It would be well, therefore, not to accept the results obtained with copper at temperatures above room temperature until further measurements have been made under more rigorous conditions.

E. A. OWEN.
R. WILSON WILLIAMS.
Physics Department,
University College of North Wales,
Bangor.

[1] NATURE, 142, 915 (1938).

Observations with Electromagnetic Microbarographs

Two electromagnetic microbarographs designed by H. Benioff to respond to pressure variations in the frequency range from five cycles per second to one cycle in thirty seconds approximately, and with sufficient sensitivity to record the natural unrest of the atmosphere, have been in operation at the Seismological Laboratory in Pasadena for approximately two years. These instruments were operated either at the same point with different characteristics, or at points separated by distances from several to more than 100 metres with identical characteristics. In the short-period galvanometer combination the response is approximately proportional to the rate of change of pressure. For periods of 1 second, the sensitivity is such that 1 mm. deflection of the galvanometer corresponds to a pressure change of 1 dyne per cm.^{2} approximately. The instruments respond to waves as well as to current variations. Discrimination between these two types of movements is made on the basis of their difference in velocity of propagation, the waves being propagated with the velocity of sound, while current variations are propagated with much smaller velocity.

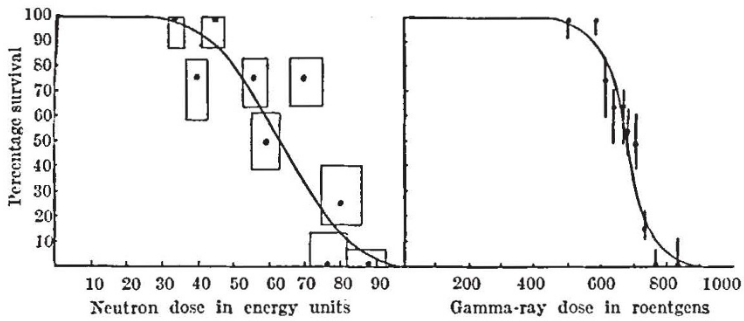
The waves are produced either by natural causes such as earthquakes, surf, other unknown sources or artificial causes (aeroplanes, automobiles, dynamite blasts, gunfire). Waves produced by battleship target practice have been used by Gutenberg to calculate sound velocities and temperatures in the stratosphere. His results agree with those obtained in Central Europe and Novaya Zemlya. The natural waves have predominant periods of 4 sec. and 20 sec. to several hundred seconds, and are largest in winter. They have exhibited no correlation with microseisms.

Air currents produce irregular disturbances throughout the whole range of recorded frequencies. They are due either to ordinary wind or to convection currents resulting from heating of the ground by solar radiation, and ordinarily the two types are not distinguishable from each other in appearance on the records. Both types of movements can be recorded indoors, although under these conditions they are modified in amplitude and in frequency characteristics. They are absent on calm, overcast or foggy days. On clear, calm days convection currents are small in winter, when they are occasionally recorded here from approximately 10 a.m. to 3 p.m. In April and November they occur from approximately 10 a.m. to 4 p.m., and during June and July they appear from 7 a.m. to 7 p.m. Strong currents of either type produce strains in the ground rock as recorded by the strain seismograph. Sudden changes in the characteristics of short-period movements sometimes accompany the passage of a cold front.

H. BENIOFF.
B. GUTENBERG.
Balch Graduate School of the
Geological Sciences,
California Institute of Technology,
Pasadena, California.

Comparison of the Lethal Effect of Fast Neutrons and Gamma-Rays on the Growing Tips of Broad Bean Roots

THE growing tips of broad bean roots have been irradiated by D-D neutrons ($\sim$ 2·9 Mev.) and by gamma-rays by techniques already described[1,2]. The duration of irradiation and the variation of intensity along the length of the root was approximately the same for both radiations. The neutrons were unaccompanied by gamma-radiation, and stray X-rays were excluded by 5 mm. of lead surrounding the specimens. The dose was measured and converted into energy units in the manner already described[2,3].



SURVIVAL OF BEAN ROOTS EXPOSED TO NEUTRON AND GAMMA-RAY ENERGY MEASURED IN COMPARABLE UNITS.

The mortality curves for gamma-rays and neutrons are shown in the accompanying figure. The apparent difference in shape between the two curves is not considered to be established in view of the magnitude of the probable errors represented by the rectangles. Individual points on the neutron curve represent the result of irradiating batches of from four to twelve beans. The probable errors of these points were estimated as follows. The probability of observing a certain mortality q in an experiment with N beans, for which the true probability of death corresponding to the dose is p, is :

$$Lt_{x\to\infty}\ {}^{px}C_{qN} \times {}^{(1-p)x}C_{(1-q)N}/{}^{x}C_{N},$$

which, for q constant, is proportional to

$$p^{qN}\ (1-p)^{(1-q)N},$$

Plotting this probability against p, and halving the area on each side of the maximum, we obtain the range of values of p within which it is a 50 per cent chance that the true value of p corresponding to the dose, lies.

It is evident that 50 per cent mortality is produced by 63 $\pm$ 6 energy units of neutrons, which may be compared directly with the value of 690 $\pm$ 35 roentgens of gamma-rays, since the unit of energy has been defined as the increment of energy per unit volume of water exposed to 1 roentgen of gamma-radiation. Neutron energy thus appears to be about