there are not enough of them yet to do more than touch the fringe of the subject. Scientific agriculture must begin to be taught and learned at all the primary schools in India, every pupil being practically instructed by means of gardens attached to each school. The agricultural education of the people must be put in the foreground of the endeavours of the Government and of all the educational authorities. Experiments at the Government farms have shown that with selected seed and proper treatment an acre can be made to yield, on an average, from 50 to 100 per cent. more than it does at present. To take an instance, the average output of wheat in India is only from nine to ten bushels per acre. In Great Britain it is more than thirty. To raise the average in India even to fifteen bushels is surely not beyond the reach of science. The same remarks might be made in regard to all the food crops. An attainable 50 per cent. more, when realised, would go far to banish scarcity and famine from the land.

PROF. RUDOLF TOMBO, jun., of Columbia University, contributed to *Science* of December 24 last an article dealing with university registration statistics in the United States. The returns are given for twenty-eight of the leading universities, three institutions having been added to the list this year, viz. Texas, Tulane, and Washington (St. Louis). In 1909 four universities—Iowa, Minnesota, New York, and Yale—showed a loss in enrolment compared with the previous year, as against two universities in 1908 and five in 1907. On the whole, there were considerable gains, the increase in several instances being quite marked. The greatest gains were made during the year by Columbia, Chicago, Wisconsin, California, Cornell, Ohio, and Pennsylvania, in the order named, each one of these having gained more than 300 students. Columbia was the only university to register an increase of above 400 students in 1909, whereas there were no fewer than eight in 1908. For the second time in the history of American universities the 6000 mark was exceeded, Columbia having a total enrolment in 1909 of 6132 students, Harvard having registered 6013 in 1903. Harvard continues to lead in the number of male academic students, being followed by Yale, Princeton, Michigan, Chicago, Wisconsin, Columbia, and Minnesota. A general depression occurred in the case of the engineering schools, Stanford being the only institution to exhibit a noteworthy gain. The important schools of agriculture showed an increase, the single exception being Minnesota. The article concludes with an individual examination of the statistics of the more important of the universities.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 20.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. C. **Bolton**: Further observations on the pathology of gastric ulcer (progress report). In four previous papers the production and properties of gastro-toxic serum, obtained by immunising the rabbit with guinea-pig's gastric cells, were described, and it was demonstrated that the ulcers produced by the serum healed within three or four weeks if the animal were in its normal condition and fed on a normal diet. Since chronic gastric ulcer in the human subject is a common malady, and gastric ulceration is initially acute, it was considered that some unknown condition or conditions must be present which delay the healing of these ulcers. It was, however, found on experiment that so long as the stomach emptied itself in the normal time it was impossible to delay the healing of gastric ulcer by increased or diminished acidity of the gastric contents or by feeding on infected food; the position of the ulcer in the stomach did not materially affect the result. The present communication deals with the effects of interference with the motor function of the stomach upon the healing of ulcer, the food and acidity of the stomach contents being normal. The gastric ulcers were produced in the cat by the local injection of gastro-toxic serum into the stomach wall, the serum being prepared by immunising the goat with the gastric cells of the cat. Motor insufficiency of the stomach, leading to retention of its contents, which is one of the commonest forms of indigestion of food in man, was produced by constricting the pylorus of the cat by means of rubber tubing, the ulcer then being formed on the anterior wall of the stomach. It was found that in these circumstances the healing of the ulcers was delayed for at least twice the normal time. The ulcers, however, eventually healed up, but the regenerated mucous membrane was of a lower type than normal. Thus it may consist on the forty-first day of a single layer of cubical cells such as should be found on the tenth day of normal healing, or of glands formed entirely of duct epithelium. It was further found that the more sclerotic the base of the scar the more badly developed was the mucous membrane. In certain cases the *normal* healing of the ulcers was occasionally delayed by necrosis of the granulation tissue forming their bases, or by excessive formation of fibrous tissue, and in these cases the mucous membrane was of the lower type. It was therefore considered that the delay in healing in motor insufficiency was an exaggeration of the condition occasionally seen in the normal state. Both conditions are due to digestion or irritation of the base of the ulcer, leading to necrosis or increased formation of fibrous tissue, so that the regenerated mucous membrane is either unable to grow over it at all or only consists of a single layer of cells or of glands of a lower type than normal. When the base is excessively fibrous the glands have not a sufficiently vascular and cellular stroma in which to proliferate.—Dr. G. **Dreyer** and J. Sholto C. **Douglas**: The velocity of reaction in the "absorption" of specific agglutinins by bacteria, and in the "adsorption" of agglutinins, trypsin, and sulphuric acid by animal charcoal. Though a fair number of observations exist as to the influence of time on the so-called adsorption processes, *e.g.* the adsorption of a dye by a fibre (Bordet, Bayliss, &c.) proving that it takes a very considerable time before equilibrium is reached, the study of the time reaction in the taking up of agglutinins by bacteria has been confined to the observations of Eisenberg and Volk. These authors maintain that the velocity of reaction is extremely fast, and that equilibrium is reached in five minutes, even at a temperature of 0° C., and that no appreciable difference is to be found in the absorption velocity, whether the reaction takes place at 0° C. or 37° C. The present authors' results, which are contradictory to those of Eisenberg and Volk, may be summarised as follows:—(1) the establishment of equilibrium in the absorption of agglutinins by their specific bacteria is not attained, as stated by Eisenberg and Volk, in less than five minutes at 0° C.; but takes a considerable time, since equilibrium is not reached at room temperature even in four hours; (2) the adsorption of agglutinin or trypsin by charcoal does not reach an equilibrium within four hours at room temperature, nor the adsorption of sulphuric acid by charcoal in twenty-four hours, or possibly even in forty-eight hours; (3) there is no justification for judging as to the nature of the interaction between an absorbing substance and a material absorbed from the rapidity or slowness with which equilibrium is attained, as has been done by Arrhenius.—Dr. G. **Dreyer** and J. Sholto C. **Douglas**: The absorption of agglutinin by bacteria, and the application of physico-chemical laws thereto. Eisenberg and Volk, in 1902, were the first to make more or less exact quantitative measurements of the absorption of agglutinins by bacteria. They showed that if agglutinating serum were treated in varying dilutions with a constant amount of homologous bacteria, the amount of agglutinin taken away was not constant, but that in a concentrated serum the absolute amount removed was greater than in a diluted serum, whilst, on the other hand, the relative amount taken away in a dilute serum was much the greater. By taking the experiments of Eisenberg and Volk, Arrhenius showed the existence of a relation between the quantity of absorbed agglutinin, C, and of the agglutinin left in the fluid, B, and expressed this relationship in the simple formula $C = kB^n$. The result of the present experiments may be summarised as follows:—(1) when an agglutinating serum in different concentrations is treated with constant amounts of bacteria, the quantity absorbed, C, may not only increase to a limit value, but may, when this point is passed, even decrease to zero when the concentration of the serum is further increased, which is quite different to

