been destroyed, below the transition temperature, by application of magnetic fields above two-thirds the critical value, a magnetic moment remained upon removal of the field.

The observed magnetic moments were independent of the measuring field provided the latter was not sufficient to put the material in the intermediate state. They depended on the temperature and upon the geometry of the specimen. For the solid spheres, the observed moments corresponded to 1 to 3 percent of the induction present at the critical field, and apparently were due solely to "frozen-in" moment. For the hollow spheres considerably larger moments were found.

Upon entry into the intermediate state, the magnetic moments increased sharply. Apparently magnetic induction set up in very small normal regions was "trapped" in its original position because of a long relaxation time required for reorientation of the normal regions. This abrupt increase in magnetic moment could be used to determine the field at which entry into the intermediate state occurred; the results were consistent with previous measurements of the critical fields for tin.

Large field-dependent damping effects were observed in the intermediate state, due to the appearance of normal areas in the superconductor. Small field dependent damping effects were observed at lower fields for the specimens with magnetic moment, but were absent when there was no moment present. This can be explained if one assumes that the moment interacts with the applied field in such a way as to produce small normal regions even at low fields.

The effects observed were reversible so long as the measuring field was less than that required to cause entry into the intermediate state. Pronounced hysteresis and relaxation effects were observed in the transition between the superconducting and intermediate states.

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Tidal Effects in the F Layer*

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A PERIODIC variation of the semi-thickness, τ, of the F layer, noted at College, Alaska,[1] was submitted to harmonic analysis. In addition to the diurnal change in the thickness (the solar diurnal wave) of the ionized layer due to the sun's ionizing radiation, waves resulting from the contractions and expansions of the layer due to solar and lunar gravitational forces were extracted. The important gravitational tidal variations are the solar semi-diurnal wave, whose amplitude was approximately 60 percent of the solar diurnal wave, and the lunar diurnal wave, whose amplitude varied from 0.1 to 1.6 times the amplitude of the solar semi-diurnal tide during the winter of 1948–49 (October–March). A semi-diurnal lunar wave is usually found in geophysical phenomena, but the incidence of a significant lunar diurnal wave at College can be explained by simple tidal theory.[2] The vertical component of the tide-producing force has a diurnal term proportional to

$$\sin 2Y \sin 2D \cos t,$$

where Y is the latitude of the station, D is the moon's declination, and t is the hour angle of the moon, and a semi-diurnal term

$$\cos^2 Y \cos^2 D \cos 2t.$$

Hence at a high latitude (for College, $Y=64° 52'$) the semi-diurnal term becomes insignificant while the diurnal term is relatively large.

An example of the lunar diurnal wave is shown in Fig. 1. The lunar diurnal wave

$$L_1 = 3.1 \sin(t+25°)$$

found in the harmonic analysis is the solid curve, while the points

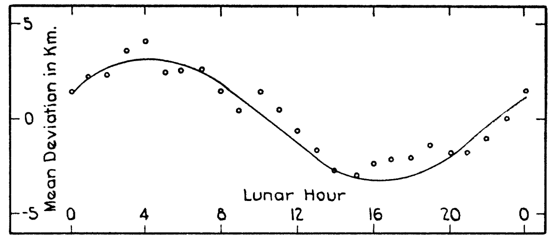

Fig. 1. Mean lunar variation of τ for December, 1947, at College, Alaska.

are the lunar-hourly means of the lunar variation of τ for December, 1947, extracted from the data.

The lunar diurnal wave is shown to be that predicted above in that the sign of the diurnal oscillation corresponds to the sign of the moon's declination (see Fig. 2).

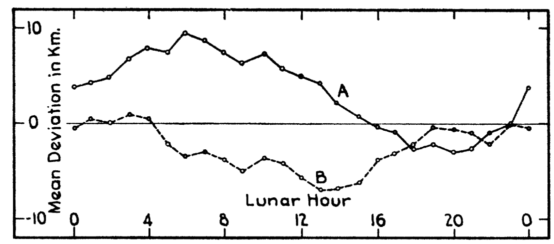

Fig. 2. Mean lunar variation of τ for intervals in December, 1947, at College, Alaska. Curve A for the days when the moon's declination was positive; curve B for the days when the moon's declination was negative.

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[1] Geophysical Research Directorate of the Cambridge Field St., A.M.C., U. S. Air Force, "State of the earth's atmosphere in the Arctic," Research Report No. 3 (February 17, 1949).

[2] P. Schureman, *Manual of Harmonic Analysis and Prediction of Tides* (United States Government Printing Office, Washington, 1941).

Gamma-Radiation from Deuteron Bombardment of Be^9

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THE bombardment of beryllium with deuterons leads to the following reactions:

a. $Be^9 + D^2 \rightarrow B^{10} + n^1 + 4.31$ Mev.
b. $\rightarrow Be^{10} + H^1 + 4.52.$
c. $\rightarrow Li^7 + He^4 + 7.09.$
d. $\rightarrow Be^8 + T^3 + 4.53.$

In cases a, b, and c, excited states of the residual nuclei are known to be formed, and the energies of some of the resulting gamma-rays have been determined.[1–3] This and the following letter summarize the results of some further measurements of the gamma-ray spectra; a more complete report will be presented at a later date.

As in the previously reported work, the gamma-ray energies have been determined from the photo-electrons produced in thorium converters, using a magnetic lens spectrograph. A vacuum connection to an electrostatic accelerator permits deuteron bombardment of targets within the spectrometer.[4] A part of the observed electron distribution is reproduced in Fig. 1, where the Compton electron spectrum from a thick beryllium converter is also shown. Other parts of the spectrum are shown in references 1 and 3, and in the following letter.

The results of a number of runs, using a thick target with a deuteron energy of 1.2 Mev, are collected in Table I. The gamma-