Table 1. PASSAGE OF PRESSURE WAVES AT NEW ZEALAND STATIONS, OCTOBER 30–NOVEMBER 1, 1961

Station	Latitude	Longitude	Time of passage (G.M.T.) First wave	Second wave	Third wave	Amplitude (mb.) First wave	Second wave	Third wave
Funafuti (Ellice Is.)	08° 31′ S.	179° 12′ E.	30.19.05	—	—	0·6	—	—
Lauthala Bay (Fiji)	18° 09′ S.	178° 27′ E.	30.19.50	—	—	0·5	—	—
Kaitaia	35° 04′ S.	173° 17′ E.	30.21.24	—	—	0·5	—	—
Auckland	36° 51′ S.	174° 47′ E.	30.21.30	31.07.37	—	0·7	0·4	—
Gisborne	38° 40′ S.	177° 59′ E.	30.21.44	—	—	0·6	—	—
New Plymouth	39° 02′ S.	174° 11′ E.	30.21.44	31.07.25	—	0·6	0·4	—
Ohakea	40° 12′ S.	175° 23′ E.	30.21.50	31.07.15	—	0·5	0·3	—
Farewell Spit	40° 39′ S.	173° 00′ E.	30.21.48	31.07.19	—	0·6	0·3	—
Paraparaumu	40° 54′ S.	174° 59′ E.	30.21.48	31.07.24	—	0·6	0·3	—
Nelson	41° 14′ S.	173° 13′ E.	30.22.02	31.07.19	—	0·6	0·3	—
Wellington	41° 17′ S.	174° 46′ E.	30.21.57	31.07.17	01.09.16	0·6	0·4	0·2
Hokitika	42° 43′ S.	170° 57′ E.	30.22.00	31.07.31	—	0·6	0·3	—
Christchurch	43° 29′ S.	172° 32′ E.	30.22.12	31.07.10	—	0·5	0·3	—
Haast	43° 52′ S.	169° 02′ E.	30.22.06	—	—	0·7	—	—
Chatham Id.	43° 58′ S.	176° 31′ W.	30.22.23	—	—	0·4	—	—
Taieri	45° 51′ S.	170° 22′ E.	30.22.10	31.07.07	01.09.31	0·6	0·2	0·2
Invercargill	46° 25′ S.	168° 19′ E.	30.22.13	31.07.04	—	0·4	0·2	—

The average speed of the pressure waves calculated from the times of the first and second passages and time of the initial explosion was 306 m./sec., or 9·9 degrees of arc per hour. This is close to the average velocity of 318 m./sec. found for the Krakatoa pressure waves[1], and falls in the speed-range 284–318 m./sec. of waves produced by various hydrogen bomb explosions in the Marshall Islands[3].

The speed of propagation of the pressure wave will be a function of temperature and wind conditions along the path. It is hoped that the New Zealand data may be of assistance in global studies of these conditions.

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PHYSICS

Gravitational and Related Constants

IN an earlier communication[1] some simple relationships between the fundamental constants e, h, c, G and α were proposed, where G is the usual gravitational constant and α the ratio of proton mass to electron mass. It is now possible to simplify and extend slightly the treatment used previously and to justify to a considerable extent the results then obtained; α will, however, now be taken as the ratio of the mass of the hydrogen atom to that of the electron.

First of all, it is necessary to consider one aspect of gravitational attraction. Imagine two uniform, spherical bodies A and B with centres distance r apart. Then the gravitational force of attraction is given by $F = k/r^2$, where k is a constant, and if the bodies are increased in size, n_1 times larger for A and n_2 times for B, $F = kn_1n_2/r^2$. This equation expresses the experimentally determined facts about gravitational force and, clearly, k has the dimensions $[ML^3T^{-2}]$, that is, identical with [charge]^2 (ref. 2). It is therefore possible to represent the force between masses m_1 and m_2 by:

$$F = Gm_1m_2/r^2 \approx G'N_1N_2e^2/r^2$$

where G' is a dimensionless constant and N_1e and N_2e are quantities of charge associated with and proportional respectively to m_1 and m_2. When $m_1 = m_2 = 1$ gm. and $r = 1$ cm., $N_1 = N_2 = N_0$ and, numerically:

$$F_0 = G \approx G'N_0^2e^2 = G''$$

With little error the following relations between e, α and G'' may be stated:

$$G''/e = 137 \text{ E.S.U.},$$

$$\text{from which } G'' = 6{\cdot}582 \times 10^{-8} \text{ (E.S.U.)}^2$$

$$\alpha^2G'' = \frac{2}{9} \text{ (E.S.U.)}^2,$$

$$\text{from which } G'' = 6{\cdot}584 \times 10^{-8} \text{ (E.S.U.)}^2$$

$$\alpha^2e = \frac{2}{9}\left(\frac{1}{137}\right) \text{ E.S.U.}$$

The third relationship follows from the other two but, for the purpose of checking, it has the advantage that the less-accurately-known G'' has been eliminated. Using the values[3] $e = 4{\cdot}8028 \times 10^{-10}$ E.S.U., $\alpha = 1837{\cdot}1$ and $137{\cdot}04$ rather than 137 (also used to calculate G''), $\alpha^2e \times 137{\cdot}04 = 0{\cdot}22213$, in close agreement with 2/9. The discrepancy between the value $6{\cdot}58 \times 10^{-8}$ for G'' and $6{\cdot}67 \times 10^{-8}$ for G has already been discussed[1].

It is significant that $1/137{\cdot}04$ is the value of the fine structure constant $2\pi e^2/hc$, but for the present purpose no use of this relationship has been made.

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Production of Superconducting Niobium Films by Vacuum-Arc Deposition

HOLLAND[1] commented that certain workers[2,3] interested in the production of vacuum-deposited thin films had shown that the electric arc could be used for this purpose. He noted that this method offered a possible solution to the problem of evaporating low-vapour-pressure metals which for various reasons could not be handled by the techniques then available. We have shown that, where films of uniform thickness are not required, the high deposition-rates obtainable from a vacuum-arc at a very short distance from the substrate greatly facilitate the production of pure films in poor vacua.

One of our major interests has been to produce superconducting niobium films with the transition characteristics of the pure bulk metal. It is a well-known fact that superconducting niobium films are difficult to prepare. The main obstacles to be overcome are: high melting temperature, low vapour