

Research Notes.

Line Groups and Fine Structure.

[F. Paschen, *Ber. d. Preuss. Akad. d. Wiss.*, **32**, 3, 1932.]

IN this paper Paschen considers the effect of hyperfine structure on the lines of a multiplet when the hyperfine separation is of the same order of magnitude as the gross multiplet separation. The effect is shown to be similar to the Paschen-Back magnetic transformation of a multiplet, but here the magnetic field is provided by the nuclear spin. Accordingly, the positions and intensities of the multiplet lines are disturbed and forbidden transitions belonging to the multiplet are produced; since each of the multiplet lines is also split on account of the hyperfine structure, the whole group of lines shows a structure which is due neither to simple gross multiplet separation nor to pure hyperfine separation of the multiplet lines. In this way the unaccounted doubling of the levels in the spectrum of Al II which Paschen had previously discovered is explained. Multiplets are also considered in which the hyperfine separation predominates over the fine separation, e.g., the $4^3P_{2,1,0}-5^3D_j$ group in Al II. It is shown that in this case the j value of the $5D$ term is not determinable since the term acts as a 3D_3 term in its combination with 3P_2 but behaves like a 3D_2 term in its combination with 3P_1 . From these observations as well as the experiments of Ritschl, Paschen concludes that the Al nucleus has a spin of $\frac{1}{2}\frac{h}{2\pi}$. The displacement of the components of the hyperfine structure pattern of $\lambda 5791$ found by Schüler and Jones is also to be explained according to Paschen on the above lines since here the difference between 3D_1 and 1D_2 of Hg I is only 3 cm.⁻¹ while the hyperfine separation of the levels is about $\frac{1}{7}$ of this. The appearance of the forbidden transitions $6s 6p^3P_0-6snd \ ^1D_2$, $n=6, 7, 8$ in Hg I is also accounted for as an effect of the nuclear moment. A continuation of these investigations is also promised.

Nitrogen Recuperation in the Soils of the Bombay Presidency.

[Part III. By D. L. Sahasrabudhe and N. V. Kanitkar. *Ind. J. Agric. Sci.*, **2**, 455, 1932.]

THE above is the third of a series of contributions by Sahasrabudhe and his co-workers to a problem of fundamental importance not only to Deccan but also to the rest of the world in general. The authors claim to have obtained definite evidence of nitrogen recuperation on the dry farm tracts which they investigated. The recuperation is facilitated by (1) wetting by monsoon followed by dry weather, (2) better cultivation, and (3) addition of organic matter in the form of farm-yard or green manure. Soil moisture and temperature are important factors determining the efficiency of the process, the optimum conditions being 20 per cent moisture and 30° C. The authors conclude that the nitrogen content of the soil is not a stable or constant quantity. There is a range for every soil which is determined by various factors, such as, moisture, temperature and aeration, which, again, are dependent on the prevalent climatic conditions.

The paper is unfortunately defective in some respects. Thus, no mention is made of the errors of (1) random sampling from the experimental area, and (2) analytical methods employed. It is not clear from the text as to how many specimens were analysed at a time but the results would have been far more valuable if the different representative samples had been analysed independently instead of being mixed together. It is hoped that the above defects will be eliminated in later publications.

Double Hydropore in the Development of *Asterias glacialis*.

IN this paper Dr. N. Narasimhamurti (*Journ. Exp. Biol.*, **10**, No. 2, 1933) observes that the addition of sodium chloride to the sea-water in the proportion of 38 grms. per 1000 cc. produces double pored larvæ of *A. glacialis* in greater numbers than is the case in ordinary laboratory cultures. The author is of the opinion that this increase in the number of abnormal larvæ in the hypertonic cultures is the result of the addition of salt, quite early in the development and that it acts as a stimulus to the growth of the larvæ equalising the difference between the right and left larval halves thus producing a right hydropore.

A New Method of Producing Extremely Low Temperatures.

(F. Simon. *Physikal. Zeitschr.*, **34**, 232, 1933.)

