The Seatoun Fault, Miramar Peninsula, Wellington

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Abstract

A brief discussion of some debatable points connected with current interpretations of the geological structure and deformation of Southern Wellington is followed by the description of a recently recognized fault (having strong topographic expression and showing some late movement) located on the eastern side of Miramar Peninsula

In recent years the crustal structure and inferred stresses of southern Wellington have received various interpretations Some points in this connection are briefly referred to in the present note, but the main object is to record a fault within the Wellington Harbour area forming a prominent topographic lineament that has hitherto escaped notice.

Relict surfaces of relatively low relief surviving within the local axial belt—the Rimutaka-Tararua Range—are taken to indicate that prior to the last (and continuing though waning) orogenic activity, the terrain formed an advanced mature land (Willis, 1927, p 499) with a relief of the order of only hundreds of feet above sea-level. The buckling and uplift of a rather narrow belt by tangential thrust from the north-west initiated the present axial range, and in the later stages, as emphasized by Wellman (1955, Fig 1) but also recorded by the present writer (1954, p 517), torsional stresses gave rise to transcurrent movement on the two classes of local faulting that were the products of the orogenic compression and uplift.

It has been postulated (Adkin, 1951, p 170, Fig 4) that a narrow strip of land-surface parallel to and forming the westward margin of the axial geanticline (the Tararua-Rimutaka Range) suffered downdrag; this was the result of a pronounced rotational movement of the axial geanticline when it was upthrust and faulted (Fig 1) The existing well-defined depressed strip—called the Port Nicholson-Porirua-Pukerua Sunkland (Adkin, 1951) for convenience of reference—has an altitude of 700ft and upwards *less* than contiguous surfaces and it separates the compressed axial belt from the gently warped, less-compressed benchlands province to the westward The synclinal fault-angle depression of the Hutt Valley forms a branch or offshoot of the Port Nicholson-Pukerua Sunkland zone and is as intimately related genetically to the Rimutaka Range as the northern part of the main sunkland zone is to the plunging and expiring south-western divergence of the Tararua Range

In the writer's view two kinds of faults—reverse and normal—are involved in the structural evolution of the area Both kinds, as insisted upon by Wellman (1955) have suffered transcurrent movement. and are classed by him as predominantly transcurrent faults, but it seems obvious that initially, in the orogenesis, upthrust by reverse faulting predominated over the torsional transcurrent component of the diastrophism. The major reverse fault—the Wairarapa Fault—was apparently the earliest rupture of the local series All other local faults—the Wellington, the Mount Wainui, the Owhariu-Kaka, etc —initiated as normal faults according to the definition of such, namely, having downthrow in the direction of the dip of the fault plane, but these faults in the Wellington area have an important peculiarity which seems to place them in a less generally recognized variety of normal faults. The usual normal fault is a product of local tension in the crust, but the steeply dipping normal faults of the Wellington area are believed to be the result of downdragging of an elongated segment of the crust due to the rotational tendency of the adjacent

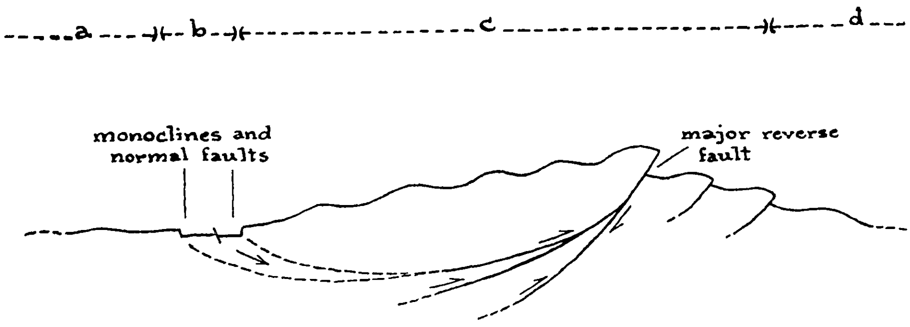

FIG. 1.—Diagram to show suggested effect of compressional rotation of the axial geanticline in the southern part of the North Island (a) Benchlands block (gentle warping and uplift), (b) "sunkland" strip (down drag), (c) axial block the Tararua-Rimutaka Range (compressional rotation and strong warping with uplift at right and downdrag at left), (d) western limb of synclinal block, the Wairarapa Valley (compression and resistance)

compressed and overthrust axial segment (Fig 1) This tension due to downdrag in distinction to tension resulting from gravitational subsidence seems to have been followed in the Wellington area (as part of a great zone of transcurrent predominance postulated by Wellman (1955)), by transcurrent movement on the local faults that increased or lessened from time to time and from place to place proportionately to the waning and fluctuating ascendency of the orogenic upthrust component. On field evidence transcurrent movement on the local faults appears to be by no means continuous or universal; in its topographic effects it appears to have been capricious and variable, occurring only when conditions were locally favourable for its effects to become apparent The faults of southern Wellington still retain much of their initial character—i e , reverse or normal according to their genetic origin, and since the modification of their type of activity by torsional stress seems to be of late development, a classification of them as transcurrent reverse or transcurrent normal would appear preferable for purposes of realistic assessment than to treat all as unqualifiedly transcurrent. It must surely be conceded that the existing relief is almost wholly due to the effects of the vertical component of the faulting movements and to the recurrent pulses of compressive upthrust and strong warping rather than to the torsional stress

