The Ecology of the Hutt Valley

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Geology of the Hutt Valley

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Within the watershed of the Hutt Valley there are only two periods of sedimentation; a very long hiatus separates them.

These two groups are (1) the very sparsely fossiliferous Mesozoic greywackes, and (2) the Quarternary terrestrial and estuarine sediments of the Hutt Valley.

Very little is known about the greywackes of the Wellington district. The folding is intensely complex in most areas and some at least have been folded in several directions. The strikes are erratic in the Fitzherbert-Wainuiomata ridge. Northwards in the Whitemans Valley–Silverstream region the strikes are systematically 045°T., and in the Rimutaka Range east of the Orongorongo crush zone the strike is regularly 040°T. Running through the Orongorongo Saddle, Whitemans and Mangaroa Valleys is an ancient healed fault, the Orongorongo crush zone. This is a zone of autoclastic breccia some 400 yds. wide, within which faulting has so pulverised both sandstone and argillites that the rock forming the zone has the macroscopic appearance of a dark grey argillite with stringers of sheared and rolled sandstone containing an unusually large number of parallel quartz veins. The crushed sediment has been indurated to a degree of hardness only slightly less than that of the argillites of the original "greywackes". In a few places a fault pug showing recent movement has been observed in the Orongorongo crush zone.

Wellington Fault

The Wellington fault was first described by Bell (1910) and named by Cotton (1912). Lensen (1958) mapped the surface traces in the upper reaches of the Hutt Valley.

Cotton (1914, 1921) drew attention to aggradation due to transcurrent buckling east of the fault in the Wainuiomata and Mangaroa valleys.

The upthrown western side of the fault forms the western wall of the Hutt Valley. On the downthrown side east of the fault there is a filling of alluvial and estuarine sediments deposited by the Hutt River.

In addition to the vertical component is a large transcurrent component displacing the western block north-eastwards with respect to the downthrown block.

Pleistocene

The writer's recent work on the Pleistocene deposits of the Hutt Valley has shown an excellent sequence through the greater part of the Pleistocene. In the Kaitoke area the Hutt River has been fixed in its course by superposition from an early Pleistocene aggradational plain on to a greywacke terrain sufficiently resistant to prevent the destruction of the old alluvial plain. For this reason the early Pleistocene record is nearly complete in the Hutt Valley.

While the upper reaches of the river have undergone cold climate aggradation, the lower reaches have been affected by interglacial and post-glacial rises of sea level. Continuous movement, both vertical and horizontal, on the Wellington fault, has lifted terrace remnants west of the fault. A fresh greywacke wall restrains river erosion to the north-west, and preserves these fragments of the older terraces.

The exposed Pleistocene in the Hutt Valley includes both the cold climate terraces and interglacial terraces to form a dovetailing sequence with relatively small gaps between cold and interglacial stages. This sequence is shown in Table 1. The distribution of the sediments is shown on the accompanying map.

In this paper it is proposed to describe only the most important characteristics of the sediments of the various stages.

Kaitoke Cold Stages

The Kaitoke gravel group is a very thick accumulation of almost completely unsorted greywacke gravel, sand and mud. The maximum thickness is 350 ft. While the average boulder size is 4 to 9 inches an appreciable number of boulders up to 4 ft. in diameter are present in the lower portions of the formation. Only one 6 in. lens of sorted mudstone has yet been seen in the whole thickness of aggradation gravels.

As well as the upper surface of the Kaitoke gravels there are two consistent matchable levels of even topped ridges within the main mass of Kaitoke gravels, at a level lower than the upper surface. There is little doubt that these ridges represent remnants of former extensive terrace surfaces. Below the higher of these two ridges and unconformable with older highest Kaitoke gravels a profile through a sequence of peats and carbonaceous mudstones has been examined by Drs. W. F. Harris and R. A. Couper. The pollen analysis is described by W. F. Harris in this symposium. It clearly shows a severe deterioration in climate as aggradation proceeded.

