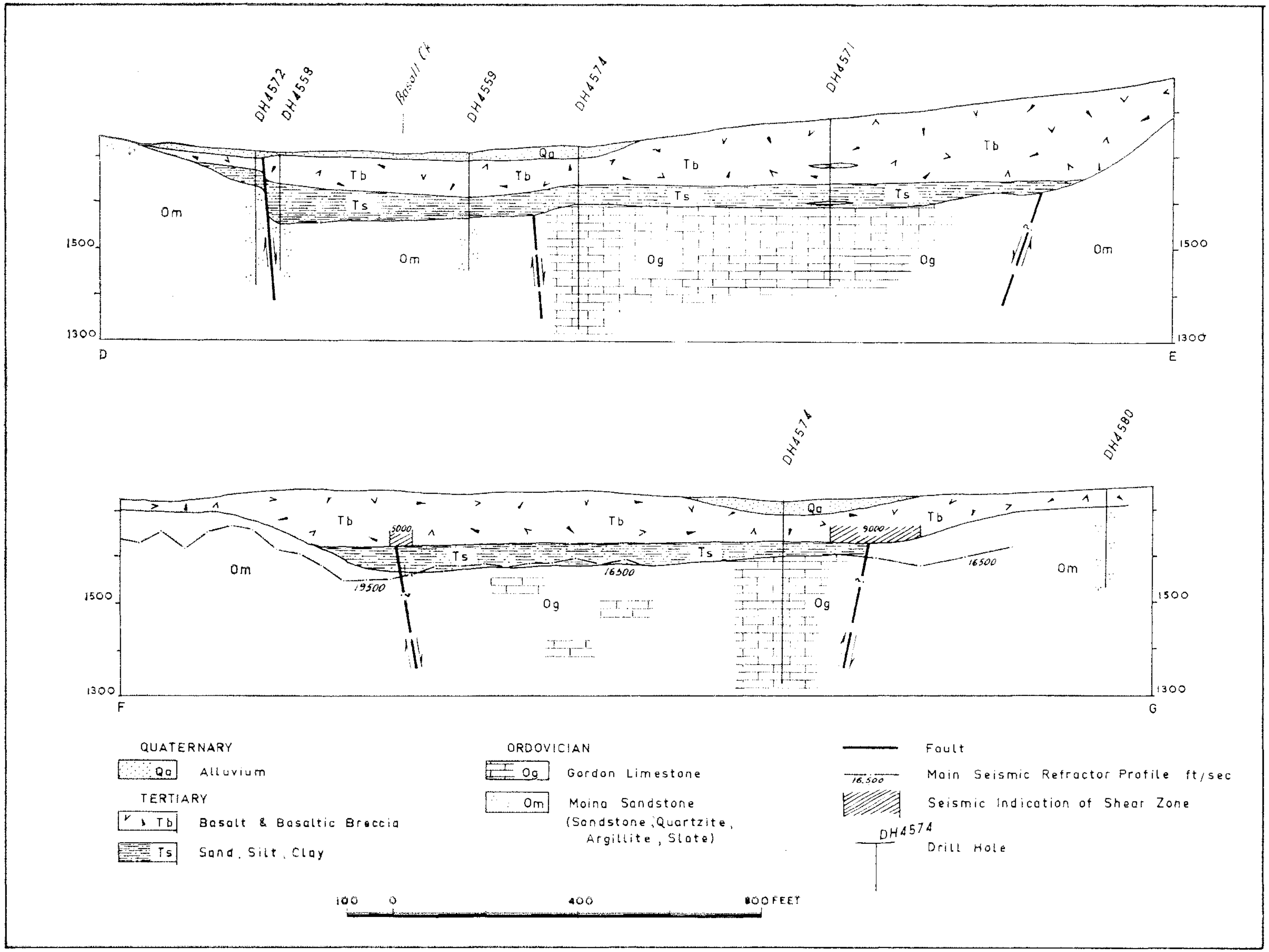


FIGURE 5.—Details of the Tertiary Deposits in the Basalt Creek Valley.

