Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Spinning Electrons and the Structure of Spectra.

RECENTLY Uhlenbeck and Goudsmit (NATURE, February 20, p. 264; see also *Naturw.*, November 20, 1925) have directed attention to the fact that a number of features of multiplet structure and the anomalous Zeeman effect can be described by assuming the electrons in the atom to possess an inherent magnetic moment, pictured as being due to a spinning motion of the electron about an axis of symmetry. This moment must be considered as having a magnitude of 1 or 2 Bohr magnetons (about 10^{-20} c.g.s. units), depending on what rules one assumes to govern the orientation of the axis with respect to an external magnetic field. The above-named authors discuss the advantages which such a view brings with it, but fail to point out some serious difficulties.

If it is permissible at all to use pictorial concepts such as the word ' spinning ' evidently implies, it must also be permissible to speak of the ' dimensions ' of an electron. These dimensions would then have to be taken as of order of magnitude 10^{-13} cm. To give a magnetic moment around 10^{-20}, the internal velocities would have to be exceedingly close to that of light. Now the elementary unit of magnetic moment, the Bohr magneton, is derived from considerations of the *orbital* motions of electrons with velocities *much smaller* than that of light (W. Pauli, jun., *Zeit. f. Phys.*, **31**, 373, 1925), in which the internal structure of these electrons does not enter at all, so that they can be regarded as point charges. It is hard to see, then, why this elementary unit should also be characteristic of the internal motion of the electrons in spite of the high velocities involved, and that with a precision which would have to be considerable, if the measurements on the anomalous Zeeman effect were to be explained in this way.

Quite aside from this objection, the validity of which could perhaps be questioned, since we may not be justified in applying the classical concepts of kinematics and electrodynamics to the case of the structure of the electron, even if we only wish to obtain rough estimates, the following difficulty arises. In order to account for the observed Zeeman effect by the hypothesis of Uhlenbeck and Goudsmit, it is necessary to assume that an orbital electron always has the same magnetic moment, of the order of a Bohr magneton, no matter in what orbit or in what atom. One is thus led to expect that this also remains true when an electron forms part of the nuclear structure. But then the nucleus, too, will have a magnetic moment of the order of a Bohr magneton, unless the magnetic moments of all the nuclear electrons just happened to cancel. For such an additional moment of the nucleus there is no place in the theory of the Zeeman effect, and the probability that in all atomic nuclei the magnetic moments of the electrons neutralise seems *a priori* to be very small.

The new hypothesis, therefore, appears rather to effect the removal of the family ghost from the basement to the sub-basement, instead of expelling it definitely from the house.   R. DE L. KRONIG.

Columbia University,
    New York.

Theories of Adsorption and the Technique of its Measurement.

SEVERAL years of measurement of sorption in the University of Bristol laboratory by the simple and searching method of the sorption balance (for description see *J. Am. Chem. Soc.*, 1924, **46**, 2781, and March 1926, **48**, 690) have taught us two things: First, most of the published data on the sorption of gases and vapours possess no quantitative significance because they refer to insufficiently cleaned surfaces. Second, the behaviour of a surface when cleaned from pre-existing impurities assumes a different and highly significant form. It is usually supposed that mere heating of a substance like charcoal to, say 400°, with exposure to an ordinary vacuum, will completely remove previously sorbed gases. This is by no means the case. For example, carefully prepared sugar charcoal, which had been activated by superficial oxidation at about 1200°, was given an exposure for five hours at 450° to a vacuum of 10^{-5} mm., and was afterwards found to sorb a maximum of 17·5 per cent. of its own weight of nitrous oxide in a protracted series of experiments. The amount of nitrous oxide sorbed was raised to no less than 26·5 per cent. by the simple expedient of re-evacuating the charcoal at 450° after its saturation with nitrous oxide, and then repeating the measurements. Similar behaviour has been observed in many other cases; for example, the observed sorption of such inert substances as hexane or decane may be increased several fold by repeating the evacuation after the charcoal has been saturated with the hexane or decane to displace other impurities from the surface.

It is evident that published data are too uncertain in magnitude to permit of accurate comparison of the sorption of various substances for the testing of conflicting hypotheses. The second influence of these neglected residual impurities is to change the character of the curve representing the dependence of the sorption upon the pressure or vapour pressure. The ordinary form of sorption curve as obtained in the presence of tenaciously sorbed impurities shows steady increase with increase of pressure. The same surface when cleaned gives not only much greater sorption, but also the sorption is practically complete at comparatively low pressures, remaining constant at a saturation value as the pressure is further increased. With methyl alcohol and with toluene, for example, the pressure of the vapour can be increased five to twenty fold without appreciable increase in the amount adsorbed once the saturation value has been attained. Moreover, the adsorption on clean surfaces is nearly instantaneous and is perfectly reversible. It therefore becomes evident that the existence of a saturation value for sorption of vapours by charcoal is normal and characteristic.

There are at present three competing theories of adsorption : First, the monomolecular films of Langmuir (1916), Henry (1922), and others, in which interaction is confined to molecules of gas or vapour in actual contact with molecules of the surface; second, the polymolecular films of Polanyi (and Williams, *Proc. Roy. Soc.*, A, 1919, **96**, 307) and Lamb and Coolidge (1920), where it is assumed that at distances many molecular diameters away from the solid surface, there is still a powerful attraction of gas or vapour molecules towards the surface, producing a film of compressed gas or even liquid ; third, the capillary condensation hypothesis of Gurwitsch, 1915, and Patrick, which assumes that liquid is condensed in bulk in the pores of a porous solid such as charcoal or silica gel.