IN the reports of the Proceedings of the Thüringian-Saxonian section of the German Physical Society which met at Breslau on the 8th and 9th January 1933 a new method of producing liquid helium is described. The principle is extremely simple. A small vessel filled with helium at about 100 atmospheres pressure is cooled to about 11° Abs. by means of solid Hydrogen and then is thermally isolated from the surroundings; the helium is now allowed to escape through the inlet itself. The work done in the expansion cools the helium so that about 60% of it becomes a liquid and remains in the vessel. The method is so simple that it could be easily demonstrated before the meeting. In the discussion that followed it was suggested that by demagnetising gadolinium sulphate, even 0.1° Abs. might be reached whereas the lowest temperature reached by evaporating helium was 0.7° Abs. (Keesom, 1932). Further details of the method are to be published in the *Zeitschrift für Physik*.

Production and Hatchability of Eggs as affected by different kinds and quantities of Proteins in the Diet of Laying Hens.

[By T. C. Byerly, H. W. Titus and N. R. Ellis. *J. Agric. Res.*, **46**, 1933. 1.]

THE above has been the subject of a number of previous researches, but the present authors would appear to be the first to obtain quantitative data in support of their conclusions. The results bring into relief the following—(1) feeding with meat, fish, crab or butter-milk as the source of protein led to not only more intensive egg production but also better hatching than that with grains and vegetables; (2) increasing the percentage of protein in the diet within limits of 11.2 and 23.6 augmented egg-production by increasing (a) intensity of production, (b) average egg-weight, and (3) diets containing vegetable proteins only increase the incidence of chondrodystrophy in the embryos of hens. Embryos in eggs from such hens had also a high second-week mortality.

The above results would suggest that there was some fundamental deficiency in the vegetable proteins tried by the authors. It would be of interest to extend their

observations to different other forms of vegetable and animal proteins and to determine the precise chemical nature of the deficiency leading to chondrodystrophy in chicken.

Habits, Structure and Development of *Spadella cephaloptera*.

IN this excellent paper Mr. C. C. John (*Q.J.M.S.*, Vol. **75**, Part 4, 1933) has endeavoured to bring together a great deal of information relating to the structure and development of *Spadella cephaloptera*, a Chaetognath. The work is all the more welcome in the field of zoology as no previous description of either development or habits has been satisfactory and as there are only a few scattered references to points of structure.

Several important points have been discovered with regard to the habits and structure. It is interesting to note that *Spadella* reproduces all the year round and that it can withstand reduced salinity and thus is pre-eminently adapted to life in bays and sounds in the mouths of rivers. The structure and function of the cement glands the secretions of which form a covering round the eggs are described for the first time. The corona ciliata which hitherto was supposed to be olfactory in function is experimentally proved to be a tactile organ. With regard to the nervous system it is noticed that the position of the vestibular ganglion and its nerves in *Spadella* is different from that in the allied genus *Sagitta*. There is a detailed account of the musculature and the chapter on reproduction is extremely interesting. The ovary is described as opening directly into the dorsal part of the seminal receptacle whereas in *Sagitta* there is a double duct along the outer side of each ovary opening posteriorly at the level of the rectum into the seminal receptacle. There is in *Spadella* a distinct tube called vagina. In the chapter on development the general account of the sequence of early embryonic stages previously based on a study of whole mounts has been verified with sections. It is remarkable that though the egg contains yolk, cleavage is regular owing to its uniform distribution. The germ cells which originate before the formation of archenteric folds are observed to separate into the distinct ovary and testis by the formation of the secondary septum which is mesodermal in origin. The hood is shown to develop as a lateral fold

on each side and not by a splitting of the lateral ectoderm as recorded by Doncaster in his paper on *Sagitta*. The male duct in *Spadella* is formed partly from the ectoderm and partly from the endoderm. In conclusion, it can be said that the paper constitutes an excellent monograph which is sure to become classical as it fills a gap in our present knowledge of the phylum Chætonatha.

The Element of Atomic Number 61.

[Maurice Curie and S. Takvorian. *Comptes Rendus*, 196, 923, 1933.]