the statement of Eisenberg and Volk; (2) it is impossible, from the greater or smaller size of the exponent "n" in the formula $C=kB^n$, to determine whether, in the case of agglutinin, we have to deal with an absorption or an adsorption process, as done by Arrhenius, as in both cases "n" may vary within nearly the same ranges; (3) the formula $C=kB^n$, proposed by Arrhenius to express the absorption of agglutinin by bacteria, as being a special example of the Guldberg and Waage law of chemical mass action, does not hold good either in the case of the absorption of agglutinin by bacteria or of the neutralisation of agglutinin by homologous bacterial filtrate; (4) the combination of agglutinin and bacteria is therefore not such a simple process as anticipated by Arrhenius, but is very possibly complex, and not improbably of the same nature as the interaction of bacterial toxins and anti-toxins.—V. H. **Veley** and A. D. **Waller**: Observations on the rate of action of drugs upon muscle as a function of temperature. The authors tested the problem by observations on the rate of action on muscle of alcohol, chloroform, quinine, and aconitine, at temperatures between 7° and 25°. They used Esson's formula, modified for their purpose, for the calculation of results,

$$\log L_0 - \log L_1 = m(\log T_1 - \log T_0)$$

(where L_0 and L_1 are the lengths of time between application of the drug and cessation of contraction, and T_0 and T_1 the absolute temperatures at which the action took place; m is the experimental constant). The values of m came out as follows:—alcohol=20·5; chloroform=14·3; quinine=26·7. (The values of m in the case of hydrogen peroxide and hydrogen iodide=20·38, and in that of chloric acid and ferrous sulphate=26·5.) The corresponding temperature-coefficients per 10° are:—alcohol=2·02; chloroform=1·63; quinine=2·52. (In a previous rough determination the authors found ether=2.) The data from which the value of m was calculated in the case of chloroform are as follows:—

Temp.	Lengths of time.	$\log T_1/T_0$	$\log L_0/L_1$	m
7°	24·5′	0000	0000	
10°	21′	0017	0670	14·3
19°	13′	0182	2753	15·1
24°	10·5′	0257	3673	14·3
24°	11′	0257	3478	13·5
				Mean=14·3

The action of aconitine is completely arrested at 7°, and manifests itself as soon as the temperature is raised to 17°.—V. H. **Veley**: An examination of the physical and physiological properties of tetrachlorethane and trichlorethylene. Symmetrical tetrachlorethane, $CHCl_2CHCl_2$, was originally prepared about forty years ago from acetylene and chlorine gas in presence of antimony chloride. It is now prepared on a large scale by the same reaction, aluminium chloride being used instead of the antimony salt. Trichlorethylene, $CHClCCl_2$, is obtained from tetrachlorethane by heating with alkalies. Certain determinations of the densities and refractive index μ_α of tetrachlorethane have been published, but those of trichlorethylene have been curiously overlooked. Values are given of densities at certain temperatures and refractive index μ_D at 17° in the paper. The effects of both substances on isolated muscle are compared with that of chloroform. It is shown that toxicities of chloroform, trichlorethylene, and tetrachlorethane are in the ratio 1/1·5/4. It is further noted that the action of trichlorethylene is more regular than that of any other drug or anæsthetic examined by this method. Preliminary experiments with living animals have shown that anæsthesia produced by this compound is also of a very regular type.—J. D. **Thomson** and Prof. A. R. **Cushny**: The action of antimony compounds in trypanosomiasis in rats.—Sir David **Bruce**, Captains A. E. **Hamerton** and H. R. **Bateman**, and Captain F. P. **Mackie**: "Amakebe" (a disease of calves in Uganda).—Sir W. **Crookes**: Scandium. This is a continuation of the paper read in April, 1908 (Phil. Trans., A, vol. ccix., pp. 15–46), in which, after describing the mode of extracting scandia from the mineral wiikite, the principal salts, twenty-three in number, were described, their formulæ and analytical results being given in detail. In the present paper the following salts are described, their preparation, analyses, and formulæ being given:—

Scandium Aurochloride, $3ScCl_3,2AuCl_3,21H_2O$.

