

Research Notes.

Effect of Simultaneous Electric and Magnetic Fields on Spectral Lines. I. Crossed Fields.

A STUDY of the effect of magnetic fields (Zeeman Effect) and of electric fields (Stark Effect) has been a guiding adjunct in the classification of spectral lines and the theoretical investigations of these effects have been of fundamental importance in the development of Quantum Principles. The simultaneous effect of magnetic and electric fields on spectral lines has now been investigated by W. Steubing and the results are reported in the *Sitzb. d. Preuss. Akad. d. Wiss. Berlin*, 1935, p. 3. We shall here summarise the effect observed when the magnetic and electric fields are perpendicular to each other. In every case the pattern due to the electric field is altered by the introduction of the magnetic field. The following regularities have been observed:

(a) The p -components of the electric field are affected.

(b) Such series lines as have a large Stark effect are very sensitive to the magnetic field while those that show small Stark splitting exhibit only a Zeeman effect. However, the separation produced is sometimes larger and sometimes smaller than that due to the normal Zeeman effect. The variation from one series to another is more than double for the same electric and magnetic fields.

(c) The lines of the sharp series, so far at least as the first members are concerned, separate as in the pure Zeeman effect, apart from an alteration in the intensities of the components. Similarly the lines due to forbidden combinations which appear under the electric field show only the Zeeman effect. The effect on the principal series is intermediate between that on the sharp series and the effect observed in the diffuse series.

(d) In the case of the diffuse series, the number of components produced by the electric field remains unaltered, but the lines broaden out asymmetrically, so that those on the longer wavelength side widen towards the red while the lines on the shorter wavelength side broaden towards the violet. These widened bands have no structure. The bands have a sharp edge on one side and trail off on the other side and have a width about five times the maximum Zeeman separation of the same line,

(e) Both in the diffuse series and in the principal series, the broadening increases with the total quantum number. The inner components are less broadened than the outer.

(f) The crossing of the fields does not give rise to any new lines.

(g) The effect of a magnetic field below 10,000 oersteds is small, but above 20,000 oersteds its effect is more marked than that due to an electric field of 100,000 volts per centimetre.

T. S. S.

The Ferromagnetism of Gadolinium.

THE only known ferromagnetic elements were until recently iron, nickel and cobalt but now another has been added to the family thanks to the labours of G. Urbain, P. Weiss and F. Trombe (*Comptes Rendus*, 1935, **200**, 2132). This new member of the ferromagnetic group is the rare earth metal Gadolinium recently isolated in great purity by F. Trombe. The only impurities were 0.7% of silicon and 0.03% of iron. Small quantities of this precious metal had to be employed and the methods developed at Strasbourg for handling quantities of the order of 0.12 gm. were found most serviceable. Gadolinium was found to be even more ferromagnetic than iron but only at low temperatures. Its Curie point above which the ferromagnetic character is lost happens to be $16^{\circ} \pm 2^{\circ}$ C. so that it is only at low temperatures that its ferromagnetic character would be displayed. The specific magnetisation σ varies with the field according to the equation $\sigma_H = \sigma_{\infty} (1 - a/H)$ and its behaviour from the boiling point of liquid nitrogen, *viz.*, 77° K. to the Curie point shows its great magnetic reluctance, for the constant a in the above equation has the value 1250 while for iron it is below 10. At 77° K., however, its specific magnetisation reaches a larger value than that for iron beyond about 15000 gauss. The absolute saturation value calculated from a T^2 -law which is found to hold even below 77° K. comes out to be 253.5 C.G.S. units while for iron it is 221.7. The atomic moment of Gadolinium is 35.4 Weiss magnetons while it is only 11 Weiss magnetons in the case of iron.

T. S. S.

The Growth of Crystals.