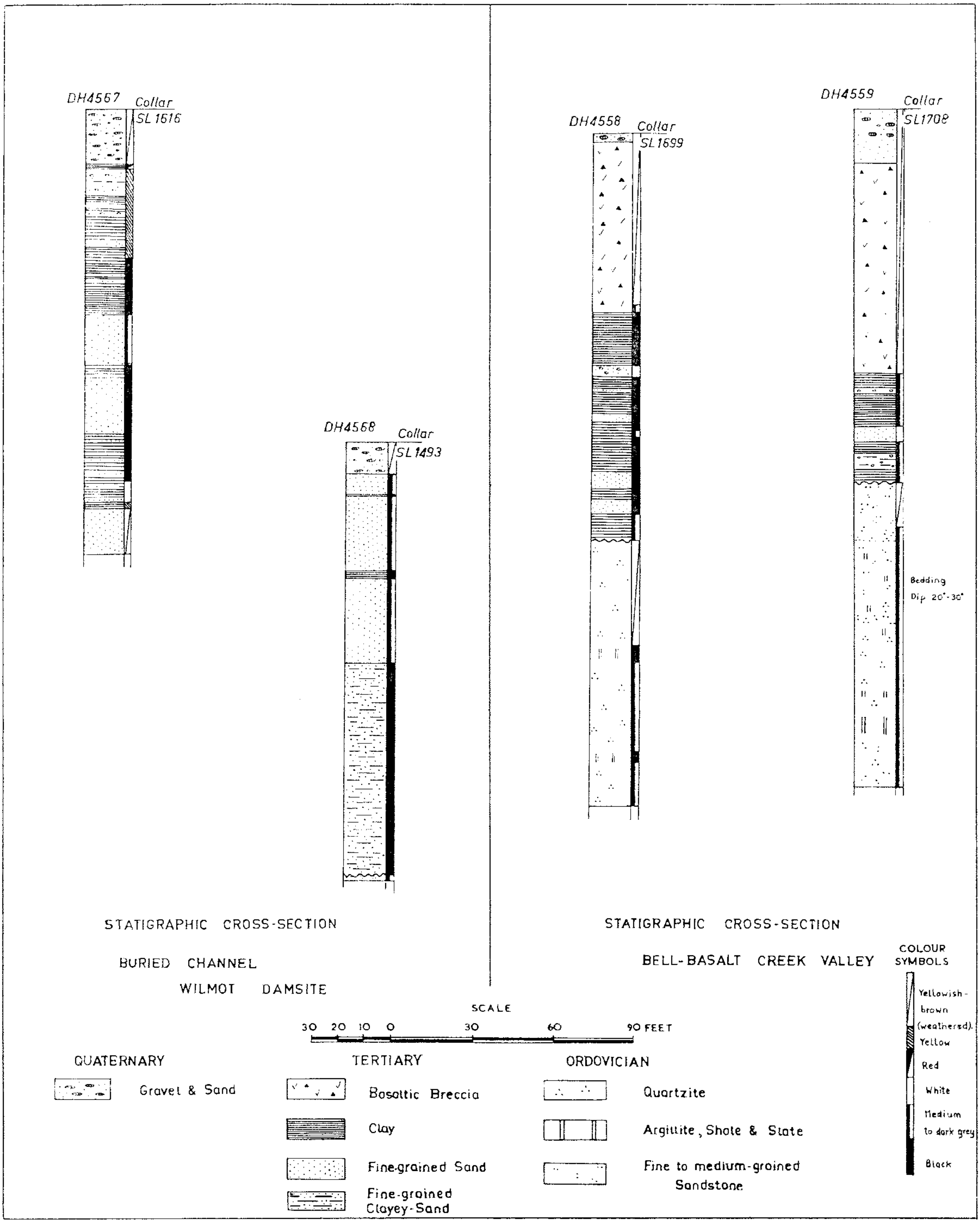
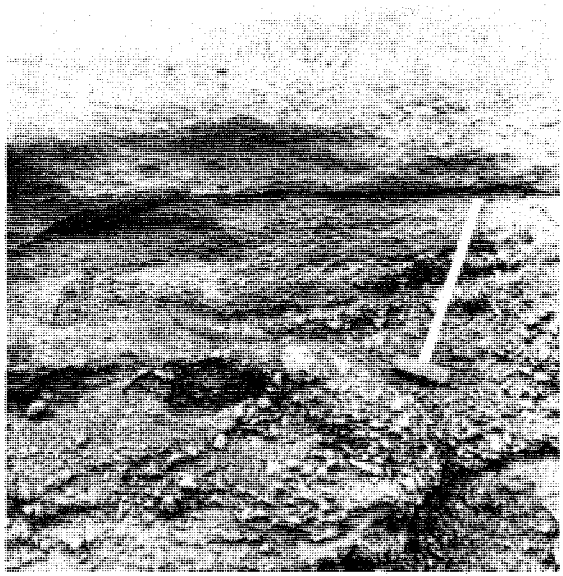


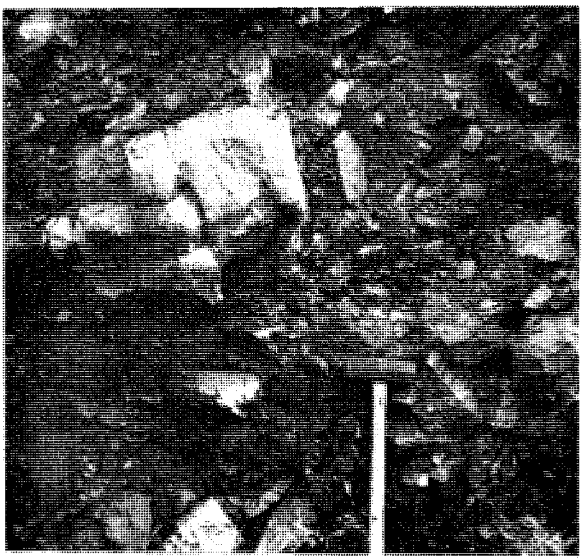
FIGURE 6.—Stratigraphic Cross-Sections.

Plate I.—The left abutment of Wilmot Damsite showing a synclinal fold in Ordovician sandstone, quartzite and argillite. A Tertiary deep lead crosses the spur just above the abutment.

PLATE II.



FIGURES 1 & 2.—Tertiary grey billy on the Iris River Terrace. A silicified gravel piedmont plain deposit showing sub-horizontal bedding.



FIGURES 3 & 4.—Tertiary grey billy above the deep lead adjacent to Wilmot Damsite. A silicified talus showing angular pebbles and boulders. Note the tubicolar sandstone boulder in Figure 4.