Formation	*Stage	
Hutt	Silverstream	Holocene
Trentham		
Pakuratahi	Pakuratahi Cold stage	Upper Pleistocene
Stoke Alluvium	Stoke Interglacial stage	
Whiteman Gravels	Whiteman Cold stage	
Belmont Gravels	Belmont Interglacial stage	Lower Pleistocene
Emerald Alluvium	Emerald Cold stage	
Normandale Allumium	Normandale Interglacial stage	
Kaitoke Gravel Group	Kaitoke Cold stages	

*While conforming to the usage of the term "stage" customary in literature on the Quaternary Epoch it is not intended to set up a New Zealand-wide geological column.

Table 1.—*Sequence of formations and corresponding stages in the Hutt Valley area.*

This locality is the only one known where fine sediments occur below any member of the Kaitoke gravel group. No doubt further detailed work will bring to light similar sequences, underlying the older members of the group, and may establish an age in terms of New Zealand marine stages for the lowest member of the Kaitoke group.

Names have not been given to the two lower surfaces represented only as even topped ridges, because their preservation and exposure is very much poorer than that of any other feature shown in the table of stages.

Although the contact between Kaitoke gravels and greywacke has been seen in only some half dozen localities, these are sufficient to draw some definite conclusions as to the nature of the surface on which they were deposited.

The gravels are always weathered to the same degree as the subjacent greywacke. Where gravels are fresh the underlying greywacke is fresh; where gravels are weathered the underlying greywacke is weathered. From this the only conclusion that can be reached is that the depth of weathering of the terrain at the beginning of Kaitoke times was, unlike the present, a relatively shallow weathering profile such as seen in the more rugged greywacke ranges. The deep weathering affecting Kaitoke gravels and greywacke took place after the deposition of all the members of the Kaitoke gravel group.

Normandale Interglacial Stage

This is preserved only as very small remnants with a few intensely weathered pebbles in weathered, leached and eroded profiles that have been disturbed by mass movement, obscuring the original depositional structures. At the present stage of work no evidence of subdivisions has been found, although theoretically deposits belonging to warm intervals between the various members of the Kaitoke group should be present. Terraces of the Normandale group occur only spasmodically on the uplifted side of the Wellington fault south of Silverstream.

Between Silverstream and Brown Owl neither Normandale nor Kaitoke sediments are preserved.

Emerald Cold Stage

The Emerald stage is represented by terraces from Silverstream to the headwaters of the Hutt River near the foot of the Rimutaka Hill, and by deeply weathered gravels and silts in much-dissected terraces. The amount of dissection is considerably less than that of the Kaitoke gravels because their height above sea level during the succeeding period of intense erosion was considerably less. A carbonaceous profile has not yet been obtained from the Emerald alluvium, so that proof of the nature of the climate during this aggradation is absent. Its position in the river profile and the known climates of terraces in similar positions give no reason for assigning this aggradational sequence to an interglacial stage. In any case its degree of weathering differs markedly from the terrace in the same sequential position in the Belmont-Normandale area where thalassostatic control of aggradation had clearly prevailed.

Belmont Interglacial Stage

This is an exceedingly important period. All terrace sediments and greywacke topographies developed prior to this period were intensely eroded and weathered during the Belmont interglacial stage. It was during this period that weathering to a depth of almost 200 ft. in greywacke and 300 ft. in gravels occurred. The weathering as might be expected from such a deep weathering profile, was accompanied by intense leaching of the upper surface and development of the red weathering described by Te Punga (1957). This was the only period during which red weathering occurred. In the upper Hutt Valley, Kaitoke and Emerald terraces are red weathered, while in the lower valley only the Normandale group has been red weathered on its surface.