The fault recently recognized by the writer extends along the eastern side of the Miramar Peninsula and may appropriately be named the Seatoun Fault (Fig. 2) It has a length of 3 miles on land above present sea-level, and presumably extends northward on the harbour bed, though now obscured by sedimentation. It is plainly related and complementary to the main Wellington Fault, both being fractures directly connected with and accentuating the subsidence (downdrag) of the Port Nicholson-Hutt Valley synclinal fault angle The greatest amount of subsidence is located at the junction of the Hutt Valley fault angle with the Port Nicholson-Pukerua Sunkland and there forms, since submergence, the deep water of the central part of Wellington Harbour (Port Nicholson)

The southern end of the visible portion of the Seatoun Fault is at the Pass of Branda on the road leading southward to the coast from Seatoun The fault scarp forms the steep hill-face below Beacon Hill, 433ft The scarp and the difference in levels between the Beacon Hill summits and the highest part of the downthrown Seatoun area indicates a throw here of nearly 200ft At the Seatoun Tunnel the trace of the fault is close to its eastern end, and the scarp is about 110ft in height. Northward, the crest of the scarp is immediately below the Convent at the upper end of Tiotio Road. The fault curves, and at Khyber Road the scarp is nearly sheer and has a height of c. 150ft, with its crest skirting the margin of Khyber Road and the talus-buried trace runs immediately behind the Worser Bay Methodist Church. Continued curvature brings the crest of the scarp to the eastern edge of the Worser Bay School grounds At Awa Road (east descent) the trace cuts across the main bend Northward of this the arc of curvature reverses, and towards Taipakupaku Road the fault bifurcates to become compound with the scarps approximately 4 chains apart on the spur forming the southern point of Karaka Bay. At Taipakupaku Road the crest of the upper scarp lies immediately below the roadway Northward from this place the double trace has a more rectilinear trend, meridional or nearly so; the upper scarp is separated from the lower one by a step or fault bench; the scarps are nearly equal in height, which is 50–60ft at each. At Nakora Road the upper scarp is at its junction with Fortification Road, and the lower one is immediately below the right-angled bend of Nakora Road (track); the distance between is here about 3 chains From this point the view northward shows convergence of the twin scarps, which come together to form a single feature just south of the Point Gordon spur.

The Point Gordon spur descends from the main hill ridge of Miramar Peninsula at Mount Crawford, 530ft. The upper part of the spur is steep, but a distinct fault scarp is absent Instead, on the crest of the spur at a point in direct alignment with the convergent double scarp to the south, is a recent scarplet indicating late movement The scarplet continues the meridional trend of the fault features immediately southward and has a length of 28 yards The scarplet face is sheer and remarkably well preserved, its height varying slightly--from 5ft to 4ft 6in to a maximum of 5ft 6in near its northern end. On either side of the spur no mark is visible, but northward a steep face or single scarp continues the alignment above the western side of Mahanga Bay (Fig. 2). The throw of the fault at this point is of the order of 150ft No evidence of transcurrent movement on the Seatoun Fault could be detected.

Three areas of downthrow to the east are interpreted as indicating the normal character of the Seatoun Fault; there is no evidence of upthrust of the ridge of the Miramar Peninsula or the adjacent ridges for three miles westward, on the contrary, these form part of a downsagged strip, of which the Seatoun Fault is a contemporary component The three larger downthrown areas of eastern Miramar are linked together by continuous narrow strips of land so that nowhere does the Seatoun Fault between the Pass of Branda and Kau Point at Mahanga Bay, intersect the harbour margin. The three downthrown areas are Seatoun flat and the low hill ridges on its south-east side; spur-ends from the north point of Worser Bay to the south point of Karaka Bay; and the lower (eastern) end of Point Gordon spur The higher part of Miramar Peninsula together with the main part of Wellington City area as well as the harbour itself, is downthrown by the Wellington Fault (plus synclinal sagging), and the Seatoun Fault, which has produced additional downthrow, is thus tectonically connected with and complementary to the Wellington Fault.

