of special interest. About the general habits of this fish, he thinks it unnecessary to write much, as Fülleborn's notes, so recently published, are but confirmed; but we are glad that he has added some on the breeding habits, which are illustrated with sketches of the nest and of the cloud of young fry attended by the male. The author concludes that the early development must certainly be regarded as furnishing abundant evidence of intermediate characters; to the Ganoids, on the one hand, and to the Teleosts, on the other. These ontogenetic nearnesses become, accordingly, of the greatest interest, since they confirm the results of the structural study of recent and fossil forms upon the Amioid descent of Teleosts.—On *Kynotus cingulatus*, a new species of earthworm from Imerina in Madagascar, by W. Blaxland Benham (Plates 33 and 34). This interesting species is remarkable for the great number and small size of the segments composing the body; there were three anterior portions sent for examination, each about 225 mm. in length; each piece consisted of some three hundred or more segments; the whole worm being probably about 450 mm. to 500 mm. in length; it possesses a clitellum of relatively enormous dimensions, with most peculiar "claspers."—Notes on the ciliation of the ectoderm of the amphibian embryo, by R. Assheton (Plate 35), describes the distribution of the cilia over the surface of the bodies of the tadpoles of *Rana temporaria and Triton cristatus*. As the author notes, the existence of a ciliated embryo among craniate vertebrates seems often to be overlooked.—On the ontogenetic differentiations of the ectoderm in Necturus (Study II.).—On the development of the peripheral nervous system, by Julia B. Platt (Plates 36-38). Even if we assume Necturus to be a monotypic genus, it would have been advisable for the authoress to have cited a specific name for the Batrachian, whose peripheral nervous system she has so painstakingly elaborated. The summary, occupying two pages, is too long to be cited, and does not admit of being further condensed; we note that "although delicate protoplasmic prolongations connecting cell with cell initiate the specialised coordination of the nervous system, a common reticulum, such as Sedgwick describes, into which nuclei migrate, does not exist in *Necturus*" [*lateralis*]. This number contains a title and index to Volume xxxviii.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 13.—"On the Behaviour of Argon and Helium when submitted to the Electric Discharge." By Dr. J. N. Collie and Prof. William Ramsay, F.R.S.

Some years ago, Natterer published the results of experiments on the passage of electricity through various gases and vapours at the ordinary atmospheric pressure; he found that the length of the spark, or the "spark-gap" varied in length in a manner approximately proportional to the number of atoms in the molecule of the gas; thus in mercury gas the distance was very much greater than that obtained in hydrogen, oxygen, nitrogen, or other diatomic gases; and in these, the spark-gap was longer than in substances of more complex molecular constitution.

Experiments of a similar nature, carried out by us on some common gases and on argon and helium, gave the results which are summarised in the following table:—

	mm.
Oxygen	23·0
Air	33·0
Hydrogen	39·0
Argon	45·5
Helium	Probably 250 or 300

The current was of constant potential and quantity; and the hammer of the coil was kept in a constant position during the experiments. Indeed, on re-testing the spark-gap with air, after the experiments were finished, the original number was reproduced.

On lowering pressure, this spark-discharge changes into a ribbon-like discharge, before the "fluffy" appearance of a so-called vacuum tube becomes visible. It appeared that this change, occurring at a definite pressure, might be measured with fair accuracy. The results of a series of such experiments is to show that the character of the discharge changes for the undermentioned gases at the pressures stated:—

	mm.
Air	73 or 74
Hydrogen	42 ,, 43
Oxygen	81
Carbon dioxide	92 or 94
Cyanogen	23
Nitrogen	33
Carbon monoxide	49
Helium	1270

A tube filled with helium shows all the phenomena of a vacuum tube when containing the gas at atmospheric pressure.

The visibility of the spectrum of one gas in presence of another was next investigated. For a full description of the method of filling the tubes, and altering the pressure, the original paper must be consulted. Only the final results are here reproduced.

Amount of Gas detectable in a Mixture.

	Per cent.	
(1) Helium in hydrogen	33	of helium invisible at 2·61 mm.
	10·9	,, barely visible at the lowest pressure.
(2) Hydrogen in helium	0·001	visible at all pressures.
(3) Nitrogen in helium	0·01	almost invisible.
(4) Helium in nitrogen	10	of helium difficult to detect.
(5) Argon in helium	0·06	still visible at all pressures.
(6) Helium in argon	33	invisible at 2·62 mm. pressure.
(7) Nitrogen in argon	25	,, 2·58 ,, ,,
	0·42	,, 1·7 ,, ,,
	0·08	,, 0·18 ,, ,, though just visible at 1·05 mm.
(8) Argon in nitrogen	37	barely visible at any pressure.
(9) Argon in oxygen	2·3	difficult to distinguish at 1·04 mm. pressure.