The intensity of weathering and erosion during the Belmont stage was great enough to produce rolling mature landscape forms throughout the Wellington region. There are no effects due to movement on the Wellington fault that were not smoothed or even obliterated in the Belmont-Normandale-Korokoro strip, so that the intensity of erosion was great enough to reduce forms developed by faulting to a mature profile by the end of Belmont time. These forms are still preserved above the lower local limit of red weathering. None the less although the topographic forms developed were smoothly rounded, the relief in the district was considerable. West of the fault, Belmont Hill rises over 1,000 ft. above the Belmont terrace, and the crest of the Rimutaka Range would have been about 2,000 ft. above the base of the Whiteman terrace at the foot of the Rimutaka Hill. Stevens (1956) includes the Belmont gravels in a large group of lower-valley gravels deposited under differing conditions at different times. He called these the Haywards gravels. From Belmont gravels at Belmont he obtained a pollen-bearing sample (N160/524) which pollen indicated a climate similar to the present.

Whiteman Cold Stage

Terraces of this stage are the oldest well preserved terraces found north of Taita. These terraces are best developed at the eastern end of Whitemans Valley, but elsewhere well developed from Brown Owl to the foot of the Rimutaka Hill Road and in the Akatarawa Valley. The two most important internal criteria for recognition are the degree of weathering and the sediment composition.

The weathering is such that, within 20 ft. of the terrace tread, even the most resistant greywacke boulder is weathered to the core, but the average hardness of the pebbles, unlike that of all earlier terraces, is not such that they can be halved with a knife.

The Whiteman terraces invariably carry a thick, 6 to 10 ft. cover of silty alluvium on their tread. This alluvium, a deep yellow-brown colour, does not exhibit leaching and reddening characteristic of the surfaces of the earliest stages.

Stoke Interglacial Stage

This stage is known from localities south-west of Haywards from the uplifted block north-west of the Wellington fault. The gravels composing the terraces are slightly harder than those of the Whiteman terraces, but this terrace does not have a thick fine alluvial cover. The thickness of gravels preserved, a maximum of 80 ft., is greater than that of any of the earlier terraces. This last observation may however be merely an accident of position rather than a peculiarity of the Stoke stage.

Pakuratahi Cold Stage

During the Pakuratahi cold stage, the latest of the terraces was built with a very steep gradient. The gravels composing the Pakuratahi stage terrace are little weathered. Staining is superficial, and excavated boulders show no more than surface cracking after drying out. The terrace shows a peculiarity of very thin cover of fine alluvium, so that cultivation brings many boulders to the surface.

Silverstream Stage: Post-glacial

The Silverstream stage included parts of Stevens' (1956) Hutt and Trentham formations. Stevens' formation names are retained for the upper portions and surfaces.

In the Lower Hutt basin there is a very great thickness of sediments. Drillholes have shown two marine beds, and others may be present in greater and as yet undrilled depths nearer the fault.

The writer is of the opinion that these two shell beds were formed during different interglacial stages. The upper one only belongs to the Silverstream stage. Lacking information regarding the exact position of the base of the sequence deposited by the Hutt River flowing at a gradient near to the present gradients, it would seem best to arbitrarily draw the base of the Hutt formation at the base of the Petone marine silts and clays. The Waiwhetu gravels of Stevens would then be regarded as equivalents of the upper part of the Trentham formation of Stevens. That this is the probable correlation is borne out by the gradient on the Trentham terrace. The projection of the profile of the Trentham terrace would place the Trentham surface at a depth of about 60 ft. below sea level at the Petone foreshore. This is just below the Petone marine beds.

The Trentham terrace in the Mangaroa Valley has aggraded to form a dam at the mouth of the Wallaceville swamp. A radiocarbon sample obtained by W. F. Harris (pers. comm.) from the lowest peat gave an age of 9,000 years B.P. Therefore this aggradation in the middle reaches of the Hutt Valley commenced in post-glacial times, perhaps as a result of increasing rainfall on a still unforested mountain terrain. The aggradation ceased before the Petone marine beds were deposited. These marine beds lie some 20 to 30 feet below the horizon of the Melling peats which are dated N160/513A and B (Stevens, 1956), as 14C NZ 30, 4470 ± 100 and 14C NZ 31, 4400 ± 100 yrs. B.P. (Fergusson and Rafter, 1957). The age of formation of the tread of the Trentham terrace is taken as 7000 years B.P.

