was sealed to the face of an ultrasonic generator. Liquid was poured in the bell-jar and the pressure in the air-space above it could be reduced by a connected pump. On working the generator, stationary waves were produced in the vertical column of liquid above it, the air-liquid surface serving as reflector. The pressure in the bell jar and the voltage applied to the generator could be adjusted to result in the production of either large or small bubbles in the liquid. When large bubbles were produced they rose rapidly through the liquid, but the small bubbles, especially at very high frequencies, could be made to stay suspended in the liquid in layers parallel to the reflecting surface. The layers were half a wave-length apart, and measurements of wave-lengths and velocities could readily be effected. Our purpose, however, was not to measure wave-lengths but to study cavitation, on which subject papers are in course of publication.

The experiment is a very striking one, and in our work the nodal layers of bubbles were particularly regular and distinct at frequencies around 170,000 cycles per second. In addition, and as pointed out by Hubbard and Loomis, the column of liquid can be thrown into resonance, the condition of exact resonance in our experiment being indicated by a slight humping of the liquid at the free surface. The height of the hump depends on the intensity of the radiation, and if the liquid be slowly drained from the bell-jar the humping recurs every time the free surface passes through the nodal levels. In this way incidental measurements were taken of half-wave lengths and velocities.

In all the determinations of velocity of sound by the ultrasonic method made in this laboratory in the last few years, we have found no detectable change of velocity with frequency, in solids or in liquids, within a range of frequency extending from 30,000 to 600,000 cycles per second.

R. W. BOYLE.
University of Alberta,
Aug. 23.

The Intrinsic Field of a Magnet.

REASONS have been given recently by J. Dorfman (NATURE, Mar. 5, 1927, p. 353) and by W. Peddie (NATURE, July 16, 1927, p. 80) against the view that there is in a magnet an intrinsic magnetic field of immense magnitude. It is true that an enormous intrinsic magnetic field explains simply, by analogy with the behaviour of fluids, how ferro-magnetic properties come into existence when a ferro-magnetic substance passes through the critical point from a high to a low temperature. By equating magnetic and thermal energies a formula can be obtained for the magnitude of this intrinsic field which at its maximum is, according to Weiss, $3R\theta/\sigma_o$, σ_o being the maximum specific magnetisation, θ the critical temperature and R the gas constant referred to two degrees of freedom of kinetic energy.

The calculation is made on the supposition that it is allowable to treat magnetic energy as the simple equivalent of the thermal energy and this leads to a value for the intrinsic field at its maximum of the order of 10^7 gausses, a magnitude so large that serious difficulties arise both in accounting for its origin and also in dealing with some of the facts of induced magnetism where, indeed, a small intrinsic magnetic field would be more appropriate. Undoubtedly forces of great magnitude exist within a magnet, but there are experimental grounds for concluding they are not such as give rise directly to ferro-magnetism. It seems necessary then to suppose that there are two fields within a magnet of different origin and magnitude, one arising from magnetic forces—a true intrinsic magnetic field—and the other, and much the larger one, arising from forces which may provisionally be classed as molecular, and that there is some mechanism whereby one field can act upon the other. It is conceivable that this action is due to the magnetic ties existing between the magnetic molecules of a ferro-magnetic substance, the effect of which is that translational movements of the molecules, controlled by the molecular forces and set up by the thermal agencies, give rise to rotational motion of the molecules, such motion being controlled only by magnetic forces. In this connexion Ewing's latest model of the ferro-magnetic atom is helpful in showing that there may be a fixed and a movable part in the atom.

At a high temperature, when translational and consequently rotational movements are violent, orientation by an external magnetic field is so vigorously opposed that only paramagnetic qualities are in evidence. When, however, the metal cools, and elastic properties appear, the molecular forces which come into action restrict translatory motion, and consequently rotational motion subsides; as there is nothing to oppose orientation of the molecules except a small intrinsic magnetic field, ferro-magnetic properties come into existence. Thus it may be the molecular field of force and not an immense magnetic intrinsic field which brings into evidence ferro-magnetism.

This view explains how any rotational movement of the molecules, if set up by thermal agencies, must involve the energy of agitation of the whole mass, which will be very large, but if set up by magnetic agencies the expenditure of energy will be very small, which is what is observed experimentally. It is also consistent with the facts of the discontinuity of the specific heat at the critical temperature and of recalescence.

Thus it is possible to reconcile the hypothesis of a very large intrinsic field which may have magnetic effects with the hypothesis that the field itself is not a magnetic field immediately controlling ferro-magnetism.

J. R. ASHWORTH.
Rochdale, Aug. 30.

Photoelectric Emissivity and Sparking Potentials.

IN a recent paper in the *Proc. Roy. Soc.* (A, **144, 73**; 1927) I have described a photoelectric theory of the sparking potentials of discharge tubes. According to this theory the sparking potential v_c is a function of the photoelectric emissivity γ, of the cathode, for the radiation accompanying the neutralisation of the positive ions at the cathodic surface.

It has been found possible to complete experiments upon the concomitant measurement of v_c and γ, for the case of a parallel disc electrode tube, with helium as the filling gas.

A measure of proportionality of γ, P, was obtained by radiating the cathode with radiation proceeding from a hot wire discharge box of special form, and measuring the photoelectric effect; v_c was measured in the usual way.

The variation of v_c with progressive purification of the helium by charcoal cooled in liquid air, was unexpected and remarkable. There occurred initially the well-known rapid decrease of the values of the sparking potential until a minimum value was attained. After this, a slow rise in sparking potential took place, until a value of anything from about 10 volts to 600 volts (according to gas pressure, etc.) higher than the minimum was attained.

Introduction of additional helium showed that the effects did not proceed from pressure changes.

Concomitant measurements of P showed a fall