In 1910, Bell (pp. 538–539) listed evidence of the occurrence of a fault, previously mapped by McKay (1892, map). trending north-east along the north-western side of Wellington Harbour and now known as Wellington Fault Bell also postulated a series of meridional subsidiary faults crossing the city and harbour area, to account for the succession of hill-ridges and intervening lower land surfaces of the southern and eastern parts of the city area. These faults seem to have been entirely theoretical and not based on any precise evidence of faulting As Cotton (1912, pp. 260–261) has pointed out, the fault lines shown by Bell on his map and accompanying section do not correspond in number and vary in position on map and section respectively; nor have they, for want of actual evidence of their existence, validity in explaining

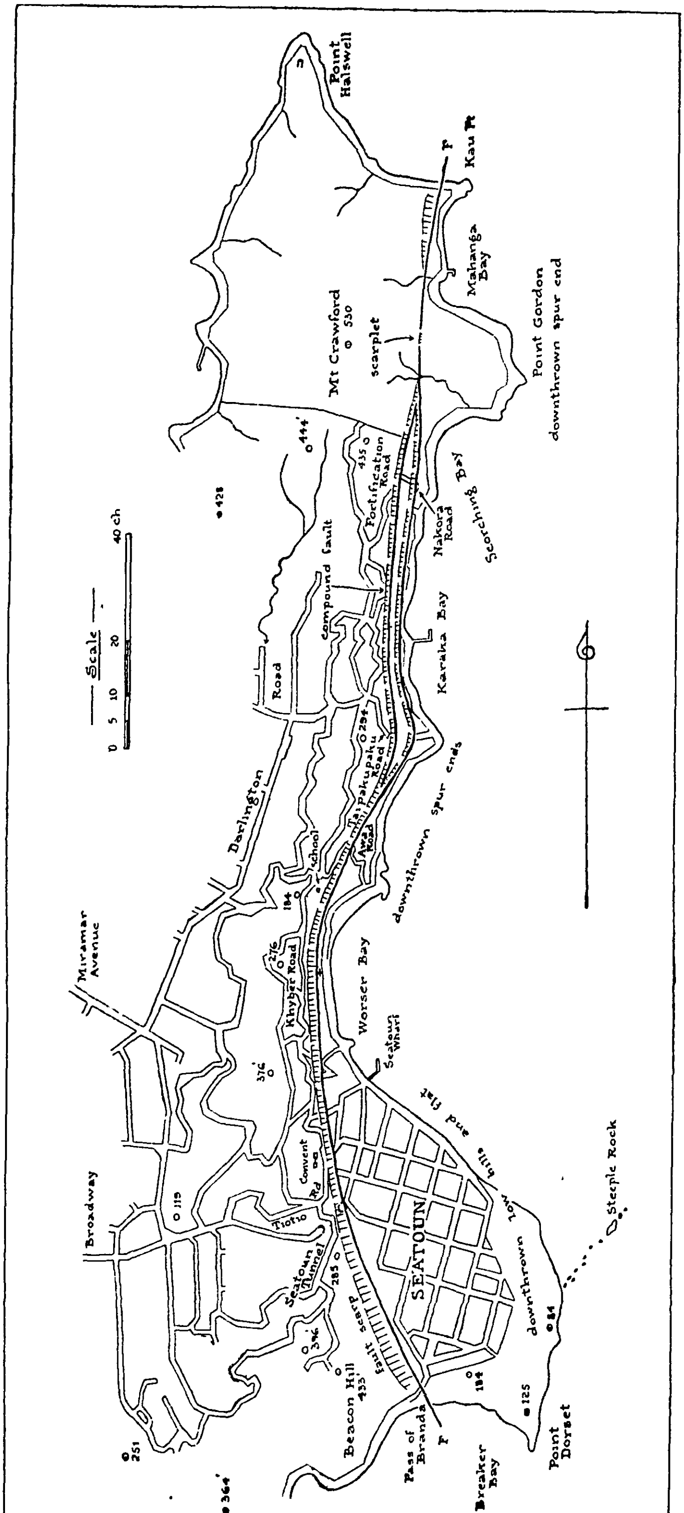

FIG. 2.—Eastern Miramar showing position, trend, and features of the Seatoun Fault.

the origin of the local topographic features, which are capable of a more satisfactory explanation. This opinion is endorsed by the present writer. In his section Bell moved a theoretical fault shown on his map as defining the western side of the harbour entrance channel to a new position on the eastern slope of Mount Crawford and thus along the eastern side of Miramar Peninsula. This line corresponds to that of the recently recognized Seatoun Fault here recorded.

The Seatoun Fault is of importance as the main factor in the production of the lowlying tectonic strip which, subsequent to the general epeirogenic subsidence (*see* Adkin, 1951, pp. 170, 172) of the Wellington area plus the Flandrian rise in sea-level, enabled the outer waters of Cook Strait to penetrate to the inner deep tectonic basin to form Wellington Harbour. The local late downthrow on the fault, shown by the 5ft scarplet on the Point Gordon spur, warrants optimism that, despite continuing (but diminishing) spasms of orogenic uplift as in 1855 and at least one of earlier date of similar kind and magnitude (good evidence of which is to be seen at Hue-te-taka, near Moa Point, in Lyall Bay, and at the outlets of Lake Kohanga-piripiri and Lake Kohangatera, near Pencarrow, Wellington Heads), the entrance channel of the harbour should persist without undue shallowing, for at least some hundreds of years.

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