THE discovery of the radioactivity of Samarium has been recently announced by Hevesy and Pahl (*Nature*, 130, 846, 1932) who suggest that this activity may be due to the presence of the element of atomic number 61. Libby and Latimer have confirmed the fact that Sm is radioactive and they also suggest that Nd and La are also possibly radioactive.

The authors measured the activity of different fractions obtained when a mixture of oxides of Nd (atomic number 60) and Sm (62) containing some La and Pr and obtained from Indian Monazite was being separated by fractionation according to the method of G. Urbain. They used a very sensitive Wulf electrometer to measure the activity and found that within the limits of sensitivity of their apparatus Nd and La do not show any radioactivity. Sm was shown to emit a very easily absorbed radiation which could not be attributed to element No. 61. There was, however, a more penetrating radiation which showed a maximum of intensity in that sample in which element No. 61 was expected to be most abundant. The penetrating power of this radiation was too large for it to be a stream of α -particles. These interesting researches are being continued.

Effect of Dairy Manufacturing Processes on the Nutritive Value of Milk—The Apparent Digestibility of Fresh Whole Milk and of Powdered Whole Milk.

(*Journ. of Nutrition*, 6, 139, 1933.)

FEEDING experiments with albino rats have shown that the apparent digestibilities of total protein, fat, sugar and total solids present in fresh whole milk and powdered

whole milk as prepared by the spray or roller process are very nearly the same. There is no experimental evidence to suggest that any one type of preparation is more completely digestible than the others. There is an indication, however, that there is variation between individuals with respect to their tolerance for certain preparations so that sometimes fictitious impressions with regard to relative total nutritive values are obtained.

The above observations are of much interest though further experiments with human subjects will be needed before any definite conclusions can be drawn. Investigations of this type have already been carried out elsewhere with school children and it will be of much practical importance if further researches can be organized with the co-operation of a number of residential institutions and under the guidance of a competent body of doctors and statisticians.

The Most Probable Values of e and h .

[R. Ladenburg, *Ann. d. Physik*, 16, 468, 1933.]

KIRCHNER (*Ann. d. Physik*, 13, 59, 1932) assumed that the short wavelength limit of the Röntgen spectrum measured by a line grating was more accurate than that obtained by means of a crystal; using the value of $\frac{h}{e}$ so obtained and the value of $\frac{h}{e^{5/3}}$ deduced from the Rydberg constant and the value of $\frac{e}{m}$ obtained by himself, he calculated the values of e and h as follows:—

$$\left\{ \begin{array}{l} \frac{e}{mc} = (1.7585 \pm 0.0012) \times 10^7 \\ R_{\infty} = 109737.4. \quad e = 2.9981 \times 10^{19}. \end{array} \right. \quad \text{(Kirchner's value).}$$

$$\text{Hence } \frac{h}{e^{5/3}} = (2.2491 \pm 0.0005) \times 10^{-11}$$

$$\frac{h}{e} \text{ (Measurement of Duane and his co-workers)} = (1.3787 \pm 0.0008) \times 10^{-17}.$$

$$\frac{h}{e} \text{ (Feder's value)} = (1.3755 \pm 0.0008) \times 10^{-17}.$$

$$\text{Hence } e = (4.798 \pm 0.006) \times 10^{-10},$$

$$h = (6.615 \pm 0.012) \times 10^{-27}$$

$$\text{and } e = (4.782 \pm 0.006) \times 10^{-10},$$

$$h = (6.577 \pm 0.012) \times 10^{-27}.$$

Now Millikan's value of e is 4.770 ± 0.005 . Accordingly, Ladenburg considers the above values of e as too high and calculates a more probable value as follows:—

