

Evidence is accumulating in several laboratories in India and abroad to show that the physico-chemical laws applicable to plants, growing in solution cultures are not applicable to plants growing in soil and the time may soon come when

we may have to apply ourselves to a radical reconsideration of our views on the mechanism concerned with the absorption of nutrients by plants under natural conditions.

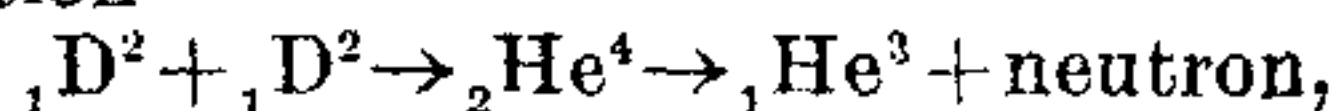
Research Notes.

A New Isotope of Hydrogen of Mass 3.

A NEW hydrogen isotope of mass 3.0151 formed by the action of dipions on dipions is reported by M. L. E. Oliphant, P. Harteck, and Lord Rutherford (*Proc. Roy. Soc., A*, 144, 692, 1934). They have studied the effects produced when dipions are employed for bombarding targets covered with a thin layer of preparations containing heavy hydrogen. These were ammonium chloride, ammonium sulphate, and orthophosphoric acid, in which the normal hydrogen had been largely replaced by diplogen. In each case enormous numbers of fast singly charged particles were found to be emitted, consisting essentially of two prominent groups of ranges 14.3 and 1.6 cms. respectively. These groups containing equal numbers of particles have been identified, the first as protons, and the second as the nuclei of a new isotope of hydrogen of mass 3.0151. The reaction assumed is



the mechanism being that as a result of close collision two dipions unite to form a new highly unstable helium nucleus of mass 4.0272, possessing an energy of about 23 million volts in excess over that of the normal helium nucleus of mass 4.0022, and this unstable nucleus then breaks up in a number of ways, one of which is indicated by the above equation. A second mode of disintegration into an isotope of helium of mass three and a neutron according to the equation



seems also possible, from among other considerations, the fact that a large number of neutrons are produced in the above experiment. This new isotope of helium of mass 3.0178 has, however, already been indicated in the bombardment experiments on lithium atoms of mass 6, by protons.

M. A. G.

Technique of Sputtering Sensitive Thermocouples.

In a paper in the April number of the *Review of Scientific Instruments* Louis Harris and

Ellis A. Johnson describe a method of construction of thermocouples sensitive to the alternating temperatures of sound waves or to small intensities of intermittent radiation. For both these purposes the thickness of the thermo-elements must be of the order of 10^{-5} cm. Cathodic sputtering offers a very convenient way of obtaining such films. The metal films are sputtered on to thin films of cellulose acetate or cellulose nitrate supported by a mica framework, in an atmosphere of argon. Using proper templates of mica during sputtering alternate strips of bismuth and antimony or bismuth and tellurium are obtained. The ends of the thermo-elements thus obtained are heavily sputtered with gold to which the leads, consisting of fine wires, are soldered. The hot junctions of the thermo-elements are blackened by evaporation of antimony under an air pressure of 0.5 mm. Used in conjunction with a low frequency amplifier even single junction couples of this type should be sensitive to about 2×10^{-10} calories per sq. cm. per sec., while multijunction elements permit the measurement of even lower radiation densities.

S. R.

Ultra-Violet Monochromators.

In an article in the *Review of Scientific Instruments* (1934, 3, 149), C. R. Harrison has described some designs for a cheap but effective monochromator for the ultra-violet. The simplest of them consists merely of a spherical concave mirror immersed in a basin of distilled water at an angle of about 30° from the horizontal; this acts as a crude prism somewhat on the principle of the Fery quartz prism, and gives monochromatic though distorted images of a high power horizontal mercury arc used as a source. Its resolving power is less than that considered suitable for a commercial monochromator, but far greater than that expected of a filter. Such an instrument should be useful for many types of biophysical and photo-chemical work.

Further improvements could be made on the above design, such as for reducing the

distortion. It has also been suggested that it should be possible to make large prisms and lenses of ice kept cool at all times by mechanical refrigeration. A few preliminary experiments on figuring ice lenses have already indicated the possibility of making extremely large optical parts at low cost.

Brownian Movement of Rotation.

