only incapacitate the gene but result in the expression of a new protein detrimental to the whole animal. Although such mutant genes might be expected to rapidly disappear from the population, further inactivating mutations might occur that could then allow these genes to become fixed in the population. There is, in any case, no reason to believe that pseudogenes *per se* have any function although, of course, new genes could evolve from them.

The molecular analysis of globin genes is probably more advanced than any other mammalian gene system at this time. It seems likely that when other gene families are equally well characterized new pseudogenes will be identified. Indeed, extrapolating from the situation in globin, one in four gene sequences may be pseudogenes. Put in simple terms this suggests that one quarter of our genes might be dead. □

Volcanic ash southern style

from Ian Smalley

WITH the eruptions of Mt. St Helens still making the headlines in the northern hemisphere this was a good time to have a conference* on volcanic ash deposits (alias tephras) in New Zealand. It might be noted that the St Helens eruption has produced about 1 km^3 of ash but the last eruption of the Taupo volcano in the mid North Island of New Zealand produced about 24 km^3, possibly all in about 15 minutes through a vent 100 m wide.

P. Froggatt (Victoria University, Wellington) reviewed the tephras from Taupo. There have been 8 major rhyolitic eruptions during the past 10,000 years. Their stratigraphy and distribution is well understood and provides useful marker beds over most of the North Island. A source vent for each eruption has now been established. The most useful and widespread marker bed is the Taupo pumice (1,820 yrs BP) which erupted from within Lake Taupo at Horomatangi Reefs. The stratigraphy and nature of the Taupo pumice have now been revised and show a variety of eruptive mechanisms. The last phase of the eruptions was the most voluminous and destructive, being a series of pyroclastic flows which swept radially outward over all topography for more than 60 km. Reconstruction of the eruptive history of this ignimbrite has important implications for older eruptions such as the Kawakawa tephra (20,000 yrs BP) and the older welded ignimbrites.

P. Kamp (Waikato University) discussed the Pleistocene tephras in Hawkes Bay and their implications for Quaternary events. The tephras provide an absolute time-scale for the Kidnappers Group sedimentary succession, the deposition of which was predominantly glacio-eustatically controlled and which matches the standard deep-sea chronostratigraphy (core V28–238). The correlation of Pleistocene tephras elsewhere in New Zealand with Kidnappers tephras may enable events on land to be tied into the sea-level chronology. Nine discrete rhyolitic tephras, which Kamp has named informally A to I, occur in the 350 m thick Kidnappers Group succession.

V. Neall (Massey University) offered some comparisons between the volcanoes in the Cascade Range in the Western United States (including Mt. St. Helens) and Mt Egmont in New Zealand. The geological setting of each volcano and its relationship to non-volcanic rocks provides useful comparisons, particularly with respect to control of pyroclastic flow and lahar mudflow distribution. Frequency of tephra eruptions in Holocene times varies from 1 per 100–200 years at St. Helens (based on the last 4,000 years record), to 1 per 250–350 years at Egmont, 1 per 500–1,000 years at Rainier and 1 per 800 years at Shasta. The Egmont tephra succession displays a remarkably uniform mineralogy in marked contrast to tephras within the last 500 years. Pyroclastic flows from Egmont have been as frequent as those produced from St Helens and Shasta, but are much less in volume.

A. Palmer (Victoria University, Wellington) considered the occurrence of airfall tephra in the loess of the Wairarapa, at the southern end of the North Island. The 20,000 yr BP Kawakawa tephra occurs as a pinkish white 5–10 cm band of coarse silt to fine sand-sized glass and pumice fragments and is consistently found at two thirds the depth of the top (Ohakean) loess unit. The tephra influences bulk density and water contents for at least 50 cm above the primary airfall material and similar bulk density and water content variations within the older loesses probably indicate volcanic ash. Some further observations on loess were provided by N. Kennedy (DSIR Soil Bureau, Rotorua) but he was concerned with what has come to be known as 'tephric' loess. Some problems are arising in the more northerly parts of the North Island with a redeposited tephra material which might be classed as a loess. According to Kennedy tephric loess is deposited during arid climatic periods and is always found sandwiched between tephras of 15,000–20,000 yrs BP. Thus the period 15–20,000 BP is regarded as cold and arid. In the Rotorua basin the average rate of accumulation during that critical period was 0.3 cm/yr.

D. Seward (N.Z. Inst. Nuclear Sci.) reported on progress in fission track dating of tephra deposits. Tephras represent time planes within both marine and continental sediments and are most suitable for stratigraphic chronology and correlation. Glass was the first material used for fission track dating of tephras but most glasses have undergone varying amounts of annealing and this has reduced the size and density of the spotaneous fission tracks, and produced a 'young' age. The most suitable mineral in the tephras is zircon. The Tertiary-Quaternary sequences in New Zealand contain sufficient tephras for a tight time scale to be realised throughout. However, because of error limits the fission track ages of individual tephras must be closely analysed before tephras from one sequence can be absolutely correlated with those from another. C. Vucetich (Victoria University, Wellington) offered some Quaternary tephra correlations, from c.40,000 yrs BP to c.300,000 yrs BP. The chronology was based on two fission track dates for zircons by B. Kohn: Puketirau tephra (Tirau) 0.22 ± 0.03 Myr and Omokoroa tephra (Tauranga) 0.36 ± 0.04 Myr and indirect dating per c.120,000 yr marine transgression.

D. Lowe (Waikato University) demonstrated the usefulness of tephra layers preserved in peats. The recent identification of more than twelve unweathered and unmixed thin discrete airfall tephras in piston cores from shallow peaty lakes near Hamilton have provided a stratigraphic record of late Pleistocene (post-Kawakawa tephra) and Holocene tephra deposits in the Waikato region. Identification of the tephras was greatly aided by using X-radiography techniques and these are being actively developed by the Waikato group, with particular possibilities seen in the techniques of xeroradiography which utilises a reusable photo receptor plate instead of conventional X-ray film.

The situation may appear hazardous but like the farmers persistently cultivating the slopes of Etna the scientists find rich results are derived from volcanic ash. The scale of New Zealand vulcanism in the past has been colossal with the Taupo eruptions judged by G.P.L. Walker to have been perhaps among the largest ever. The enormous spread of volcanic material in New Zealand means that the datable volcanic events in the north can offer useful stratigraphic indicators even down into the glaciated south. □

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*Tephra Workshop meeting, held at Victoria University, Wellington, on 30 June and 1 July 1980. Organised by C. Vucetich, R. Howarth and P. Froggatt; proceedings to be published by the Geology Department, Victoria University.

0028-0836/80/350841-01$01.00