ridge; from consideration of P phase arrivals at Australian stations, this is believed to be a mislocated ridge shock. Thus the Campbell Plateau appears to be aseismic, at least during this period. The marked offset in the ridge at about 51° S., noted by Brodie and Dawson, could suggest a fracture zone similar to those reported along the equatorial part of the mid-Atlantic ridge by Heezen *et al.*[2]. However, no epicentres have been located near this feature during the period considered.

The Bureau of Mineral Resources has operated a seismological station at Macquarie Island since 1951. A puzzling feature of Macquarie Island records of shocks in the group north-west of Auckland Islands has been a frequent anomalously late T phase arrival. These arrivals had been provisionally interpreted as T waves reflected at the edge of the Campbell Plateau. The new bathymetric map makes this interpretation entirely feasible. Typical paths for such reflected T phases are shown in Fig. 1.

Material on the T phase as recorded at Macquarie Island is being prepared for publication. This will include more detail concerning these reflexions.

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P Amplitudes from *Longshot* at Australian Stations

THE P phase from the nuclear explosion *Longshot*, detonated beneath Amchitka Island at a depth of 2,300 ft. on October 29, 1965, was well recorded at most Australian seismograph stations. The amplitudes of ground displacement at these stations have been plotted against distance in Fig. 1. These amplitudes were calculated from the peak-to-peak amplitude of the first cycle of P motion on each record. U.S. Coastal and Geodetic Survey station abbreviations have been used in the figure, with the addition of the recently established Warramunga array at Tennant Creek (TCA), and the South Australian station at Cleve (CLV). Details of the stations have been given by Doyle and Underwood[1].

Despite the scatter common to all amplitude studies, the data clearly show a sharp decrease in amplitude between 92° and 93°. It is unlikely that this marks the shadow boundary of the core, especially as studies of PcP from nuclear explosions[2-4] indicate that the depth of the core-mantle boundary is not far from that calculated by Jeffreys[5]. It is more probable that the effect is due to the influence of the D'' layer[6]. A recent study of travel times by Cleary and Hales[7] suggests that $dT/d\Delta$ is approximately constant from about 93°. A condition

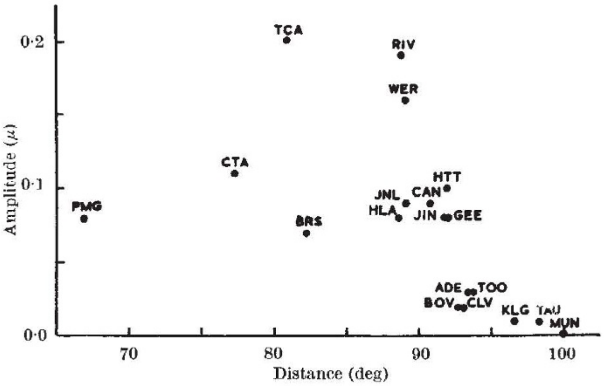

Fig. 1. Ground amplitudes from *Longshot* versus distance.

approaching this would account for the decrease in amplitude.

At Cleve and Adelaide, the small P amplitudes disclose a larger impulsive arrival about 1 sec later. This is too late to be pP, and any arrival which had travelled along the path of the initial P would be similarly diminished in amplitude. The phase is therefore most readily interpreted as PcP, providing further evidence that the bottom of the P ray path is above the core-mantle boundary for this distance.

The period of P decreases from 1·1 sec to 0·8 sec as the distance increases within the range, but the decrease appears to be fairly uniform and unrelated to the amplitude change. This phenomenon, together with travel time observations, will be discussed in detail elsewhere.

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A Model for the Occurrence of Large Earthquakes

THIS communication outlines a probability model which seems to provide an adequate basis for making predictions concerning the occurrence of largest earthquake magnitudes over time: (*a*) The number of earthquakes in a year is a Poisson random variable with mean α; (*b*) X, the earthquake magnitude, is a random variable distributed with cumulative distribution function:

$$F(x) = Pr\ (X \leqslant x) = 1 - e^{-\beta x},\ x \geqslant 0 \qquad (1)$$

From these assumptions it follows that Y, the largest annual earthquake magnitude, is distributed with cumulative distribution function $G(y)$, where

$$G(y) = Pr\ (Y \leqslant y) = \sum_{k=0}^{\infty} \frac{e^{-\alpha}\,\alpha^k}{k!} \left[F(y)\right]^k$$

$$= \exp\left\{-\alpha\left[1 - F(y)\right]\right\} = \exp\ (-\alpha e^{-\beta y}),\ y \geqslant 0 \qquad (2)$$

The cumulative distribution function (2) is called the "type 1" distribution of largest values in the terminology of Gumbel[1].

In order to estimate the parameters α and β from $y_1, y_2, \ldots, y_n$, the largest annual earthquake magnitudes in n years, one arranges these values in order of increasing size $y_{(1)} \leqslant y_{(2)} \leqslant \ldots \leqslant y_{(n)}$, where $y_{(j)}$ is the jth smallest annual maximum magnitude. To each $y_{(j)}$, one associates the value $G(y_{(j)}) = j/(n+1)$. The parameters α and β are found from the least-square fit to the equation

$$\log\left[-\log G(y)\right] = \log \alpha - \beta y \qquad (3)$$

derived from equation (2).

It should be noted that $\alpha e^{-\beta y}$ is the expected number of earthquakes, N_y, in a given year which have magnitude exceeding y. It follows that

$$\log N_y = \log \alpha - \beta y \qquad (4)$$

which is of the same form as the widely used empirical formula