obtained from either batteries or the central station supply. Both direct current and alternating currents can be used, but in the latter case a rectifier must be placed in circuit.

Messages can be sent to practically any number of telewriters from one transmitter, thus assuring the same message being received simultaneously on the various receivers.

The Postmaster-General has granted a licence for twenty-one years to the Telewriter Syndicate, and after 1911, when the National Telephone Company's licence expires, the Telewriter Syndicate will operate its own system and establish telewriter exchanges, paying royalties for the same. These lines will be independent of the Post Office telephones, but will be leased from the Post Office, and telephonic communication in addition is to be a *sine qua non* on all these lines.

At present the telewriter is established chiefly on private lines, and is working satisfactorily in many large warehouses, stores, and offices, but messages and sketches have been successfully sent from London to Manchester over the Post Office telephone trunk lines, which were used, by permission, for the experiment. Arrangements and special instruments are now being made with the view of sending similar messages over the existing trunk telephone line from London to Paris.

SOME ENTOMOLOGICAL PAPERS.

AMONG recent papers on entomology in serials with which we have been favoured, special reference may be made to one by Mr. P. H. Calvert on the dragon-flies (Odonata) of Mexico and Central America, published in the Proceedings of the Academy of Natural Sciences of Philadelphia for October last. This paper, which is mainly based on the article by the same author in the *Biologia Centrali Americana*, forms an important contribution to the study of insect-faunas generally, and treats in great detail of the relationships of the group under consideration. It is assumed—and probably correctly—that the adult insects do not wander far from the haunts of their aquatic larvæ, but until this is definitely ascertained the generalisations, as the author points out, must be regarded as more or less provisional.

To the sixth part of vol. v. of the Annals of the South African Museum Mr. L. Peringuey contributes a seventh instalment of his account of the coleopterous fauna of the country, dealing in this instance with considerably more than one hundred species and several genera described as new. The paper, which is illustrated by two monochrome plates, is of a purely taxonomic character, with the descriptions in Latin.

An addition to our knowledge of the aphides of Japan is furnished by Mr. G. Okajima in vol. viii., No. 1, of the Bulletin of the College of Agriculture of the Imperial University of Tokio. This paper is devoted to the description of three new species of Trichosiphum, a genus founded so recently as 1906 for the reception of another Japanese representative of the group. To the same issue this author contributes a more generally interesting paper, namely, one on the structure of the aphid antennæ. These antennæ are composed of not more than six joints, of which the third and later ones (especially the third) usually bear sensory pits. For their distal portion the name "flagellum" is adopted. It is found that, as regards minor characters, the antennæ present specific differences which harmonise well with the various groups into which the family has been divided.

In a third paper in the serial last cited Mr. T. Miyake gives a list of Japanese Panerpidæ, together with descriptions of ten new species of the type-genus, all of which are illustrated in an accompanying plate. All the new species, which display the general type of colouring characteristic of these elegant insects, agree with the other Japanese members of the group in regard to a peculiarity in one part of the wing-venation.

Under the title of *Indian Forest Memoirs*, the Government of India has commenced the issue of a new quarto serial, intended for the publication of the more important results of the investigations of the Imperial Forest Research Institute. The publication of *Indian Forest Records* is to be continued for minor papers, and the two serials are to constitute the Forest Zoology Series. The first part of the Memoirs is devoted to an account, by Mr. E. P. Stebbing, of some undescribed Scolytidæ of economic importance from the Indian region. Until recently, very little was known with regard to the Indian representatives of this group of bark-boring beetles, and scarcely anything of their life-histories and food-plants. It is now ascertained that the Scolytidæ are of very considerable importance to the Indian forester, this being specially the case as regards the great coniferous forests of the Himalaya. Other species, referable to the genus Sphærotrypes, are, however, detrimental to the sal-forests and other broad-leaved timber-trees. In the present memoir Mr. Stebbing describes three new species of the last-named genus, five of Polygraphus, and two of Dryocetes. Among the species of Sphærotrypes, one, *S. assamensis*, infests the sal-timber of Assam and eastern Bengal, and a second, *S. quercyi*, the oaks of Kumaun.

The Angolese tiger-beetles of the subfamily Cicindelinæ form the subject of an article by Messrs. F. Creighton Wellman and W. Horn in the Proceedings of the Academy of Natural Sciences of Philadelphia for November, 1908. Angola, it appears, is divisible into three distinct physical regions, namely, lowlands, mountainous slopes, and high plateau, the climate of the second of these being cooler and moister than that of the first, although not to the same degree as the third. Each of these areas has its own special tiger-beetle fauna, that of the middle zone possessing the largest number of species.

