more, until we can perform at sea operations equivalent to our triangulation and astronomical measurements on land, Stokes's formula furnishes the only means of obtaining the distance between the geoid and the spheroid over the oceans, that is, over nearly three-quarters of the area of the globe, unless again we resort to hypothesis. For example, the geoid may be computed for any region, whether on land or sea, by assuming a definite theory of isostasy. Interesting specimens of the contours of the geoid computed on the theory of isostasy may be found in the "Geodetic Reports of the Survey of India", vol. 5, and in the *Geophysical Supplement to the Monthly Notices of the Royal Astronomical Society* (vol. 3, No. 1, Jan. 1932).

Even with the admitted sensitiveness to the effect of error in reduced values of gravity, and with the consequent uncertainty in the geoid heights, the formula may be accurate enough to give valuable information about certain geophysical questions to which even a rough answer may be of value. For example, is the geoid over the deeper parts of the oceans depressed below the spheroid of reference, as the theory of isostasy would require, or is it raised above the spheroid, as certain observations of gravity at sea, admittedly too few to be conclusive, would seem to suggest ? Is the form of the geoid more nearly a triaxial ellipsoid than an ellipsoid of revolution ? Or more accurately stated, does the ellipsoid most nearly representing the earth as a whole deviate from an ellipsoid of revolution sufficiently for the deviation to have substantial geophysical significance ?

Of course, as Mr. Gulatee suggests, Stokes's formula may be useful for determining relative or differential elevations of the geoid above the spheroid. It seems to me, however, that in regions where triangulation and astronomical observations are available the deflexions, as determined from these, ought to give a better idea of the differential elevations from Stokes's formula. The main value of the latter is for absolute elevations.

WALTER D. LAMBERT.

U.S. Coast and Geodetic Survey,
Washington, D.C.,
March 21.

[1] NATURE, **129**, 279, Feb. 20, 1932.

Errors in Thermal Measurements

PROF. PARTINGTON directs attention [1] to errors which are likely to be present when resistance thermometers are used in measurements of heats of adsorption. He does not refer to thermocouple thermometers directly, but he includes in his references papers which describe their use. Although calorimeters in which such thermometers are used are far from perfect, the situation is not quite so black as his letter might lead one to believe. For example, results have been obtained with these thermocouple calorimeters which agree with those of the ice calorimeter.[2]

The nature of the errors met with in measurements of heats of adsorption depends to some extent on the type of adsorption studied. Where adsorption is very rapid, care must be taken that the following conditions hold. It is essential that (*a*) the calorimeter be *completely* surrounded with objects at a constant temperature, (*b*) that the gas be admitted to the centre of the adsorbent and not to the sides of the mass, and (*c*) that sufficient length of the thermocouple leads be immersed in the adsorbent. (*a*) and (*c*) can be tested by the admission of an inert gas which will change the temperature in the neighbourhood of the junction

unless the enclosure is at constant temperature, or if appreciable quantities of heat are conducted away by the thermocouple leads outside the calorimeter. When such precautions are taken, no maxima are obtained on the differential heats of adsorption curves similar to those recorded in results of earlier work.[3] When a high vacuum is obtained after adsorption, as is the case for the adsorption of oxygen on charcoal, the rate at which heat is distributed throughout the calorimeter is slow. In this case, it takes two to five minutes before the rate of cooling obeys Newton's Law. This causes an uncertainty in the value deduced for the heat of adsorption of not more than 5 per cent, and in some cases the error may be much less than this.

Where adsorption is not very rapid, (*b*) is an unnecessary precaution.[4] Since adsorption is slow, it is, however, necessary to make continuous measurements of pressure and temperature simultaneously in order that suitable corrections can be made to the cooling curves. In such cases, however, since adsorption usually occurs at high pressures, the thermometric lag is generally small.

The development of thermocouple calorimeters for measurements of heats of adsorption is of importance since these afford the best means of measuring these values at temperatures other than room temperature.

W. E. GARNER.

Department of Physical Chemistry,
University, Bristol,
May 2.

[1] NATURE, **129**, 615, April 23, 1932.
[2] Bull, Hall, and Garner, *J.C.S.*, 839; 1931. Marshall and Bramston-Cooke, *J.A.C.S.*, **51**, 2019; 1929.
[3] Bull and Garner, NATURE, **124**, 409, Sept. 14, 1929.
[4] Garner and Kingman, *Trans. Far. Soc.*, **27**, 322; 1931.

Free Ethyl

THE demonstration by Paneth and his collaborators of the existence first of the methyl [1] and quite recently of the ethyl [2] radicals in the free state has not, so far as we are aware, received independent confirmation. As apparatus capable of giving high streaming rates at suitable pressures being available in connexion with other researches which are engaging our attention in these laboratories, it appeared of interest to repeat the thermal dissociation of lead tetraethyl.

The material supplied by British Drug Houses was fractionated in a vacuum before use, and the operations were carried out in hydrogen, especial precautions being taken to ensure the absence of oxygen and moisture in the gas or on the surface of the apparatus. The velocity of the gas stream was 7·5 metres per second at pressures varying from 1-3 mm. through the transparent silica tube of 6 mm. internal diameter in which the phenomena were observed. So far as they went, our results confirm entirely the experiments of Paneth and Lautsch,[2] namely: (1) the removal of lead mirrors was readily detectable 10 cm. away from the source of the aggressive agent, (2) there was reformation of material which in turn yielded a mirror on heating, (3) an approximate measurement of the life period gave a result of the same order as that found in the original experiments.

T. G. PEARSON.
P. L. ROBINSON.
E. M. STODDART.

University of Durham,
Armstrong College,
Newcastle-upon-Tyne,
April 7.

[1] Paneth and Hofeditz, *Ber.*, **62**, 1335; 1929.
[2] Paneth and Lautsch, *Ber.*, **64**, 2702; 1931: *idem ibid.*, 2708.