ALTHOUGH a considerable amount of information has been accumulated on the nature and constitution of crystalline materials, not much is known about their actual mode of formation and other details regarding their growth. An interesting and convenient method of studying the evolution of crystals is to follow the changes in the interference colours of thin crystals. Preliminary observations have been made on these lines by Perrin, Marcelin and others, who found among other things, that the increase in thickness is a discontinuous process, the smallest step being of molecular dimensions. L. Kowarski has taken up a further detailed examination of this interesting subject, and the first qualitative studies on the formation and growth of *p*-toluidine crystals by controlled sublimation, are reported in *J. de Chimie Physique*, 1935, 32, 303. According to the state of the support, a razor blade, the sublimed crystals may be single, of uniform thickness, and possessing freely curved contours (curved region); or else, they may be in groups and aggregates in each of which there is a fixed orientation and stratification (oriented region). In this region, the appearance of the crystals is very complex, and the growth is particularly active in regions of recent formation (buds). On rapid heating small drops of liquid appear on the crystal surfaces. A number of phenomena indicate a reciprocal relationship between the movement of these drops and the intensity of crystal growth.

Metallic Membranes.

FOR the study of permeability and membrane equilibria, collodion membranes possess many valuable properties, but have the characteristic of taking up only a negative charge in aqueous solutions. It is however frequently desired to have a positive charge on the membrane, and this is achieved by such devices as loading the membrane with different dyestuffs. In this process not only the sense of the potential but also the whole complex of surface forces are altered. The corresponding method of charging amphoteric membranes (*e.g.*, gelatin) by changing the pH of the solutions has also similar complications. To get over this difficulty and to get a membrane whose charge can be easily changed, N. V. Kultascheff and R. A. Santalow (*Z. anorg. allgem. Chemie*, 1935, 223, 177) have studied the preparation and

properties of metallic membranes. These membranes are successfully prepared by heating a thin foil of an alloy of two metals (*e.g.*, brass) so that the more volatile component evaporates leaving behind a membrane with pores of nearly molecular dimensions.

Atomic Weight of Protactinium.

THE atomic weight of not a single member of the Actinium series has so far been determined by purely chemical methods. Aston's work on Actinium D has no doubt given the value for the atomic weight of Protactinium as 231. In spite of the difficulties in getting appreciable quantities of Protactinium, A. V. Grosse (*Proc. Roy. Soc.*, 1935, 150, 363) has prepared the double fluoride K_2PaF_7 in the highest state of purity, and after careful conversion to Pa_2O_5 found the ratio $K_2PaF_7 : Pa_2O_5$. He gives the mean value for the atomic weight of Pa as 230.6 with an accuracy of ± 0.5 . This precision determination of atomic weight is of importance in fixing up the atomic weights of the other members of the actinium series.

M. P. V.

Surface Tension of Aqueous Solutions of Electrolytes.

G. JONES AND W. A. RAY (*J. Am. Chem. Soc.*, 1935, 57, 957) find that the surface tension of a sufficiently dilute solution of an electrolyte is lower than that of water itself. This observation is of great interest, if it is confirmed and shown to be a general phenomenon; and is of particular importance as it is not in accordance with the theories developed by Wagner and later by Onsager and Samaras.

K. S. G. D.

On the C-C Bond Energy.

W. LASAREFF has recently made a calculation of the C-C bond energy in diamond and aliphatic molecules (*Physica*, 1935, 2, 737) which widely departs from the accepted values. He has argued that a carbon atom is in the (6S) state while a carbon atom in the gaseous state is in the (3P) state ($\Delta E = 97 \pm 5$ k. cal.) and that the difference between the energies of these two states has to be considered when calculating the C-C bond energy by means of the data regarding the sublimation heat. Lasareff's value for the bond energy in diamond is 132 ± 3.5 k. cal., while the accepted value is about 75 k. cal.

Lasareff has also calculated the bond energy in the aliphatics which comes to 128 k. cal. It is clear that this calculation of the C—C bond energy will lead to important consequences for many problems in chemical calculations.

N. S. N.

Vitamin K.