THE significance of the irregular Brownian movement of translation executed by tiny solid particles has been pointed out long ago in 1905 by Einstein and Smoluchowski as thermal vibrations in the sense of the gas kinetic theory. Now, these particles should also similarly exhibit irregular motions of rotation about their centres of gravity. V. Schmieschek has described an experiment (*Z. Techn. Physik.*, 1934, 15, 178) which claims to photograph these motions and thus provide further experimental evidence for the gas kinetic theory. The principle of the experiment consists in allowing a very bright small spot of light as from the positive crater of an arc lamp to be reflected from the surface of a tiny silver crystal on to a photographic film. Regular hexagonal crystals of maximum diameter 0.03 mm. were prepared and suspended in water contained in a vessel with plane parallel sides. It will not be possible to observe the tiny irregular rotations of these crystals with an optical system such as the eye or eye-microscope since such rotations will but correspond to a small bundle of light. When, however, the light falls on a matte surface tiny spots of light can be seen (and photographed) to execute zig-zag motions. An amplitude of vibration of 1 mm. was observed on a plate placed at a distance of 20 cm. from the crystal particles. This must correspond approximately to an angle of rotation for the crystal of $8' \times 9'$ and therefore, as the diameter of the crystal was 0.02 mm. to an actual displacement of one edge corresponding to another considered as stationary, of only 0.00005 mm. Specimens of photographs taken are presented.

A New Colour Test for Vitamin A.

THE reputed antimony trichloride test for Vitamin A due to Carr and Price, has at least two drawbacks:—(1) the initial blue colour that is produced is not stable, and therefore unreliable as a basis for the quantitative estimation of the vitamin, and (2) it

is not specific for vitamin A as other carotenoids also answer the same colour test. Rosenthal and Erdélyi have by a simple modification of the Carr-Price reaction succeeded in developing a test, characteristic of vitamin A (*Biochem. J.*, 1934, 28, 41). The method consists in using 0.5 per cent. freshly prepared solution of catechol in chloroform, in addition to the usual Carr-Price reagent. The mixture containing catechol, antimony trichloride and the vitamin A containing substance is immediately transferred to a water bath at 60°C. and warmed for one to two minutes. The blue colour first produced changes over to an intense violet red, which is more stable than the blue of the Carr-Price reaction. Carotenoids do not give this reaction. The intensity of the violet-red colour is proportional to the concentration of vitamin A and the reaction can therefore be employed for the quantitative colorimetric estimation of the vitamin using a 0.01 per cent. solution of potassium permanganate for comparison.

B. N. S.

The Separation of the Enzymes and Toxic Principles of the venom of *Crotalus adamanteus*.

RATTLE snake venom contains a proteinase and a cephalinase, two enzymes which are responsible for its anti-coagulant action on blood. Their separation from each other has for the first time been accomplished by Dunn (*J. Pharmacology and Exp. Med.*, 1934, 50, 393) who has employed two distinct methods for the purpose. Fractional precipitation of the venom by subjecting a solution of the venom (in 1 per cent. sodium chloride) of pH 5.2 to a temperature of 85°C. removes the proteinase completely, at the same time causing little decrease in the cephalinase activity of the filtrate. A 20 per cent. urea extract of the coagulum, after dialysis, exhibits a slight proteoclastic activity. Cephalinase can be completely adsorbed by a somewhat aged preparation of Aluminium Hydroxide C. The author has made the interesting observation that whereas freshly prepared Aluminium Hydroxide C adsorbed both the enzymes quantitatively, the same preparation eight months old adsorbed only the cephalinase leaving the major portion of the proteinase in solution. The adsorbent twelve months after preparation failed to adsorb either of the enzymes. Aluminium Hydroxide A adsorbs both the enzymes,

which can be eluted from the adsorption by a phosphate buffer solution (pH 6.9) to which 25 per cent. of its volume of glycerol has been added.

B. N. S.

The Movement of Food Materials in the Cotton Plant.

THE growth of the cotton plant is a problem of immediate concern to the Indian agriculturist, as this country is the second largest in cotton production. Any research or investigation relating primarily to the development of this species is, therefore, of the utmost importance. Mason and Philis of the Cotton Research Station, Trinidad, have formulated tentatively their views on the translocation of food materials in this plant (*Emp. Cotton Grow. Review*, XI, 121, 1934). During the vegetative phase the mineral nutrients absorbed by the roots are transferred to the leaves along with the transpiration current. The roots receive carbohydrates from the foliage for their growth and development. Thus the leaves are not only the store-house of sugars but also of the bulk of the mineral salts and they further act as the distribution centre of these products to other parts of the plant. According to the authors, during the vegetative phase, storage of inorganic materials takes place in the roots, stems and leaves. In the reproductive stage the manufactured food materials are translocated to the developing bolls. During this period, absorption of minerals through roots is inhibited, the plant in consequence ceasing to function in course of time.

The mechanism of the translocation of food materials, chiefly organic, is rather interesting. The sugars in the leaves first travel to the fine veins, against a gradient and thence are translocated through the sieve tubes of the phloem region, which extends to the bolls and traverses the bark of leaf stalks, etc. Here the direction of translocation is not unidirectional. The more significant feature about the movement of sugars in the sieve tubes is the rapidity of transportation which is thousands of times greater than the movement due to physical diffusion, the mechanism of which is still obscure.

The distribution of mineral elements from the leaf is also through the phloem, where the majority of them are mobile, but calcium and iron appear immobile. In the cotton plant, calcium does not appear to be present in the sieve tubes, while chlorine is largely

available in them. It is useful to point out here that accurate micro-chemical analyses of the saps of the several tissues only can help in the examination of these materials. By their ringing tests, the authors have produced evidence of leakage of potassium, magnesium and chlorine into the woody tissues, and that these do not accumulate in the portion above the ring.