In this place reference may be made to investigations undertaken in Cornell University by Mr. B. H. Guilbeau, of which the results are published in the *American Naturalist* for December, 1908, as to the mode in which the "cuckoo-spit insects" (Cercopidæ) secrete the foam in which they are enveloped. By cleansing the nymphs from the investing froth, it has been ascertained that the fluid issues from the anal aperture, and is converted into froth by periodical removals of the tip of the abdomen, which is re-introduced holding each time a bubble of air. Viscosity is imparted to the fluid by the secretion of the glands of Batelli.

In conclusion, brief mention may be made of an interesting article, by Mr. A. H. Swinton, on the vocal and instrumental music of insects, the first instalment of which appears in the January number of the *Zoologist*.

THE CHARGES ON IONS.[1]

THE ratio of the charges of ions in liquids to those produced by various methods in gases is a factor that enters into many investigations connected with molecular theories, so that it is of importance that the connection between these charges should be investigated by some accurate method.

The simple relations that hold between the charges of ions in liquids can be easily deduced from the theory of electrolytic conduction. It follows immediately from determinations of the electrochemical equivalents that the charge on any ion in a liquid is either equal to that on a hydrogen atom or an exact multiple of it. No method has been devised for determining this charge directly, but the value of $n \times e$, the product of the number of molecules in a cubic centimetre of a gas at standard pressure and temperature (15° C.) and the charge e expressed in electrostatic unts, is accurately known, and is approximately $1{\cdot}23 \times 10^{10}$.

In gases it is possible to obtain a rough estimate of the charge on an ion. The method of determining the charge, which requires a cloud to be formed in the gas, was given by the present writer (Proc. Camb. Phil. Soc., vol. ix., part v., February, 1897), and was first applied to the ions in newly prepared gases. The same principle was subsequently used by Sir J. J. Thomson and Prof. H. A. Wilson in determining the charges on ions produced by Röntgen rays, ultra-violet light, and radio-active substances (J. J. Thomson, "Conduction of Electricity through Gases"). The numbers obtained for e in electrostatic units range from 3×10^{-10} to 9×10^{-10}, but an

[1] Based upon papers by Prof. J. S. Townsend, F.R.S., and Mr. Haselfoot, communicated to the Royal Society January and November, 1908.

accurate estimate of any of the charges has not been obtained owing to the difficulties of experimenting with the clouds. As no trustworthy [1] independent estimates have been made of n, the value of the product $n \times e$ for gaseous ions can only be obtained by this method within wide limits differing by a factor of 10 or 20. It cannot, therefore, be maintained that the direct determination of e in gases leads to any trustworthy information as to the simple relations that hold between the charges on the ions.

A more accurate comparison of the charges on the various kinds of ions can be obtained from determinations of the rate of diffusion of ions in gases and the velocity under an electric force. With this object in view, the rates of diffusion produced by various methods in gases were determined, and it was shown that the value of $n \times e$ for negative ions in gases agreed within 10 per cent. or 15 per cent. with the value for monovalent ions in liquids, and the value for positive ions in gases was somewhat larger (J. S. Townsend, "Diffusion of Ions in Gases," Phil. Trans., vol. cxciii., 1899, and vol. cxcv., 1900). The probable error in the numbers obtained is about 10 per cent. or 12 per cent., so that it is desirable to know more definitely if all these charges are exact multiples of the same atomic quantity, as it is a question of fundamental importance.

The problem of the determination of $n \times e$ for gases has been again undertaken, and a simple experiment has been devised whereby the exact value of $n \times e$ can be immediately deduced from the ratio of the charges acquired by two conductors under special conditions. The method is explained in a paper in the Proceedings of the Royal Society, vol. lxxx., January, 1908, and two papers recently communicated (November, 1908) contain further experiments by the present writer on ions produced by Röntgen rays, and an investigation by Mr. Haselfoot of the ions produced by radio-active substances.

The principle of the method consists in finding the extent to which a uniform stream of ions having a circular cross-sectional area, S, opens out as the ions travel a given distance under a known electromotive force. For this purpose three plates, A, B, and C, are arranged parallel to each other, the middle plate, B, and the lower plate, C, having each a circular aperture cut through its centre. A disc, D, is fixed in the aperture of the plate C, so that the surfaces of the disc and surrounding plate are in the same plane, the disc being a little smaller than aperture in order to insulate it from the plate. The area of the hole S in the middle plate B is equal to the area of the disc *plus* half the air-gap between the disc and the plate C. The plates A and B are connected to suitable numbers of accumulators so as to maintain the same uniform field above and below the middle plate B. The plate C and disc D are insulated, and each maintained at zero potential by a special form of induction balance, which gives the charges acquired simultaneously by the disc D and plate C. The gas in the space between A and B is ionised by Röntgen rays or by radio-active substances, and a uniform stream of ions passes through the aperture in the middle plate. The ions travel to the lower plate under the uniform electric field, and the stream opens out by diffusion, so that some of the ions q_1 arrive on the disc D, and the rest q_2 arrive on the plate C. The ratio q_1/q_2 is found accurately by means of the induction balance, and the value of $n \times e$ may be obtained from the ratio. The equation connecting $n \times e$ and the ratio n_1/n_2 is somewhat complicated, and it would be impossible to explain in a short space how the connection between these quantities is found, but it may be stated that a complete solution of the problem can be obtained in a series of Bessel's functions.