From these experiments it appears that at high pressures, a discharge passes much more readily through helium than through other gases; but at a low pressure, if passage of current can be inferred from luminosity of spectrum, all other gases convey current more readily than helium does; and nitrogen conveys current more readily than argon. This is probably connected with the known fact that decrease of pressure promotes dissociation. The experiments on the relative luminosity of these gases were made with electrodeless tubes, hence it cannot be objected that the passage of current is determined by the attraction of the material of the electrodes for the gas under experiment.

"On the Absorption of the extreme Violet and ultra-Violet Rays of the Solar Spectrum by Hæmoglobin, its Compounds, and certain of its Derivatives." By Dr. Arthur Gamgee, F.R.S., Emeritus Professor of Physiology in the Owens College, Victoria University.

The investigation, of which the chief results are communicated in this paper, had for its starting-point the observation of the late Prof. J. L. Soret, of Geneva, who showed that, in addition to the absorption bands in the visible spectrum, solutions of the blood-colouring matter are characterised by an intense absorption band in the extreme violet between G and H. The present research has been conducted with the aid of photography, quartz prisms and lenses being employed.

The following are some of the principal results of the investigation:—

I. The compounds of hæmoglobin with oxygen, carbonic oxide, and nitric oxide present, even in highly dilute solutions, an absorption band between Fraunhofer's lines G and H. In the case of oxy-hæmoglobin the mean ray absorbed coincides with λ 414·0, that is to say, the centre of absorption is slightly nearer the red end of the spectrum than Soret had stated; this observer placed the centre of absorption at *h* (λ 410·1). As Soret had indicated, in the case of the compound of carbonic oxide with hæmoglobin, the absorption band is slightly displaced towards the less refrangible end of the spectrum. The combination of hæmoglobin with nitric oxide presents an absorption band occupying precisely the position of that of the CO-compound. In the case of these two compounds, the mean ray absorbed corresponds to λ 420·5.

II. When the molecule of *dissociable* oxygen is removed from oxy-hæmoglobin, either by the action of reducing agents, or by boiling *in vacuo*, the absorption band in the extreme violet is remarkably displaced towards the less refrangible end of the spectrum, the centre of absorption corresponding to λ 426·0.

III. The absorption of the extreme violet depends on the iron-containing moiety of the hæmoglobin molecule, for, whereas it is not presented by the albuminous product of the decomposition of the blood-colouring matter, it is characteristic of the acid compounds of hæmatin and of hæmochromogen.

IV. Solutions of alkaline hæmatin, even when enormously diluted (1 : 30,000 of water), exert a general absorption of the ultra-violet and extreme violet, but present no trace of definite absorption, either in the extreme violet or the adjacent ultra-violet region.

The compounds of hæmatin with acids, *e.g.* hæmatin hydrochloride, present even in solutions of great dilution (1 : 25,000—1 : 50,000) an intense absorption band, which encroaches more and more on the ultra-violet as the strength of the solution increases. With a solution containing one part of crystallised hæmatin hydrochloride in 20,000 parts of glacial acetic acid the band extends between *h* and M, the most intense absorption being between *h* and L. In highly dilute solutions the band which is still intense absorbs both H and K.

V. Solutions of hæmochromogen (reduced hæmatin of Stokes) exhibit an intense absorption band between *h* and G. The band has the same position as the band of CO-hæmoglobin, but is more intense. From the examination of solutions of various strengths, it results that the mean ray absorbed corresponds to λ 420·0.

VI. The absorption of the extreme-violet and ultra-violet by methæmoglobin indicates that this body is the product of a partial decomposition of the molecule of oxy-hæmoglobin.

VII. The band in the extreme-violet (and ultra-violet), which is characteristic of hæmoglobin, its compounds, and certain of its iron-containing derivatives, in no respect depends upon the iron in the molecule. This conclusion is based (1) on the fact that none of the compounds of iron, organic or inorganic, possess the property of producing a definite absorption in the extreme-violet or the adjacent ultra-violet; (2) upon the study of hæmatoporphyrin, a body derived from hæmatin by the removal of the iron which this body contains.

Acid solutions of hæmotoporphyrin of extreme dilution exhibit an absorption band between *h* and H. If the solution be slightly more concentrated K is absorbed, and with increasing concentration of the solution the absorption of the ultra-violet extends more and more. Alkaline solutions of hæmatoporphyrin absorb the same spectral region, but the intensity of the absorption is greater.

VIII. Neither bilirubin, hydrobilirubin, nor urobilin present any definite absorption band in the region of the spectrum, where the absorption band of hæmoglobin and its derivatives occurs.