Scandium aurochloride is prepared by mixing strong solutions of the component chlorides, and allowing the mixture to evaporate slowly over sulphuric acid in a vacuum desiccator. The double salts separate out in a felt-like mass of needle-shaped crystals of a yellow colour and very deliquescent. The water of crystallisation gradually goes off when the salt is kept in a desiccator over sulphuric acid, definite hydrates being formed. In this manner the following hydrates have been formed:—

8-Hydrate Scandium Aurochloride, $3ScCl_3,2AuCl_3,8H_2O$, and the

2-Hydrate Scandium Aurochloride, $3ScCl_3,2AuCl_3,2H_2O$.

By long-continued drying at 100° all the water is driven off, and the aurochloride melts to a clear orange-coloured liquid, solidifying to a crystalline mass on cooling. After keeping the salt for several days at 100° the liquid gradually becomes solid and crystalline, and in this state it is anhydrous, and has the composition $3ScCl_3,2AuCl_3$. Scandium platinocyanide, $Sc_2[Pt(CN)_4]_3+21H_2O$, is formed by the metathesis in the cold of scandium sulphate and barium platinocyanide. It crystallises out in large monoclinic prisms on a rhombic base, the angles of which are 81° 20′ and 98° 40′. They are very soluble in water, and are insoluble, or nearly so, in absolute alcohol, and frequently group themselves in rosettes. They are dichroic, crimson by transmitted light, and a rich metallic green by reflected light. The reflected and transmitted rays are oppositely polarised. Scandium iodate, $Sc(IO_3)_3+18H_2O$, is prepared by the metathesis of a soluble scandium salt with ammonium iodate. It forms a white crystalline powder almost insoluble in water. Scandium sulphite, Sc_23SO_3, is a white insoluble powder formed by mixing a soluble scandium salt with sodium sulphide. It is anhydrous, and gradually decomposes on exposure to dry air.

Scandium Malate, $\begin{matrix} CH(OH)COO \\ | \\ CH_2 — COO \end{matrix} \rangle Sc(OH),H_2O$.

Malic acid and scandium hydroxide react when rubbed together with a little water, and the liquid becomes clear on being heated. When gradually cooled a precipitate appears, and at the ordinary temperature of the laboratory the solution is opaque and almost solid. Scandium malate is a granular white powder, soluble in hot and difficultly soluble in cold water. It is easily soluble in ammonia, and is not precipitated from the ammoniacal solution by dilute acetic or malic acid.

Scandium Malonate, $CH_2 \begin{matrix} COO \\ COO \end{matrix} \rangle Sc(OH)$

Scandium hydroxide dissolves readily in a cold aqueous solution of malonic acid, and on being heated the solution deposits a semi-transparent granular precipitate, having no crystalline appearance under the microscope. This precipitate partially dissolves on cooling. If this solution is boiled for some time a dense precipitate is formed, which does not re-dissolve on cooling. According to the mode of preparation scandium malonate contains either one or two molecules of water:—

Mono-hydrated Scandium Malonate, $CH_2 \begin{matrix} COO \\ COO \end{matrix} \rangle Sc(OH)+H_2O$,

and

Di-hydrated Scandium Malonate, $CH_2 \begin{matrix} COO \\ COO \end{matrix} \rangle Sc(OH)+2H_2O$.

Basic Scandium Malonate, $CH_2 \begin{matrix} COOSc(OH)_2 \\ COOSc(OH)_2 \end{matrix}$.

When a large excess of scandium hydroxide is gently warmed with an insufficient amount of malonic acid to dissolve it, and the filtered solution is well boiled, a basic salt is precipitated having the above composition.

Scandium Tartrate, $\begin{matrix} CH(OH)COO \\ | \\ CH(OH)CCO \end{matrix} \rangle Sc(OH)$.

Scandium hydroxide is added to a strong solution of tartaric acid with slight warming until the greater part of the scandium hydroxide is dissolved, care being taken to keep the base in slight excess. The turbid solution is filtered and boiled. A granular precipitate comes down.

This is well washed with boiling water and dried in a desiccator over sulphuric acid. Formed in this way, scandium tartrate forms a white crystalline powder, insoluble in hot and slightly soluble in cold water, and insoluble in alcohol.

$$\text{Scandium Racemate, } \begin{matrix} CH(OH)COO \\ | \\ CH(OH)COO \end{matrix} \Big\rangle Sc(OH), 4H_2O,$$

is prepared in a similar manner to the tartrate. The two salts are, however, not quite similar, as the racemate comes down less plentifully on boiling, and it is not anhydrous as is the tartrate, but contains four molecules of water, one of which is driven off at 115°.

$$\text{Scandium Lævo-tartrate, } \begin{matrix} CH(OH)COO \\ | \\ CH(OH)COO \end{matrix} \Big\rangle Sc(OH), 2H_2O,$$

is prepared in a similar way to the tartrate. When dried in a desiccator over sulphuric acid it contains one molecule of water. Dried in the air it contains two molecules of water.

$$\text{Scandium Meso-tartrate, } \begin{matrix} CH(OH)COO \\ | \\ CH(OH)COO \end{matrix} \Big\rangle Sc(OH), H_2O,$$

is prepared by gently warming a slight excess of scandium hydroxide with aqueous meso-tartaric acid, and then boiling the filtered solution. The meso-tartrate comes down as a white granular precipitate. The analysis of the compounds of scandium with tartaric acid and its isomers has been complicated by the tendency to form basic salts admitting of no simple formulæ. Thus both the tartrate and lævo-tartrates occasionally form salts containing percentages of scandium ranging near to 23·5, with a deviation of two- or three-tenths of a unit one side or the other. The nearest basic salt which contains such an amount of scandium has the composition

$$5\left\{\begin{matrix} CH(OH)COO \\ | \\ CH(OH)COO \end{matrix}\right\rangle Sc\ OH + \begin{matrix} CH(OH)COO{\cdot}Sc : O \\ | \\ CH(OH)COO{\cdot}Sc : O \end{matrix}$$

and contains 23·49 per cent. of scandium.