THE nature and distribution of a vitamin, possessing curative properties against a deficiency disease resembling scurvy in chicks, but which cannot be prevented by ascorbic acid, has been described by Henrik Dam (*Biochem. J.*, 1935, **29**, 1273). The factor is designated Vitamin K, and constitutes the anti-hæmorrhagic factor (or factors) in the diet. It is fat soluble, being found in the easily soluble non-sterol fraction of the unsaponifiable matter. It occurs in hog liver, hemp seed, and in certain vegetables like tomatoes, kale and orange peel. It is different from Vitamins A, D and E; cod-liver oil is practically devoid of it. There is an enormous retardation of the clotting of the blood of chicks suffering from this hæmorrhagic diathesis, and the quantitative estimation of the Vitamin is based on the determination of the clotting time.

Asexual and Sexual Reproduction in Ascidians.

N. J. BERRILL (*Journ. Morph.*, 1935, **57**, No. 2), as a result of the comparative study of a number of ascidians, has come to the conclusion that the processes of bud development and sexual development are, in the ascidians, at variance. Initial bud masses may consist of cells varying from 40 (*Distaplia*) to 1,000 or more (*Ectinascidia*) and in all cases the cells undergo a number of cleavages before differentiation begins. Gross differentiation into parts of the organism occurs first and only later cytological or cellular differentiation is seen. In sexual development cleavage and differentiation are fundamentally dissociable, the rate of cleavage and the number of cells produced dependent on the yolk-cytoplasm ratio and the size of the egg respectively. Often in early development the differentiation noticed, refers not to the differentiation of the adult structure but to the precocious differentiation of peculiar larval structures. In some cases a telescoping of the differentiation of the larval structures takes place, without, however, affecting the development of adult

structures. The author concludes that the difference between asexual and sexual reproduction really consists in the presence of a larval organisation in the latter, whose differentiation is due to the liberation of substances in the egg during maturation. The rest of the egg unaffected by this substance and which must solely be responsible for the development of the adult organism is usually small and repeated division must precede the differentiation of adult characters.

Development of *Patella vulgata*.

THE embryology of *Patella* is, in spite of the earlier memoirs of Wilson and Patten, still incomplete and in a number of respects our knowledge of this subject is inaccurate, as shown by F. G. W. Smith in his latest paper [*Phil. Trans. Roy. Soc. Lond.*, 1935, **225**, No. (B) 520, 95–125]. The divergence of opinion between Wilson and Patten regarding the origin of endoderm and mesoderm cells is cleared by the present author who states that the whole of the macromere in the quadrant D gives rise to mesoderm while the macromeres of quadrants A, B and C alone give rise to the endoderm. The foot arises in the form of single median protuberance. The development of the radula is for the first time completely followed and it is seen that the radular formula undergoes two changes before it assumes the adult arrangement. The entire process of torsion is described as well as the changes during metamorphosis.

A Petrographic Use of Fluorescence.

TILL now the property of fluorescence has been used for the determination of individual minerals. But recently Alonzo Quinn (*American Mineralogist*, Vol. 20, No. 6) has shown that such a study could be extended to identify the textural relationships in igneous rocks, if they are photographed in ultra-violet light under special conditions. In connection with his study of the nephelite syenite, he has reproduced several such photographs where the distinction between the minerals is very clear. The hornblende is black, sodalite white and felspar and nephelite grey, thus showing that sodalite was the fluorescent mineral. Though such an investigation involves the employment of different types of films, filters and other specialised appliances for different rocks, yet the method will have considerable value

in the determination of textural relationships of minerals—especially fluorescent—in rocks.

Differentiation in Hawaiian Lavas.