The experiments have been made with different forces and pressures, and it has been found that the value of $n \times e$ for negative ions is in all cases within 3 per cent. or 4 per cent. of the value $1{\cdot}23 \times 10^{10}$; under conditions where the greatest accuracy can be obtained the results are in closer agreement with this number.

For positive ions the value of $n \times e$ depends on the nature of the radiation. With non-penetrating secondary rays from a polished metal surface the value obtained was $1{\cdot}26 \times 10^{10}$, and for penetrating rays from a tarnished surface, or a surface covered with a thin layer of vaseline, larger values were obtained, the greatest being $2{\cdot}4 \times 10^{10}$.

Thus the negative ions have always a charge which is exactly equal to the charge on a monovalent ion in a liquid electrolyte, and the positive ions have either a single or a double charge, the number of either kind in a conducting gas depending on the nature of the radiation.

The values of $n \times e$ for positive and negative ions produced by the α and β rays from radio-active substances are both approximately $1{\cdot}23 \times 10^{10}$.

In addition to the above results, a notable effect of small traces of moisture on the motion of negative ions was observed. When the gas is very dry the negative ions move as if they were very small particles, but when a small amount of moisture is admitted the mass of the negative ion is greatly increased, and obeys the same laws of diffusion as the positive ions. The motion of the positive ions under similar conditions is not affected by the dryness of the gas. JOHN S. TOWNSEND.

[1] Prof. Perrin has recently announced a new method of determining n, which gives trustworthy results. The number n comes to 3×10^{19} and corresponds to an atomic charge $4{\cdot}1 \times 10^{-10}$. (Jean Perrin, *Comptes rendus*, October 5, 1908).

METEOROLOGICAL CHARTS OF THE INDIAN OCEAN.[1]

THE Indian Ocean is claiming at the present time a large share of the attention of meteorological offices. Recent issues of NATURE have contained notices of meteorological charts for this area issued by the Meteorological Department of the Government of India and by the Meteorological Institute of the Netherlands (NATURE, vol. lxxviii., pp. 169, 487). The present charts are prepared by the Deutsche Seewarte. In area they exceed considerably those referred to above, for they embrace the region between latitudes 30° N. and 50° S., and longitudes 18° E. (Cape Town) and 158° E. The Australian waters and the eastern margin of the Pacific Ocean are thus included, while special inset charts extend the area northwards to include the Yellow Sea and the Sea of Japan. To deal effectively with the results, a scale of approximately 6 mm. to one degree at the equator has been selected, and in consequence an inconveniently large size of page, viz. 36 inches by 27 inches, has had to be adopted.

The preparation of the results has occupied five years. The meteorological information has been abstracted mainly from the log-books of German vessels, but we are glad to note that, in addition, use has been made of all available published information. The arrangement of the data on the charts, of which there is one for each month, is similar to that adopted on the charts for the Atlantic Ocean issued by the Seewarte. Conspicuous blue wind roses show for each square of 5° the percentage frequency of calms and of winds from each of sixteen directions. The mean wind force for each direction, on the Beaufort scale, is indicated by the number of barbs on the wind arrows. Small but distinct black arrows give the directions of surface currents, with the average and the maximum observed displacement in nautical miles per day. Special attention has been devoted to a critical examination of the current data, and several interesting articles on the subject appear on the backs of the charts. A statement of the number of observations on which each wind and current arrow is based would have been welcomed by students.

In addition, each chart gives the tracks for steam and sailing vessels, the normal paths of hurricanes, the frequency of fog and ice, and the lines of equal magnetic declination. The region of easterly variation is distinguished by a special tint. The text printed over the land areas gives, in addition to the necessary explanations, a brief summary of the weather conditions of each month, with special reference to the frequency of hurricanes.

On the back of each chart we find four smaller maps, giving the annual change of magnetic variation, the average air temperature over sea and land, the average temperature of the surface water, and the average barometric pressure. In connection with the latter, we miss

[1] Deutsche Seewarte, Monatskarten für den indischen Ozean. (Hamburg Eckardt und Messtorff, n.d.)