From the photo-electric effect, according to Lukirsky and Prilez'aev,

$$\frac{h}{e} = (1.3716 \pm 0.0014) \times 10^{-17}.$$

From measurement of ionization potential of Hg by electron impact, according to Lawrence,

$$\frac{h}{e} = (1.3752 \pm 0.0027) \times 10^{-17}.$$

From the radiation constant c_2 ,

$$\frac{h}{e} = (1.3728 \pm 0.0030) \times 10^{-17}.$$

$$\text{Mean } \frac{h}{e} = (1.3728 \pm 0.0011) \times 10^{-17}.$$

These values show that the measurements with the line grating are unreliable.

$$\frac{e}{m} \text{ (Kirchner)} = (1.7585 \pm 0.0012) \times 10^7,$$

$$\frac{e}{m} \text{ (Houston)} = (1.761 \pm 0.001) \times 10^7,$$

$$\frac{e}{m} \text{ (Perry and Chaffee)} \\ = (1.761 \pm 0.001) \times 10^7,$$

$$\frac{e}{m} \text{ (Campbell \& Houston)} \\ = (1.7579 \pm 0.025) \times 10^7.$$

$$\text{Hence mean } \frac{e}{mc} = (1.760 \pm 0.0006) \times 10^7.$$

$$\text{Therefore } \frac{h}{e\sqrt{3}} = (2.2486 \pm 0.0003) \times 10^{-11}$$

which differs very little from Kirchner's value, $(2.2494 \pm 0.0005) \times 10^{-11}$.

$$\text{Thus } e = (4.770 \pm 0.006) \times 10^{-10}.$$

Combining this with Millikan's value, viz., $(4.770 \pm 0.005) \times 10^{-10}$ the most probable value of e is found to be

$$e = (4.770 \pm 0.004) \times 10^{-10}$$

$$\text{and hence } h = (6.547 \pm 0.009) \times 10^{-27}.$$

Ladenburg concludes that the crystal measurements are correct while the line grating measurements are affected by some unknown error.

Using the above values, Ladenburg obtains

$$\frac{1}{\alpha} = \frac{ch}{2\pi e^2} = 137.307 \pm 0.048.$$

This differs materially from Eddington's theoretical value $\frac{1}{\alpha} = 137$.

Spermatogenesis of the Mouse.

PAUL R. CURTRIGHT of the University of Pittsburg has recently published a paper (*Journal of Morphology*, Vol. 54, No. I, December 5, 1932) on the Spermatogenesis of the Mouse (*Mus musculus*, var. Albula)

and confirms the diploid number of chromosomes to be forty. The number has been verified in the spermatogonia and the somatic cells of the mouse embryo. A continuous spireme is not present in the spermatogonia but elongate leptotene threads develop early in the prophase. There is no evidence of a 'bouquet' stage at any time. The sex chromosomes are of the X and Y type and are shown to exist early in the growth period. The X chromosome is a relatively short, three chromomered structure and the Y a shorter two chromomered one. The bivalents are of varied shapes and the union of the bivalents during diakinesis is very intimate. During diakinesis union takes place between corresponding chromomeres and this affords significant evidence of the allelomorphism of the chromomeres in the mammals. A chromosome nucleolus in the spermatocyte whose presence distinguishes the spermatogonial nucleus from that of the spermatocyte divides at the time of diakinesis and the divided portions which are equal in size are interpreted as the largest pair of autosomes. The haploid number of twenty is verified in both primary and secondary spermatocytes.

The Blood Circulation of Animals possessing Chlorocruorin.

H. MUNRO FOX (*P.R.S.*, B 779, Vol. 112) has described a series of very interesting experiments on the blood vascular system of Sabellids and Serpulids possessing chlorocruorin. The author, however, has not restricted himself to the polychaetes but has also experimented on chick, crustacea and molluscan embryos with reference to reversible inhibition due to CO_2 . He points out how the circulation of blood is rhythmic and is not under the control of the central nervous system. After the retreat of these worms into the tubes the pulsation in the vessel ceases. Spirigraphis is noted to live uninjured in such state for 8 hours after which it makes a fresh opening and comes out. Curiously, however, when these polychaetes are placed in sea water whose pH is below 6.0, the contractions of the vessels stop. Possibly this cessation of pulsation is due to the accumulation of CO_2 in the tube when these animals contract.