At the present time a good deal of work has been done on the crystallisation of basaltic magma. For most of the American petrographers Hawaiian lavas have become the common material for petrographic work, and Barth's work on the rocks of the Hawaiian Islands has become classic, and his conclusions are in keeping with the experimental deductions of Bowen. But recently Howard A. Powers (*American Journal of Science*, V Series, No. 175) with an intimate knowledge of the Hawaiian volcanoes and lavas, has drawn attention to certain features which vitally affect the theories of magmatic differentiation. He has been able to trace a definite relation between magmatic differentiation and cycles of volcanic activity, and

opines that "basalt of uniform composition represents essentially undifferentiated primary magma and the occasional eruptions of the decadent stage bring to the surface the various products that result from the differentiation of the original magma". With regard to the crystallisation of the pyroxenes in basalts he differs from Barth and holds that diopside phenocrysts do not form in primary magma and that orthorhombic pyroxenes should not be omitted from the sequence of pyroxenes in basalts.

Discussing the problems of magmatic differentiation so far as it applies to Hawaiian lavas, he has shown that different phases of volcanic activity produce different types of basalts from the most undifferentiated lime-basalts to the most highly differentiated nephelite-melilite basalt. In conclusion he suggests that "fractional crystallisation alone is not sufficient to explain the differentiation of the Hawaiian lavas".

Science Notes.

Growth of the Shoot in Asparagus racemosus Willd.—Mr. S. Sarup writes:—The elongation of the shoot of *Asparagus racemosus* Willd. is very rapid in the beginning, attaining a definite length before the axillary shoots begin to grow. Four shoots in a single young plant reached 80.5 cms., 76.7 cms., 75.9 cms. and 83.0 cms.,

in about a week's time. This height varies with the age, and the size and number of rhizomes. It was 300 cms. and 150 cms. in two other plants of different ages. In a young plant of *Asparagus sprengeri* the three shoots reached 29.4 cms., 32.0 cms., and 27.2 cms., respectively.

Growth of the shoot of Asparagus racemosus: increase in cms. after every 12 hours.

1st shoot								4.7	6.0	3.3	6.3	6.5	6.7	7.6	6.5	5.2	5.9	1.6	
2nd shoot					4.9	3.8	4.8	6.7	6.0	7.7	6.6	8.4	8.7	7.3	7.9				
3rd shoot	1.0	2.0	2.0	3.0	4.0	5.8	4.4	5.8	4.1	5.9	4.2	7.8	7.5	2.5	6.9	6.0	5.5	1.5	1.6

Slow

Rapid

Max.

Slow

The growth rate is slow in the beginning, then it becomes rapid until it attains a maximum when it gradually falls off. Taking the actual figures in one case (3rd shoot) we find that the rate of growth rises slowly in the early stages, then it becomes more rapid till it goes up to 7.8 cms. and 7.5 cms. every 12 hours and then it falls to 6.9 cms. for 12 hours. Then it begins to decrease a little till it falls from 5.5 cms. to 1.5 cms. The figures for the other shoots follow the same course.

The readings in the last column were begun as soon as the shoot tip had just come out of the earth and the observations were continued till the axillary shoots were developed. Some discrepancies are due to the fact that external conditions were not uniform.

There appears to be a periodicity in the day and night rates of growth. The suggestive figures for the 2nd and 3rd shoot are like this:—

2nd shoot	..	4.8	6.7	6.0	7.7	6.6	8.4		
3rd shoot	..	4.0	5.8	4.4	5.8	4.1	5.9	4.2	7.8
Shoot of <i>Asparagus sprengeri</i>	..	1.2	4.2	1.7	3.2	1.8	1.6	1.2	

In *Asparagus racemosus*, the rate of growth is about 25 per cent. higher in the day than in the night. During the day the plant is adding new material continually (cf. Blackman, V. H., *Annals of Bot.*, 33, 353).

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The Quaternary System $\text{CaO-Al}_2\text{O}_3\text{-SiO}_2\text{-Fe}_2\text{O}_3$ in Relation to Cement Technology—Building Research Technical Paper No. 16. His Majesty's Stationery Office (Post Free 1s. 1d.).—The