

plane, than the single charged particles hitherto considered. This must also have an important bearing on the theory of radio echoes, should it be proved that these are produced outside the earth's atmosphere.

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¹ *Proc. Camb. Phil. Soc.*, 21, 577; 1923.

Method of obtaining a Visible Spectrum of Waves of Radio Frequency.

IN the course of a research on the heating effects of radiation of wave-lengths 10 to 200 metres, it was found that for a given wave-length there is a maximum heating effect produced in a medium the specific conductivity and dielectric constant of which are connected with the frequency by a simple law. This law, proved theoretically as well as shown experimentally to hold for dilute solutions, is

$$\frac{2c}{nD} = 1,$$

where c = specific conductivity in absolute units, D = dielectric constant, and n = frequency of wave. This law accounts for the curious selective heating effects observed in such high frequency fields, which give promise of great application in medical science.

The above relation suggested that it might be possible to produce a spectrum of a radio-field, where

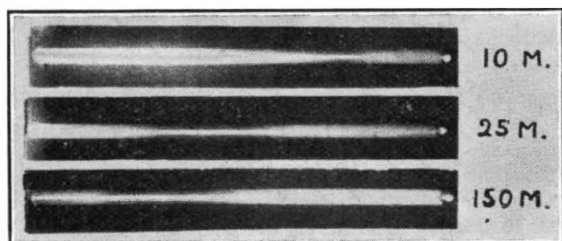


FIG. 1.

a line would by its position in the spectrum indicate the wave-length emitted by a valve oscillator. A jelly of about four per cent agar-agar in distilled water was impregnated with finely powdered tetriodo-mercurate of silver. This substance is orange-red when hot and canary-yellow when cold, the change being quite sharp at about 35°C. (It is used and described by Pariseau, *Can. Med. Assoc. Jour.*, 20, 146; 1929.) A glass tube was filled with the jelly, a small section at a time, a few drops of an electrolyte being added to the hot jelly before each addition, so that the conductivity increased as we passed along the tube. When the completed tube was placed in the field of radiation of an oscillator, it was found that if there was sufficient intensity, a red patch appeared in the jelly in a position where the conductivity was that determined by the relation given above. The accompanying photograph (Fig. 1) shows how the device acts as a crude spectrograph. The colour change is quite marked but is difficult to record photographically.

Neither the dispersion nor the resolving power are at present great, but an attempt is being made to prepare a film of the substance in which the con-

ductivity will vary continuously. Interesting results might be found with ultra-short waves, as any changes in the dielectric constant would show themselves as anomalous dispersion, as do changes in the refractive index with light.

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Isolation of the Film Responsible for the Passivity of an Iron Anode in Acid Solution.

A RECENT paper (*J. Chem. Soc.*, 1930, p. 478) showed that the *direct* solvent action of dilute sulphuric acid on ferric oxide films is very slow. The *rapid* removal of a ferric oxide film from iron by acid is due to the formation of the local cell iron/acid/ferric oxide, which produces cathodic reduction of the ferric oxide to the rapidly soluble ferrous oxide. If the whole surface receives anodic treatment, this cathodic reduction is prevented, and hence an iron anode may remain passive in acid solution.

Further work has now shown that it is possible to isolate the film responsible for this type of passivity. The electrodes used consist of cold-rolled electrolytic iron abraded with No. 1 emery and degreased in carbon tetrachloride. The anode, fixed at 70° to the horizontal at a distance of 4.5 cm. from a vertical cathode, is viewed continuously through a binocular microscope. The electrolyte is normal sulphuric acid, and time is allowed for the dissolution of any 'air-formed' films. An e.m.f. of 6 volts is then applied to the cell; the anode at first is active, suffering corrosion, but soon passivity sets in, and evolution of oxygen commences. If the circuit is now broken for a short time, and restored, the anode is found once more to be active, and iron passes into solution; in due course, passivity returns, and in this way the iron can be made active and passive alternately.

Microscopic observation shows that during the passive periods, the anode is quite bright; but when, after the 'off' period, the current is again turned on, a series of horizontal shadow-fringes pass upwards over the surface, due to the wrinkling of a surface film. This film must have been present in optical contact with the metal during the passive stage; but it only becomes visible when the metal immediately below it is dissolved away. By alternately making and breaking the circuit (with variation of the e.m.f. between 4 and 6 volts, if required), it is possible to separate the transparent film intact from the electrode over quite large areas. Success depends on making and breaking the circuit at the right moments, chosen by watching the appearance of the skin through the microscope. The current is employed to undermine the skin, and prevent its destruction, whilst the 'off' periods serve to produce the local failure of the skin required for the commencement of undermining, and at later stages may be used to destroy the film at any points where it adheres too obstinately to the metal (this destruction is caused by the formation of the local cell iron/acid/oxide).

The film is less easy to preserve than that obtained from iron rendered passive in potassium chromate solution (*J. Chem. Soc.*, 1927, p. 1020); the fragments readily twist themselves into masses recalling 'cobwebs', whilst in some cases the film, as it peels from the anode, rolls up 'like a carpet' into long tight rolls, which under low magnification may be mistaken for fibres. But although mechanically flimsy, the films are stable chemically and can survive an hour in normal sulphuric acid, provided they are free from

metallic iron. Some specimens of iron have yielded a skin containing opaque inclusions—no doubt a further example of the 'interlocking' of oxide and metal studied in earlier work (Evans and J. Stockdale, *J. Chem. Soc.*, 1929, p. 2651).