Flowback of minerals during the later stages of development is the view of physiologists and the same is gaining ground day by day. The authors have further shown that such flowback is evident from the corolla of flowers when these change colour from yellow to red.

The views put forth above are only tentative and call for critical examination at the hands of physiologists. It seems necessary to add that methods of micro and ultra-micro nature need to be evolved for testing saps and tissues of comparatively small dimensions.

V. I.

Coffee and Human Efficiency.

It is not uncommon to find that coffee is either lauded or berated vigorously, in its relation to human efficiency. The subject is so old and in spite of the controversy, its consumption is only on the increase. The scientific aspect of coffee in the diet has not been lost sight of by investigators. Unlike other researches which relate to the administration of coffee and beverages from coffee on pathological conditions, R. C. Cheney (*J. Amer. Pharm. Assoc.*, 23, 143, 1934) has devoted his attention to the physiological effect of coffee on human subjects of normal health. Opinion is generally divided as to the efficacy of coffee in improving muscular function, but in the present instance, evidence is adduced of positive effects in that direction. Among other things, the following factors were studied: blood pressure variations, respiration and time for recovery after fatigue. The experiments were carried out under identical conditions, with the treatment either with hot water, black coffee or caffeine in hot water, as the variable. Prior to the fatigue test the several drinks mentioned above were administered and the actual test consisted in lifting weights every ten seconds to complete fatigue. It was found that the work done was least in non-treated or hot water treated days and most in caffeine days, with that on the coffee day

lying in between the two. As regards blood pressure, no variations were noticed, while an increased respiratory activity in the coffee treatment indicated a greater oxygen consumption. This latter activity is related to intercranial pressure, decreasing the rate of cerebrospinal fluid secretion. Evidence has already been presented on the increased salivary secretions in volume per unit volume as a result of coffee drinking. Professor Hollingworth has reported a clearly distinguishable stimulation of the mind due to coffee. Thus there is sufficient evidence to say that coffee invigorates the brain and other parts of the central nervous system. Caffeine in coffee is less effective—probably due to the presence of other substances in the same—than separately. Fatigue is delayed.

But it must not be assumed from this that coffee can replace other foods in the normal course. Although its stimulating action persists for a considerable length of time after consumption, it is at best an aid to human efficiency and can never be a substitute for body fuel. The increased efficiency is perhaps due to the simultaneous invigoration of both the circulation of blood and general respiratory metabolism. It is therefore advantageous to avail of this aid during moments of depression and fatigue.

V. I.

Polymorphic Phenomena and Crystal Structure.

AN interesting paper on this subject by Tom F. W. Barth appears in the April issue of the *American Journal of Science* (XXVII, Fifth Series, No. 160). The author starts with the following definition of polymorphism—"Polymorphism includes every possible difference encountered in the crystalline lattice of a substance of constant chemical composition, excepting homogeneous deformations," and then proceeds to classify the several polymorphic changes occurring in crystals into three groups:—(1) A complete alteration of the space-lattice with the formation of a new type structure. Since the type of structure is changed, this case could be referred to as polytypy. (2) A distinct change in the syngony (*i.e.*, geometrical symmetry) of the space-lattice although the atomic arrangement, density, or cleavage properties are so slightly affected

that the type of structure is preserved and merely a new variant of structure is formed. Such differences in the syngony properties could be referred to as polysyngony. (3) A change in the physical properties without any change of the syngony of the lattice. A new variant of structure is thereby formed but the type is of course preserved. Such properties of a crystal could be referred to as polytropy. In the latter part of the paper the polymorphism of potash feldspar has been specially treated. Notwithstanding the fact that apparently monoclinic alkali feldspars composed of submicroscopically twinned triclinic units do occur in nature, it can be shown that potash feldspar is trimorphous.

L. R. RAU.

Micro-Hardness of Minerals.

IN a recent number of the *American Mineralogist* (19, No. 4, April 1934), H. C. Hodge and J. H. McKay have given a brief account of their determination of what they call the 'micro-hardness' of minerals with the help of a special instrument called the microcharacter. The minerals comprising the Mohs scale of hardness have been specially selected for investigation and the data obtained have been tabulated as follows:

Mohs scale	Width of cut in Microns	Micro- hardness
1. Talc	93.6	1
2. Selenite	90.3	11
3. Calcite	8.8	129
4. Fluorite	8.4	143
5. Apatite	5.5	517
6. Orthoclase	3.2	975
7. Quartz	1.9	2700
8. Topaz	1.7	3420
9. Corundum	1.4	5300
(Var. Sapphire)		

The authors suggest that the micro-character may be applied to a more complete study of the hardness of minerals, particularly in regard to (1) the hardness-changes produced by changes in composition (2) the hardness-changes produced in variously oriented crystals in an aggregate; or (3) the study of hardness with a view to the identification of the components of aggregates.

L. R. RAU