Letters to the Editor.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

The Isotopes of Antimony.

OWING to the kindness of Prof. G. T. Morgan, who prepared a specimen of pure antimony trimethyl for this purpose, I have now been able to obtain the mass-spectrum of antimony. The element is characterised by two lines of nearly equal strength at 121, 123. The first is the more intense by perhaps 10 to 20 per cent. If sufficient exposure is given two faint companions are visible at 122, 124, but the general evidence suggests that these are due to hydrogen addition products. The isotopic nature of the lines 121, 123 is amply confirmed by the appearance of similar pairs 15 and 30 units higher, due to molecules of their monomethides and dimethides. The most trustworthy measurements show that the masses of the isotopes of antimony are most probably less than whole numbers by one to two parts in a thousand.

These results show that the chemical atomic weight 120.2 at present accepted is certainly too low. They are, however, in excellent agreement with the value 121.77 recently obtained in America by Willard and M'Alpine.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, November 16.

Experiments on the Theory of Soil-acidity.

IN a recent paper "On the Adsorption of Ions" (*Phil. Mag.* (VI.) 44, 321) the origin of soil-acidity has been discussed (pp. 338-45, especially pp. 343-45). In the following a short account is given of some experiments carried out with Mr. Kamalacharan Bhattacharya and Mr. Bankim Chandra Roy.

It was suggested that the acidity is due to the adsorption by the gels (of silicic acid, aluminium oxide, and ferric oxide) of the anions of acids. The adsorption is so strong that the adsorbed substance cannot be washed out by water, and the aqueous extract is neutral. The anions are adsorbed on the surface by "chemical forces" whereas an equivalent number of cations forms the mobile second sheet of the double layer. If the cations consist in part of H⁺ ions, in treating with excess of a neutral salt (KCl) solution there is a displacement of the cations of the second layer by the cations of the neutral salt, as the latter is present in relatively enormous concentration, and as the forces acting on the cations of the mobile second sheet of the double layer are mainly electrical in nature.

Experiments have been carried out with powdered precipitates of silica, ferric oxide, and alumina. Of these, silica has been found to adsorb appreciable quantities of acids, e.g. acetic, citric, hydrochloric, and nitric. The adsorption is so strong that on repeated washing the adsorbed substance cannot be removed so that the aqueous extract soon becomes perfectly neutral. On now shaking the precipitate with KCl—which is tested with indicators to be perfectly neutral—the aqueous extract (free from particles of the precipitate) is found to be distinctly acid. The amount of the acid depends on the amount of the precipitate. In the extract with the neutral salt solution, acetates or citrates could not be detected.

The formation of insoluble salts of alkali metals or replacement of hydrogen ions by metallic ions in

complex silicic acids is evidently out of the question. It is unanimously agreed that silica is an acid, and the probability of forming definite complex acids with acetic acid is very remote.

It might be argued that the acids are adsorbed as such, that is, the entire molecule is adsorbed. This point has been settled by simultaneous experiments on electro-osmosis. The apparatus used was a modification of that used by Briggs (*Journ. Phys. Chem.* 22, 1918, 256), which the writer found was employed by Dr. Ishikawa in the Physical Chemistry Laboratory of Prof. F. G. Donnan, University College, London. The sample of pure precipitated silica (British Drug Stores, Ltd.) we are using shows a marked negative charge in pure water. On treating with acetate the charge increases as shown by the rate of motion.

The results are accurate within about 10 per cent.

	Velocity in cm. per min.
Pure water	2 cm.; 2.05 cm.
N/1000 sodium acetate	3.9 cm.
N/2000 acetic acid	2.7 cm.; 2.7 cm.
N/1000 sodium hydroxide	3.4 cm.; 3.2 cm.
N/100 acetic acid	1.7 cm.
N/1000 hydrochloric acid	2.3 cm.
N/1000 potassium chloride	3.1 cm.

It will be seen that in the presence of sodium acetate and potassium chloride the negative charges increase 100 and 50 per cent. respectively. The experiments have been carried out under identical conditions. In the case of sodium acetate the presence of hydroxyl ions have to be taken into account. It will be seen, however, that acetanions are adsorbed to a greater extent than hydroxidions, and it is well known that the more strongly adsorbed substance largely displaces the other which is not so strongly adsorbed. In the case of potassium chloride the question of hydrolysis does not arise.

As is to be expected from the greater mobility of the hydrogen ions and the views of the writer (*Far. Soc. Disc.*, Oct. 1921, *Phil. Mag.* (VI.) 44, 330-37), the acids of the same concentrations show a smaller charge than their salts. The charge is, however, undoubtedly greater than that with pure water, so that there is unmistakable evidence of the adsorption of anions, but owing to the effect of hydrogen ions the charge indicates a smaller adsorption than is really the fact.

We are at present engaged in working with the gels (which are likely to have greater specific surface) and with chemically pure silica or silicic acid gel. It appears that the electro-osmotic apparatus is also capable of further improvements.

These experiments clearly show that we are really dealing with the kinetic exchange of ions (hydrogen or Al⁺⁺⁺ in the case of soil acidity) in the second sheet of the double layer or present as electrically adsorbed, as suggested by the writer. It is not necessary to assume the hydrolysis of potassium chloride into alkali and acid in water, or the displacement of hydrochloric acid from alkali chlorides by humus acid, or the formation of insoluble salts of alkali metals, as has been done in the past.

There is other corroborative evidence in support of this point of view.

J. N. MUKHERJEE.

Physical Chemistry Department,
University College of Science, Calcutta,
September 20.

New Spectra of Water Vapour, Air, and Hydrogen in the extreme Ultra-violet.

AFTER reading of the excellent work of Prof. Wood on the extension of the Balmer series of hydrogen, I decided to investigate the Lyman series of hydrogen