The evidence and discussion above raised the possibility that the Pakuratahi, and indeed all the preceding cold stages as represented by the terrace treads formed during each stage, carried beyond the peak of cold into the period of ameliorating climate. There is certainly no possibility of subdividing the Waiwhetu artesian gravels and in the sections through the Trentham surface in the Mangaroa Valley, no break has been found between the Trentham gravels and the underlying Pakuratahi gravels. Indeed only an assessment of accumulated evidence can be used to demonstrate that Pakuratahi gravels must underly the Trentham gravels, both in the Mangaroa Valley and the Upper Hutt basin. The chief criteria for separation are:

1. The Trentham terrace has a cover a few feet thick of very sticky dark brown alluvium.
2. The gradient of the Pakuratahi terrace is greater than that of the Trentham terrace at any place.

Pleistocene General

These detailed descriptions are of sediments belonging to stages of the Pleistocene epoch. The period of time is short in a geological sense. Reasonable estimates range from 600,000 to 1,000,000 years. Because accumulating ice in glaciers in polar and present temperate regions lowered sea level by several hundreds of feet not once but several times, and because changing climates led to widespread deforestation, alluviation in inland regions was much greater than usual.

While there is a clear record of eight fluctuations of climate and sea level in the Hutt Valley a further three stages in the Normandale and Kaitoke groups are probable.

It appears therefore that the Hutt Valley contains clear records of four periods of cold climate and low sea levels alternating with four periods of high sea levels and climates as warm or warmer than the present. A further two records of cold climate are less well preserved.

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Notes on the Soils of the Hutt Valley

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The soils of the Hutt Valley can be described in three groups according to their occurrence on either (1) river flats, swamps and sand dunes or (2) terrace lands or (3) moderately steep and steep hillsides. Moderately steep and steep hillsides occupy approximately 80% of the district whereas the other two divisions each total about 10% of the area.

On the river flats, swamps and sand dunes, the soils occur in strips generally parallel to the meandering courses of the streams or growth of the beaches. This pattern is due principally to the effects of water, firstly in sorting the materials according to size and secondly, in controlling the circulation of air through the pores of the soil. Thus gravel and sand soils occur along the stream channels and beaches and on these soils plant growth is limited by too much air and too little water. Along the river banks the soils are sandy loams and loams which are the most fertile soils of the district, partly because the water and air circulate freely yet maintain a satisfactory level for plant growth. In the river basins the soils are silt loams and clay loams in which the moisture content generally rises with distance from stream channels and becomes more and more the chief limiting factor to plant growth. As the effects of moisture increase, subsoils change in colour from yellow to grey and in the intermediate stages show many rusty-coloured mottlings. The extreme effects of moisture are seen in the southern end of the Mangaroa basin where tilting of the land produced a depression in which the surface is continuously wet, and decomposing organic matter has accumulated as peat. This peat is very fibrous and extremely acid (pH 3.6) and would require heavy and frequent applications of fertiliser for pastoral use. All other soils of this group are moderately acid (about pH 5.5) and slightly deficient in phosphate and lime. Under intensive use careful management is required to prevent deterioration of structure and depletion of organic matter.

The soils of the terrace lands are formed on the remnants of old floodplains now elevated from 20 to 800 feet above stream level through repeated uplifts of the land during the last 500,000 years. As a consequence of the uplifts all the deposits, excepting those on the lowest terraces, have been eroded and now comprise plateau, rolling and easy hill land. The sediments consist of lightly consolidated silt and gravel beds derived principally from the erosion of greywacke but including a little volcanic ash deposited over the district during ancient eruptions. Five series of soils are mapped—Heretaunga soils on the lowest set of terraces, Judgeford soils on the second lowest set, Matamau and Ngaio soils on the intermediate sets, and Kaitoke soils on the highest and oldest set.

The Heretaunga, Judgeford and Matamau soils are similar in having a profile of brown friable silt loam over yellowish brown friable silt loam. The differences of colour, organic matter and plant nutrients between top and subsoil distinguish the Heretaunga soils from the soils on the river flats. Judgeford soils differ