Linnean Society, December 16, 1909.—Prof. E. B. Poulton, F.R.S., vice-president, in the chair.—Rev. T. R. R. **Stebbing**: (1) Report on the Crustacea Isopoda and Tanaidacea collected by Mr. Crossland in the Sudanese Red Sea; (2) Isopoda from the Indian Ocean and British East Africa. Among the Red Sea species the most interesting novelty is one named *Lanocira latifrons*, in allusion to the peculiar widening of the frontal process. In British East Africa, Wasin has yielded a new genus and species meriting the significant appellation *Kalliapseudes makrothrix*, which may be rendered in the vulgar tongue as the "long-haired beauty of the Apseudidæ." The species is remarkable for the extensive fringes of feathered setæ on the mandibles, maxillipeds, and first gnathopods, as well as for the short round-ended finger of its second gnathopods. In the Stanley Gardiner collection the new species *Apanthura xenocheir* is unique within its own family in the structure of the hand and finger of the first gnathopods. The new genus and species *Pontógelos aselgókeros*, of the family Eurydicidæ, from Mauritius, displays a prolongation of the first antennæ hitherto unexampled in that family. Several new species and a new genus of Epicaridea, isopods parasitic on other crustaceans, are described from specimens transmitted by Miss M. J. Rathbun, who had extracted them with great care from the crabs of the Stanley Gardiner Expedition. In one instance it proved that the maternal pouch of the parasite was occupied, not by the usual enormous mass of eggs, but by another parasite, probably itself an epicaridean, though strangely metamorphosed. The discussion of this difficult tribe was opportune for offering a tribute of respect to the memory of the late Prof. Alfred Giard, one of whose latest writings was a luminous essay on Lamarck and Darwin.—Prof. G. H. **Carpenter**: Pycnogonida from the Red Sea and Indian Ocean, collected by Mr. Cyril Crossland.—R. **Shelford**: A collection of Blattidæ preserved in amber, from Prussia.—A. W. **Waters**: The Bryozoa from collections made by Mr. C. Crossland, part ii., Cyclostomata, Ctenostomata, and Endoprocta. The collections dealt with only contain sixteen species, and these are nearly all known from the Mediterranean, while nine are British. In this and the previous paper ninety-nine Red Sea species and varieties are referred to; of these, 34 are known from the Atlantic, 26 from British seas, 39 from the Mediterranean, 34 from Indian and neighbouring seas, 17 from Crossland's Zanzibar collection, 8 from Japan, 35 from Australia. The classification of the Ctenostomata is examined, and it is considered that the group Stolonifera of Ehlers must be divided into Vesicularina and Stolonifera. In the first there is usually a moderately thick erect stem from which the zoœcia arise directly, and they all have gizzards, an organ not general in the Ctenostomata, and probably confined to this group. In the Stolonifera as now reduced there is a delicate creeping rhizome expanding at intervals, and from these places the zoœcia arise, usually in pairs. There is no gizzard. The gizzards of the Vesicularina usually have a large number of sharp and irregular teeth surrounded by a band of strong muscles, but in Cryptopolyzoon the gizzard has but two teeth with nearly flat edges.

Geological Society, January 12.—Prof. W. J. Sollas, F.R.S., president, in the chair.—C. I. **Gardiner** and Prof. S. H. **Reynolds**; with a palæontological appendix by F. R. C. **Reed**: The igneous and associated sedimentary rocks of the Glensaul district (County Galway). The general succession of the rocks of the Glensaul district is given, in descending order, in tabular form. The graptolitic beds occurring in the Mount Partry beds have yielded nineteen species, which indicate the upper part of the zone of *Didymograptus extensus*. The commonest species met with are *D. extensus*, Hall, and *D. bifidus*, Hall. In a previous description of the rocks of the Tourmakeady district, the term Shangort beds was applied to a series of grits and tuffs, and the term Tourmakeady beds to an associated series of calcareous strata which generally take the form of limestone-breccias. In the Glensaul district it is not possible to draw a sharp line of distinction between the two rock-types. The fossils from the Shangort and Tourmakeady beds show a close resemblance to those of the Tourmakeady district, but the finding of certain additional forms, especially *Nileus armadillo* and Niobe sp., has impressed the close connection between this fauna and that of the Orthoceras Limestone of Sweden, and it is rather of Arenig than of Llandeilo age. The conclusion is in conformity with the field evidence. The relegation of the Shangort and Tourmakeady beds of Glensaul to the Arenig would imply a similar age for those of the Tourmakeady district. The Glensaul district contrasts strongly with that of Tourmakeady as regards the character of the crystalline igneous rocks, which are all quartz-felsites. One species of Illænus, one of Niobe, one of Nileus, two of Bathyurus, three of Cheirurus, one of Pliomera, one of Encrinurus, one of Phacops, and a new species of Bathyurellus are described; also three species of Orthis, one of Hyolithes, one of Rafinesquina, one of Camerella, and one of Porambonites.—Prof. E. W. **Skeats**: The gneisses and altered dacites of the Dandenong district (Victoria), and their relations to the dacites and to the granodiorites of the area. The area described lies about twenty-five miles south-south-east of Melbourne. The early geological surveyors regarded the dacites as Palæozoic "traps" passing into the granodiorites. Prof. J. W. Gregory described the rocks as dacites, probably of Lower Tertiary age, resting upon the denuded surface of the granodiorites and of the adjoining Lower Palæozoic sediments. The field-relations of the rocks are described, and gneiss is shown to occur between the dacite and the granodiorite. The contact with the plutonic rock is abrupt. No foliation or banding occurs in the granodiorites, but acid veins pass from the junction into the altered dacite and also cut across the foliations of the gneiss. The field-evidence shows that the dacites are older than the granodiorites, and also that the gneiss was formed before the intrusion of the acid veins. The chemical evidence indicates that differentiation of a magma took place; the dacite was first erupted, and, following on that, the granodiorite (of more acid composition) was intruded into the dacite. In the altered dacites a schistosity occurs near the contact, ilmenite is changed to biotite by reaction with the felspar in the ground-mass, biotite is corroded by the