The results confirm the views of Hedges (*J. Chem. Soc.*, 1928, p. 976), that anodic passivity—like other types—is due to a protective film. Since Benedicks and Sederholm (*Z. Phys. Chem.*, 138, 123; 1928) have photographed the film which causes passivity in nitric acid, it may now be claimed that, for each important type of passivity, the film responsible has been rendered visible.

The removal of oxide-films by the cell iron/liquid/ferric oxide, which takes place so rapidly in acid, occurs slowly in neutral solutions. Mr. S. C. Britton, working in this laboratory, has found that heat-tinted iron kept in oxygen-free *N*/10 potassium chloride for two weeks loses its colour; a similar treatment appears to be capable of removing much thicker films, such as mill-scale, and also films too thin to be visible; the removal proceeds at least in part by undermining. These facts may explain the important discovery of McAulay and Bastow (*J. Chem. Soc.*, 1929, p. 85), who found that mere immersion in oxygen-free potassium sulphate brought iron specimens to a 'standard state', in which subsequent movements of the electrode potential were reproducible and independent of the previous history.

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Nutritional Status and Sex Determination.

RECENT correspondence in *NATURE* (R. R. Gates and D. V. Daran, Mar. 1, p. 309, and D. M. Cayley, April 5, p. 527) indicates that diversity of opinion still exists in regard to the question of 'multiple sexes' or 'nutritive heterothallism' in the fungi. The lower plants have yielded a great deal of information of a fundamental nature on sex, and the outcome of such correspondence must certainly be a further advance of knowledge with its applications not restricted to the fungi.

Nutritional status was long ago considered to play a part in sex determination in animals, but, largely through lack of well-controlled experiments, the idea lost favour. Nevertheless, evidence from a variety of sources is redirecting attention to the question. That nutritional state, without any relation to such phenomena as parasitism, may affect the ultimate sex expression in insects is the conclusion I have reached as a result of studies on the 'flour beetle' *Tribolium confusum* Duval. The evidence will be published in greater detail in the near future, but a summary at the present time may be of interest.

The sex ratio of newly hatched unfed larvæ, under controlled conditions of temperature, humidity, light, nutrition of the parents, and subsequent nutrition of the larvæ, has been altered by starvation. The alteration in sex ratio was not due to differential mortality of the sexes, since the change was considerably larger than the total mortality up to pupation, when it was possible to determine the sexes by genitalia characters. (The mortality ranged from 0 to 2 per cent, with an average of 1.2 per cent.) However, the change in sex ratio is not a simple relation between starvation and the production of a preponderance of one sex, or between time of starvation and resultant sex ratio, for with one day's starvation there is an increase in the preponderance of males, while with two and three days'

starvation the number of males decreases and there is a preponderance of females. The net result is that while life lasts there is an oscillation of the sex ratio. Graphically, the curve representing this oscillation has an axis which slopes somewhat from a slight excess of males to a lower proportion of males with increase in starvation period.

The oscillating nature of the change in sex ratio indicates that either some forms change from one sex and back again, or that certain forms of both sexes change to the other sex after different periods of starvation. The conclusions reached are that either:

1. A proportion of the population is stable as regards its expression of sexuality, while a proportion is more easily converted to the opposite sex one way or the other; or

2. That forms of either sex may be changed to the opposite sex but that there are gradations of sexual stability only upset after varying periods of time.

The effect of nutrition on sex determination undoubtedly takes place *per medium* of its effect on the biochemical and biophysical state of the body fluids, and through them also on the germ cells. In insects one does not consider that more than two sexes occur, but the results briefly quoted above indicate that there are at least gradations in constitution which show a relation between nutritional status, dependent on time of starvation, and the ultimate sex expression.

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A New Band System probably due to a Molecule CP.

WHEN investigating the band spectra of phosphorus I tried a discharge in a mixture of argon and phosphorus vapour. This discharge, with suitable arrangements of the concentrations of the two gases, shows an intense and extended band system in the wave-length region $\lambda 4000\text{-}\lambda 2900 \text{ \AA}$. which does not occur in pure phosphorus vapour. So far as I am aware it has not hitherto been recorded. At the same time the Swan bands of the C_2 molecule are very intense in the visible region, obviously due to tap grease and sealing wax. As in a mixture of argon and a small trace of nitrogen, under the same conditions of discharge, the CN bands are specially strong (the C_2 bands of course also being present), it seems very probable that the new band system is due to a molecule CP which would be the analogue of CN. So far as I know, such a molecule, or a molecule $(GP)_2$ which would be analogous to $(CN)_2$, has not been found chemically. If the above conclusion that the new band system is due to CP is correct, it might be possible also to get chemical evidence of some simple CP compound. In order to obtain a further test of the above conclusion, an attempt is being made to get exposures strong enough to show the bands due to the isotope molecule $C^{32}P$ which would make possible a definite identification of the emitter of the bands in question.

The structure of the band system and the single bands is very simple and in agreement with the assumption that they are the analogue to the $^2\Sigma\text{-}^2\Sigma\text{-CN}$ bands. The fine structure is clearly resolved except near the heads. Only one *R*- and one *P*-branch seem to be present. The distance between head and origin of the bands is very small, corresponding to a large alteration of nuclear distance. A preliminary vibrational analysis yields the following formula for the heads:

$$\nu = 29103.6 + [832.4(v' + \frac{1}{2}) - 5.44(v' + \frac{1}{2})^2] - [1239.0(v'' + \frac{1}{2}) - 6.75(v'' + \frac{1}{2})^2].$$