

plexes," found in folklore, by reference to the organisation of a given society. Inversely it allows us also to trace the pattern of instinctive and emotional tendencies in the texture of the social fabric. By making the theories somewhat more elastic, the anthropologist can not only apply them to the interpretation of certain phenomena, but also in the field he can be inspired by them in the exploration of the difficult borderland between social tradition and social organisation. How fruitful Freud's theories are in this respect I hope to demonstrate clearly in the pending publication previously mentioned.

BRONISLAW MALINOWSKI.

Department of Ethnology,
London School of Economics,
University of London.

Spectra of Isotopes.

THE quantum theory of line spectra developed by Bohr has been most successful in explaining the spectrum of hydrogen and helium, and by a further hypothesis the spectra of the alkali metals. By asserting that elliptic orbits are possible, as well as circular orbits, Sommerfeld succeeded in explaining the Stark and Zeeman effects and the fine structure of spectral lines. It is significant that Bohr's equation for the frequency of the spectral series also explains the difference between the series spectra of isotopes of the same element. The experiments of Aronberg and Merton on the structure of 4058 Å. of isotopes of lead showed, however, a remarkable discrepancy between the shift predicted by the theory and that actually observed. Similarly Merton's experiments on the line 6708 of lithium showed that the line consisted of two components 0.151 Å. apart, while the theoretical shift was 0.087 Å. The quantum theory is unable to account for this large separation observed.

Recently Ehrenfest, commenting upon the validity of the simple Bohr equation, remarked that the equation cannot be true in general for atoms with several electrons, as in this case the radiating electron compels the remaining electrons to execute the motions of reaction which influence the nucleus. Moreover, Nicholson has shown that, by the choice of simpler orbits and by the supposition made by Sommerfeld, as to invariability of energy W for all possible orbits, the inner orbit has a radius of about one-tenth of that of the outer orbit. It has thus been shown that the external electron moves in the field of the nucleus, which is asymptotically a Coulomb field, and that Bohr's formula cannot be far wrong for a rough determination of the separation to be looked for in the spectra of isotopes.

Prof. McLennan, however, in an account of interesting experiments (Proc. Roy. Soc. A 714, p. 33, and A 711, p. 342) on the structure of the line 5460 of mercury and the line 6708 of lithium, and isotope displacement, has found that when the radiation constituting the green line of mercury is passed through moderately luminous vapour, the main component and components $+1$ and -1 are distinctly absorbed. In an attempt to explain the complex structure of the lines from the point of view of the isotopic structure of the elements, the view is put forward that the spectral displacement for isotopes should be given by the atomic number multiplied by the displacement calculated on Bohr's theory, and the main components of 5460 are attributed to isotope 200, and the component $+1$ and -1 to isotopes 198 and 202 respectively.

In the light of the recent experiments of Bronsted and Hevesy, who succeeded in separating the isotopes

of mercury, and showed also that the isotopic composition of mercury of terrestrial origin is the same, it is difficult to conceive why, in Prof. McLennan's experiments, the lines corresponding to isotopes 198, 200 and 202 should alone be absorbed, while the lines corresponding to the other isotopes are not absorbed. Further, if, according to Aston's experiments, isotopes 197-200 exist in mercury in largest proportion, one would naturally expect that the most intense component of 5460, that is, the main component, should naturally correspond to isotope 197. Similarly in the case of lithium, he found that the line 6708 consists of a quartet, the average displacement of one doublet being about 3 to 4 times as great as the calculated separation, namely, 0.087. But generally it is found that enhanced lines are developed when an arc is operated in vacuo, thereby showing that it cannot be supposed that these lines are true arc lines, which is in conformity with Nicholson's view that the radiation 6708, which McLennan examined, might be the principal spark line of lithium, which has a value very close to 6708.

These facts naturally lead one to question whether McLennan's view has real physical significance. To settle this point a careful examination of the structure of some bright line spectra was undertaken in this laboratory. The most recent experiments of Aston (*Phil. Mag.*, May 1923, p. 934) have definitely established that tin is a highly complex element, being a mixture of eight isotopes of atomic weights 120, 118, 116, 124, 119, 117, 122 and 121, in which case the isotope displacement for 5631, for isotopes 120 and 124, and 120 and 116, is roughly equal to ± 0.0007614 , that is, for 116 and 124, 0.001523; while according to McLennan's view it is equal to 0.03807 and 0.07614, which is well within the limits of resolution of an ordinary Lummer plate or Fabry Perot etalon. Therefore the structure of the lines 5631 and 4524 was carefully examined by a Lummer plate, the R.P. of which for 5631 = 250,000. In these experiments the arc was enclosed in a chamber surrounded by a water jacket, and the radiation from the arc was examined at different pressures. It was found that even when the pressure was low (that is, of the order of 1 mm.) both the lines were simple in structure, especially the line 4521, which was very sharp. These experiments do not, therefore, support the view put forward by McLennan.

A. L. NARAYAN.

M. R. College, Vizianagaram,
South India, September 11.

A Substitute for the McLeod Gauge.

ALTHOUGH numberless accounts have appeared of the precautions necessary in the obtaining of high vacua, some serious workers seem still to imagine that they can reach "a perfect vacuum" or "a pressure of 0.001 mm." in an apparatus from which absorbed water has not been removed. The lingering of this ancient superstition is due to the prevalence of the McLeod gauge; if any gauge which indicates vapours as well as permanent gases had been in general use, it could never have arisen. Historians may dispute whether the invention of the McLeod gauge has advanced or retarded the development of science; but there is no doubt that to-day, though it may have special uses (such as the calibration of other gauges) under rigidly controlled conditions, it is usually a mere relic of the past.

Compared with its adequate substitutes the McLeod gauge has not even the merit of convenience. In particular, although some workers who are perfectly aware of its limitations continue to make it a normal component of any pumping system, it is not the most