ground-mass, and hypersthene is altered at its margin to biotite and quartz. Finally, granules of blue tourmaline occur in the contact-rocks. In the gneiss, hypersthene is not found, ilmenite is rare, and the rock is foliated. The gneiss is probably a modification of the dacite, but evidence as to its origin is incomplete. It may be the result of extreme contact-metamorphism of a dacite of peculiar character, such as a tuff. Possibly it was produced by differential movement in the dacite before complete consolidation, and certainly before the intrusion of the granodiorite.—H. J. **Grayson**: Recent improvements in rock-section cutting apparatus. The apparatus comprises a slitting disc of mild steel and two bronze grinding laps mounted on a substantial wooden table. The discs and laps are each 10 inches in diameter, and revolve at about 900 revolutions a minute. The discs and laps are connected with endless belts, which in turn are connected with wheels driven by a 1-horse-power electric motor. Special clamps are used to attach the rock-specimen and to cut the slice. A goniometric crystal-holder, permitting of slicing in any desired direction, is described, and can be fitted to one of the clamps. Clamps swinging radially across the grinding laps permit the parallel grinding of the slice to any thinness. A polishing lap can be placed in the position of one of the grinding laps. The finishing of the slice is done by hand on a slate disc.

Zoological Society, January 18.—Prof. J. Rose Bradford, F.R.S., vice-president, in the chair.—S. A. **Neave**: Collections of butterflies made during four years spent in northern Rhodesia and adjacent territories. The collection comprised 450 species, of which thirty were new to science, besides several rare and little-known species, including the rare *Acraea mirifica*, Lathy, and the hitherto unknown female.—J. T. **Cunningham**: Marine fishes and invertebrates of St. Helena. The scientific results of a visit to the island in February and March, 1909, for the purpose of investigating the condition and prospects of the fisheries of the island. The author's report on the results of the investigation from the economic point of view has been presented to the Colonial Office. The invertebrates collected have been examined and identified by specialists of the Natural History Museum, namely, Dr. Calman, Mr. Edgar Smith, Prof. Jeffrey Bell, and Mr. Kirkpatrick, the last-named having described a new species of sponge and a new hydroid. The fishes have been worked out by the author himself, and include two new species, one belonging to the Stromateidæ and one to the Cyphosidæ. The three kinds of Albacore occurring at St. Helena are shown to be identical with the three species diagnosed at Madeira by the Rev. R. T. Lowe in 1839, namely, *Thynnus alalonga*, *T. albacora*, and *T. obesus*, species which have been confused or rejected by recent ichthyologists; the synonymy and distribution of these are for the first time correctly elucidated.—Dr. W. T. **Calman**: Second and concluding part of a report on new or rare Crustacea of the order Cumacea, from the collection of the Copenhagen Museum. This portion of the report deals with the families Nannastacidæ and Diastylidæ, and twenty-seven species are described, all of which are regarded as new, and three new genera are established.—Prof. W. M. **Smallwood**: Hydroids and nudibranchs of Bermuda.

Institute of Metals, January 19.—Sir Gerard A. Muntz, Bart., president, in the chair.—O. F. **Hudson** and E. F. **Law**: A contribution to the study of phosphor-bronze. This paper was intended to amplify the conclusions arrived at by A. Philip, who presented a contribution on phosphor-bronze to the Institute of Metals at the Birmingham meeting of the institute in 1908. The authors endeavoured to indicate the relation between the mechanical and other properties of the copper-tin-phosphorus alloys and their constitution and structure. A useful diagram was included in the paper showing the constitution of all the alloys containing up to 25 per cent. of tin. The paper included notes on the examination and analysis of the phosphor-bronzes, and was illustrated by a remarkably clear and numerous collection of photomicrographs illustrating the structure of the alloys. Many of these photographs were originally of 1000 diameters, and these were further enlarged by being projected on a screen from lantern-slides made from autochrome plates, the marvellous blue-green and red colourings of the various constituents thereby being brought before the notice of the audience in a very novel and effective manner.—T. Vaughan **Hughes**: The failure in practice of non-ferrous metals and alloys, with particular reference to brass loco-tubes. This was essentially a practical, as distinct from an academic, paper, and dealt especially with an investigation into the cause of a breakdown of brass loco-tubes which had led to serious casualties and a Government inquiry. The failure was found to be due to the formation of a "scale," only 0·05 mm. thick, which offered a resistance of 20 megohms to an E.M.F. of 250 volts when dry and 150,000 ohms when wet. This electrical measurement showed the heat conductivity of the scale, and explained the over-heating of the tube at the point where the breakdown had occurred.—C. O. **Bannister**: The use of carbonaceous filters in the smelting of zinc. The paper was a corollary of that entitled "Notes on the Production of Pure Spelter," by J. S. G. Primrose, read at the Manchester meeting of the institute in October, 1909. Mr. Bannister described particularly the filters used in the Hopkins fumeless zinc process. The process was stated to have begun with the object of producing lead-free zinc only, but it now embraced three objects—the manufacture of pure spelter, the prevention or reduction of zinc fume, and the obtaining of higher yields.

