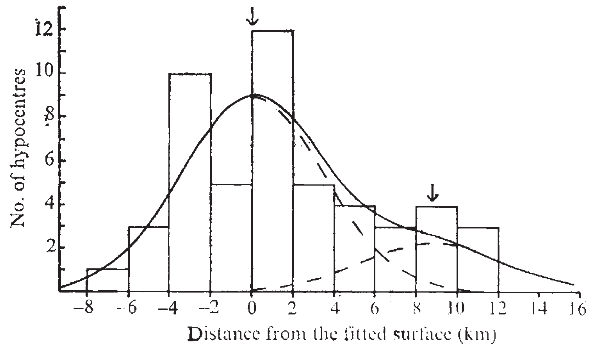

Fig. 3 Histogram of distances of hypocentres from the lower quadratic surface (see text), and the predicted distribution of 39 hypocentres on the surface of the plane and 10 hypocentres 8.8 km above the surface of the plane, with normal distributions and standard deviations about their means of 3.5 km.

Fig. 3 together with the predicted distribution for 39 hypocentres on the surface of the plane, and 10 hypocentres 8.8 km above the surface of the plane, with normal distributions and standard deviations of 3.5 km about the means in both cases.

The evidence suggests strongly that the North Island deep seismic zone is about 9 km thick and that the earthquakes initiate in the top and bottom surfaces of the zone. Mechanism studies[6] show no clear differences between earthquakes originating on either surface, and our results differ, therefore, from those from the Kurile Islands[7] where there is a 30 km thick zone with differing earthquake mechanisms above and below. Further studies are to be done to locate less well recorded earthquakes and to improve the absolute locations.

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Possible large creep event apparently preceded by a dilatant precursor

The invar wire earth strainmeter at the Nelson underground field station of the Physics and Engineering Laboratory, New Zealand, has produced the record shown in Fig. 1. The size of the two strain steps shown was far too great to be recorded on the tidal chart recorder but have been established with complete confidence from the amount of mechanical adjustment needed at the time of the inspection visits. Long term invar expansion has been removed from the curve shown. This is measured independently on an identical instrument decoupled from the earth using a sample of the same wire held at the same temperature and tension, but referred to very old large diameter Pyrex glass tubes as a reference length. Ideally, these should be of fused silica. The equation of the long term expansion agrees quite closely with that reported by Kaye[1] in 1911.

There were no earthquakes at the times of the two events shown and it is postulated that the strain change of 1.2×10^{-5} was produced by a large creep of about 20 cm, possibly on the nearby Waimea fault. On the surface this lies 5 km from the station but the creep was perhaps deep and without surface expression. In contrast to California, most seismic events in New Zealand do not correlate well with known active faults[2], and this event may be no exception. The apparent precursor about 20 months before would, if caused by rock dilatancy, indicate an earthquake of about magnitude 6 (ref. 3), but instead an aseismic creep event occurred. Work by Chinnery[4] indicates that a 20 cm displacement is of the order to be expected from an earthquake of magnitude 6. The second much smaller event is regarded as an 'after-creep' of the first.

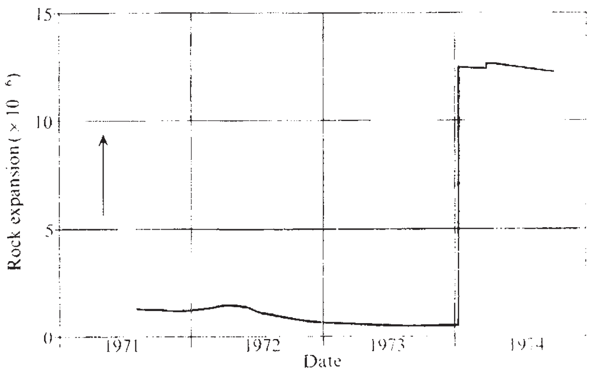

Fig. 1 Long term earth strain record from Nelson underground field station (41.5° S, 172.9° E; 150 m deep) from the time recording began in July 1971. The installation of the instrument[6] was carried out in early February 1971. The curve has been derived both from measurements at the time of the inspection visits and from the high sensitivity chart recorder which has an automatic stepper giving an effective range of approximately 70 chart widths.

Wire tension increased at the time of each event and therefore they can hardly be attributed to instrumental defects. No other comparable events have been recorded on two other strainmeters of the same design which have been operating at other distant stations for similar periods of time. There is also a difference in the rate of strain accumulation before and after the event. Extrapolation of the present rate would indicate another such event in approximately 20–25 yr which, of course, might then appear as an earthquake. It is interesting that in 1941 there was an earthquake of magnitude 5.5 at just this location[5] (41.6° S, 172.9° E), although at a depth of 80 km.

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Mechanism for the persistence of tectonic lineaments

It is widely recognised that major faults and other linear zones of tectonic activity may remain intermittently active through extended periods of geological time: I suggest a mechanism which may account for this persistence.

Examples of long lived linear tectonic belts are known in most continents although their significance was probably