Royal Meteorological Society, January 19.—H. **Mellish**: Presidential address, on some relations of meteorology with agriculture. The close dependence of agriculture upon climate and upon the periodical variations of the weather has been recognised from the earliest times, but the relations are of such a complicated character, and the difficulty of separating the effects of the different factors is so considerable, that as much progress as might have been expected has perhaps not been made in applying the data of meteorology to the purposes of agriculture. The president first referred to the writings of various authors on the subject of temperature and rainfall, as affecting the wheat and other crops, and then proceeded to deal with such questions as the liability of some crops, and especially of fruit, to injury from frosts; the influence exercised by forests upon climate, and especially upon rainfall; and the study of phenology. He next considered what steps meteorologists could take to further the application of the data of their science to the various problems of agriculture. It is doubtful whether farmers make as much use of the forecasts and weather reports as they might. Possibly this may arise because they are not familiar with the technical terms in which the reports are necessarily couched. This might be remedied in the course of time if instruction on the subject could be worked into the courses at the agricultural schools and colleges. The Royal Meteorological Society has lost no opportunity of urging the importance of the subject to farmers, and also the inclusion of meteorology under the head of nature-study in the schools, and there are reasons to think that this is having some effect.

MANCHESTER.

Literary and Philosophical Society, December 14, 1909.—Mr. Francis Jones, president, in the chair.—Dr. S. **Russ**: A note on radio-active recoil. When radium emanation is condensed at the bottom of a glass tube from which the air has been removed, active deposit particles are radiated up the tube. This phenomenon has been attributed to the recoil of the atom when an α particle is ejected from it. A disc suspended above the emanation may be the recipient of the active deposit particles. An analysis has been made of the decay curves exhibited by such a disc when exposed for different times. The conclusions arrived at are that the numbers of Radium A and radium B particles projected from the emanation are about equal, and that in comparison with them the quantity of radium C projected is insignificant. This latter result has recently been shown experimentally by Dr. Makower and the author.—D. M. S. **Watson**: A preliminary account of the bibliography of the post-Triassic Sauropterygia.

January 11.—Mr. Francis Jones, president, in the chair.—Prof. F. E. **Weiss**: Variability in the flowers of Tropæolum hybrids. A year ago a Tropæolum was observed by Prof. Weiss which showed at the same period three types of flowers, some yellow, some yellow with red markings, and some completely claret coloured. There seemed no marked periodicity in the occurrence of these flowers in 1908, though sometimes the yellow and sometimes the parti-coloured flowers predominated; but in an offspring of this plant it was noticeable that the parti-coloured and red flowers occurred only during the fine, hot weather in the second week in August, while during the cold and wet periods of July, September, and October all the flowers were yellow. This indicated a determining influence of temperature and light, and it is borne out by experiments in self-fertilising the variously coloured flowers. In the second (f_2) generation a variety of different plants arose by segregation, and the colour of the parental flower had no determining effect, yellow flowers yielding red offspring and *vice versa*. Incidentally, the segregation of characters in the second (f_2) generation showed that in Tropæola, dwarfness is recessive to tallness, as is the case in sweet-peas, and that red sap is a dominant character, though sometimes not apparent owing to unpropitious external conditions. This potential redness is, of course, different from the latent condition of a recessive character, which cannot be called into evidence by external conditions.

DUBLIN.

Royal Irish Academy, January 10.—Dr. F. A. Tarleton, president, in the chair.—Sir Robert S. **Ball**: Contributions to the theory of screws, viz.:—(1) on the expression for the virtual coefficient of two vector-screws; (2) on the composition of twists or wrenches on vector-screws; (3) on the pitch operator,

$$\Delta = \frac{d}{dp_1} + \frac{d}{dp_2} + \ . \ . \ . \ + \frac{d}{dp_n}.$$

(4) applications of quaternions to the theory of screws; (5) use of quaternions in the theory of reflected screws; (6) quaternion investigation of the screw reciprocal to five given screws; (7) representation of screw systems of the third order by linear vector functions. The virtual coefficient of two screws α and β is

$$\tfrac{1}{2}\{(p_\alpha + p_\beta)\cos\theta - d\sin\theta\},$$

where p_α p_β are the pitches of the two screws, and d is the length of their common perpendicular. It is here explained how θ can be measured without any ambiguity when α and β are regarded as *vector-screws*. The pitch operator Δ can be applied to any general formula connecting n screws belonging to an $(n-1)$ system, and by successive application a group of new formulæ can sometimes be derived. The application of quaternions to the theory of screws is founded on Hamilton's theorem as developed by Joly, that if μ be a vector moment and λ a vector force, then $S\mu/\lambda$ is the pitch of the screw on which the wrench lies, and $V\mu/\lambda$ is the vector perpendicular from the origin on the screw. One of the most fundamental theorems in the theory of screws asserts the existence of one screw and, in general, only one screw reciprocal to five given screws. The expression is here given of the vector coordinates of the screw reciprocal to the five screws

$$(\mu_1, \lambda_1)\ ;\ (\mu_2, \lambda_2)\ ;\ (\mu_3, \lambda_3)\ ;\ (\mu_4, \lambda_4)\ ;\ (\mu_5, \lambda_5).$$

This is, as might be expected, a symmetrical form with regard to the five screws, and leads, among many other results, to a concise expression for the sexiant which when equated to zero gives the condition that six screws shall belong to a five-system. Joly showed that Hamilton's beautiful theory of linear vector functions receives its geometrical representation by the system of screws of the third order. The fundamental properties of linear vector functions can be explained as immediate consequences of the theory of screws.

PARIS.

Academy of Sciences, January 17.—M. Émile Picard in the chair.—E. **Bouty**: The electric cohesion of neon. Although the molecular weight of neon is intermediate between argon, the molecular weights, and helium, its dielectric cohesion is much lower than that of the latter. The dielectric cohesion of neon is lower than that of any known gas; from the point of view of the obstacle opposed to the electric discharge, 57 cm. of neon are equivalent to a layer of 1 cm. of air.—W. **Kilian**: A new example of phenomena of convergence in ammonites: the origins of the group *Ammonites bicurvatus*.—A. **de Gramont**: The distribution of the ultimate lines in stellar spectra.—A. **Demoulin**: The K systems and congruences.—M. **Cisotti**: An application of the method of Jacobi.—Ludovic **Zoretti**: Ensembles of points.—L. **Décombe**: The elimination of directing electric couples, and effects due to asymmetry, to the absence of regulation and to contact electromotive forces in quadrant electrometers.—Edmond **Bauer** and Marcel **Moulin**: The constant in Stefan's law and the radiation of platinum. In a recent paper the authors described a method of determining the constant σ in Stefan's equation $E=\sigma T^4$ by the comparison of the radiation of a black body at 1064° C. with the radiation of a platinum sheet, known, in absolute measure, by experiments in a vacuum. It was assumed that the radiation of platinum followed Lambert's law up to large angles of emission; the latter assumption has now been proved by experiment to be inaccurate, and the introduction of the resulting correction reduces the original value of σ from $6{\cdot}0\times10^{-12}$ to $5{\cdot}3\times10^{-12}$, a figure in good agreement with the $5{\cdot}32\times10^{-12}$ of Kurlbaum.—A. **Colson**: The difficulties of chemical bibliography. A reply to some criticisms of M. Baubigny.—E. **Kohn-Abrest**: The action of heat upon aluminium in a vacuum. Aluminium is volatilised appreciably at 1100° C. in a vacuum, setting free silicon from the walls of the tube if the latter contains a silicate.—G. **Charpy** and S. **Bonnerot**: The cementation of iron by solid carbon. In these experiments both the iron and the carbon were submitted separately to a prolonged heating in a vacuum until no trace of gas was given off. The iron and carbon were then heated in contact at 1000° C., in a high vacuum, for several hours. No trace of carbon was absorbed by the metal under these conditions, although cementation was produced if traces of air were present.—Pierre **Camboulines**: The action of the vapours of carbon tetrachloride on anhydrides and oxides. The action of carbon tetrachloride vapour upon thirty-three oxides was studied. Silica and boric anhydride were not attacked; in the other cases a reaction took place at temperatures between 215° C. (niobic anhydride) and 580° C. (chromium oxide), the pure chloride of the metal being formed, excepting with niobic anhydride, thorium, and uranium oxides. With these a mixture of chloride and oxychloride was formed. This reaction furnishes a good general method for the preparation of anhydrous metallic chlorides.—R. **Fosse**: The transformation of some aromatic alcohols into phosphinic acids by hypophosphorous acid.—Gabriel **Bertrand** and G. **Weisweiller**: Vicianose, a new reducing C_{11} sugar. By the action of a diastatic preparation extracted from *Vicia angustifolia* upon the cyanhydric glucoside vicianine described in a previous paper, a new reducing sugar has been isolated. It has the composition $C_{11}H_{20}O_{10}$, and is the first definite biose prepared by the diastatic hydrolysis of a glucoside.—Marcel **Guerbet**: The condensation of secondary butyl alcohol with its sodium derivative; 3-methyl-5-heptanol and an alcohol, $C_{12}H_{26}O$, result from this condensation.—A. **Verneuil**: The synthetic reproduction of the sapphire by the method of fusion. Blue sapphires, possessing the colour and optical properties of the natural stone, have been prepared by heating alumina containing 1·5 per cent. of magnetic oxide of iron and 0·5 per cent. of titanic acid in the oxyhydrogen blowpipe.—A. **Conte**: Anomalies and spontaneous variations in the domestic birds.—Louis **Masson**: The tolerance of bacteria to antiseptics. Three species, *B. pyocyaneus*, *B. subtilis*, and *B. anthracis*, were grown in cultures containing small amounts of antiseptics (resorcinol, salicylic acid, copper sulphate, and mercuric chloride), and the

proportion of the antiseptic was increased in successive cultures. The bacteria adapted themselves to increasing amounts of the poison, and attained a maximum resisting power, followed by a rapid fall, losing the whole of the acquired resistance. The tolerance was thus shown to be a temporary phenomenon, an example of the resistance of the species to variation.

CALCUTTA.

Asiatic Society of Bengal, January 5.—Hem Chandra **Das-Gupta**: A probable identity between *Clypeaster complanatus*, Duncan and Sladen, and *C. duncanensis*, Noetling. The author gives reasons for thinking that *C. duncanensis*, Noetl., was founded on large specimens of *C. complanatus*, Duncan and Sladen.—I. H. **Burkill**: Fashion in iron styles. A paper to show that the iron styles used in India for writing on palm leaves are of different types in different parts of the country. The iron styles of the extreme south-west are heavy; those of the centre of the Coromandel coast are peculiarly long and generally light; those of Orissa are quite characteristic; the type which is like a clasp-knife is confined to the south. The paper is a supplement to the account of Indian pens published recently in the Agricultural Ledger, No. 6, of 1908–9.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.—Long Period Determination of the Rate of Production of Helium from Radium: Sir James Dewar, F.R.S.—Note on Carbon Mono-sulphide: Sir James Dewar, F.R.S., and Dr. H. O. Jones.—On the Extinction of Colour by Reduction of Luminosity: Sir William de W. Abney, K.C.B., F.R.S.—The Initial Accelerated Motion of Electrified Systems of Finite Extent, and the Reaction produced by the Resulting Radiation: G. W. Walker.—On the Nature of the Magnetokathodic Rays: H. Thirkill.—On the Velocity of Steady Fall of Spherical Particles through a Fluid Medium: E. Cunningham.—The Photo-chemical Formation of Formaldehyde in Green Plants:—Dr. S. B. Schryver.

ROYAL INSTITUTION, at 3.—Assyriology: Rev. C. H. W. Johns.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Equitable Charges for Tramway Supply: H. E. Yerbury.

FRIDAY, JANUARY 28.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Some Uses of Mechanical Power in Engineering Construction: H. F. Donaldson.

SATURDAY, JANUARY 29.

ESSEX FIELD CLUB (at Essex Museum of Natural History, Stratford), at 6.—Trawl Fishing in the North Sea: S. H. Goodchild.

MONDAY, JANUARY 31.

ROYAL SOCIETY OF ARTS, at 8.—Textile Ornamentation: Alan S. Cole, C.B.

INSTITUTE OF ACTUARIES, at 5.—Some Points of Interest in the Operations of Friendly Societies, Railway Benefit Societies, and Collecting Societies: A. W. Watson.

TUESDAY, FEBRUARY 1.

ROYAL INSTITUTION, at 3.—The Cultivation of the Sea: Prof. W. A. Herdman, F.R.S.

ROYAL SOCIETY OF ARTS, at 4.30.—Imperial Colonial Development: C. Reginald Enock.

ZOOLOGICAL SOCIETY, at 8.30.—On a Collection of Freshwater Crustacea from the Transvaal: Hon. Paul A. Methuen.—(1) Littoral Marine Fauna: Kerimba Archipelago, Portuguese East Africa, collected by J. J. Simpson. Sept., 1907, to May, 1908. Holothurioidea; (2) Marine Fauna: Mergui Archipelago, Lower Burma, collected by J. J. Simpson and R. N. Rudmose-Brown. Holothurioidea: Dr. Joseph Pearson.—A Revision of the British Species of Ostracoda belonging to the Subfamilies Candoninæ and Herpetocyphridinæ: Dr. G. Stewardson Brady.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Further discussion*: The Reconstruction of the Tyne North Pier: I. C. Barling.—*Probable Papers*: Notes on the Sheffield Water-supply and Statistics relating thereto: L. S. M. Marsh.—Statistical and Experimental Data on Filtration: W. R. Baldwin-Wiseman.

WEDNESDAY, FEBRUARY 2.

ROYAL SOCIETY OF ARTS, at 8.—An Improved Method of Electro-plating: A. Rosenberg.

SOCIETY OF PUBLIC ANALYSTS, at 8.—Annual Meeting, Presidents' Address.—The Composition and Analysis of Tea: R. R. Tatlock and R. T. Thomson.—The Examination of Turpentine Substitutes, and the Determination in Turpentine of Hydro-carbons other than Terpenes: J. H. Coste.—The Determination of the Acid Radical, and its Relation to the Constitution of Commercial Bismuth Subnitrate: J. Bristowe P. Harrison.—On Sheep Dips: J. S. Remington.

ENTOMOLOGICAL SOCIETY, at 8.—A Revision of the Labiduridæ, a Family of the Dermaptera: Dr. Malcolm Burr.

THURSDAY FEBRUARY 3.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On the Relative Sizes of the Organs of Rats and Mice bearing Malignant New Growths: Dr. F. Medigreceanu.—The Thyroid and Parathyroid Glands throughout Vertebrates: F. D. Thompson.—The Transmission of *Trypanosoma lewisi* by the Rat-flea (*Ceratophyllus fasciatus*): Prof. E. A. Minchin and J. D. Thomson.—Further Evidence of the Homogeneity of the Resistance to the Implantation of Malignant New Growths: Dr. E. F. Bashford and Dr. B. R. G. Russell; The Contrast in the Reaction to the Implantation of Cancer after the Inoculation of Living and Mechanically Disintegrated Cells: Dr. M. Haaland.

RÖNTGEN SOCIETY, at 8.15.—The Essential Ambiguity of X-ray Representation, and some Methods of Solution: Dr. W. Cotton.

LINNEAN SOCIETY, at 8.—Further Discussion of the Origin of Vertebrates: Dr. A. Smith Woodward, F.R.S., Prof. A. Dendy, F.R.S., and other speakers, with Dr. Gaskell's reply.

FRIDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 9.—The Heredity of Sex: Prof. W. Bateson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Construction and Setting-out of a Low-level Sewer: L. T. Wilson.

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