Physical Society, March 13.—Prof. Carey Foster, Vice-President, in the chair.—Mr. J. H. Reeves read a paper on an addition to the Wheatstone's bridge for the determination of low resistances. The piece of apparatus described can be used for measuring the resistance of metre lengths of wires of low resistance, the only additional apparatus required being a sensitive galvanometer, a Post Office form of resistance box, and a metre bridge. It differs from the ordinary Kelvin bridge in that instead of balancing by varying the length of the standard wire between the two contacts, the distance between these contacts is maintained constant, as is also the length of the wire which is being measured, and balance is obtained by altering other resistances in the network. The author has made a number of tests which show that by his arrangement the resistance of metre lengths of copper wires between the limits of No. 22 S.W.G. and a stranded cable of 7 No. 16's can be determined with an accuracy of 0·1 per cent.—Mr. Reeves also read a note on the exact value of Matthiessen's standard. Prof. A. Gray (communicated) said that the author had in his arrangement combined the fixed standard employed in Matthiessen and Hocking's modification of the ordinary bridge with the greater celerity of working arising from the smaller number of operations to be performed when the Kelvin bridge is used. Prof. Gray thinks that he, and probably others, used a method similar to that of Mr. Reeves; but that the paper is of great utility, since it shows how time may be saved and existing apparatus utilised. Prof. Ayrton said that the advantage of the method described lay in the fact that it was independent of the resistances at the contacts. In Carey Foster's method, however, the coils had to be interchanged, and inaccuracy might be introduced owing to the varying resistance of the mercury contacts. Unless the mercury cups and the copper plates at the bottom were cleaned every day and the contacts re-amalgamated, the resistance of the mercury cups was very variable. With regard to the question of Matthiessen's standard, it is to be remembered that the specific conductivity of copper has been steadily increasing. This increase was particularly noticeable in the copper prepared by the Elmore process, where, during the deposition of the metal, an agate burnisher is kept continually passing over the surface. Fitzpatrick had explained the rise in conductivity of copper by supposing that the density of the copper now supplied was greater than that of the copper used by Matthiessen, and this explanation seemed quite satisfactory. Mr. Reeves's experiments, however, have conclusively shown that this is not the true explanation. It was now possible to obtain copper in large quantity having a conductivity of 103 on Matthiessen's scale. The Chairman (Prof. Carey Foster) explained how, when using his method, the accuracy of the result depends not on the elimination of the small resistances at the mercury cups, but on the constancy of these resistances. Matthiessen and Dr. Russell found that the specific gravity of copper was apt to be low on account of the presence of dissolved oxide, and they were the first to pass hydrogen gas through the molten metal to remove this oxide. Mr. Appleyard gave a simple diagramatic sketch of the author's arrangement, and also pointed out that better results would probably be obtained with a galvanometer of one or two ohms resistance. Mr. Campbell said that it ought to be definitely settled whether Matthiessen's standard was the conductivity per unit volume or per unit mass. Since copper was always bought by weight, he, as a practical man, strongly advocated the adoption of the mass conductivity; further, in this case the measurement of the specific gravity would be avoided. Mr. Reeves having replied, a communication by Herr Puluj on kathode rays was read by the Secretary.—Herr Puluj exhibited some Röntgen photographs taken by means of a form of Crookes' tube, which he had described in a memoir published in 1889. With this tube he has succeeded in obtaining impressions with exposures of only two seconds. Herr Puluj considers that the particles of matter torn from the kathode, which convey negative electrostatic charges, by impact on the glass walls, or on screens, equalise their electric charges, and in this process call forth not merely a disturbance of the material molecules, but also of their ether envelopes. Each portion of the glass or screen bombarded by the kathode stream becom es the starting-point of ether waves, which, according to their oscillation period and oscillation character are either visible rays (phosphorescence) or invisible Röntgen rays. The oscillations of the invisible rays may take place in the longitudinal direction, but no convincing argument has up to now been brought forward to support this view.—The Secretary also read a note on permeability to Röntgen rays, by Messrs. Ackroyd and Knowles. The authors have exposed a plate on which a number of pieces of metal, oxides, and sulphates were placed to the Röntgen rays in order to see whether the permeability of bodies to these rays depends on the atomic or molecular weight of the body. In each case it was found that the opacity increased with the molecular weight. Mr. Blakesley said that he considered the Röntgen rays to be the propagation of electrostatic strain through space. With reference to the non-refrangibility of these rays, he had observed in one of the photographs, exhibited by Mr. Swinton, a dark line at the edge of the shadow of a wooden pencil, which might have been due to the refraction of the rays by the wood. Mr. Blakesley has, however, found that this line is due to the varnish on the pencil. Some Röntgen photographs of quartz and ebonite rods not only did not exhibit these dark lines, but there was a very slight indication of a bright line just on the edge of the shadow, which would indicate that the refraction of these rays was less in the rods than in the surrounding medium.—Mr. Edser exhibited some photographs taken with Mr. Jackson's form of tube, in which a concave kathode is employed. Mr. Edser said that the whole of the tube on the kathode side of the anode plate phosphoresced, so that the Röntgen rays seem to partake of the character of diffused light. Prof. Ayrton said Mr. Jackson had found that the kathode rays form a parallel beam and do not first come to a focus and then again spread out. The Chairman said that some observations made by Mr. Porter agreed with those of Mr. Edser. Mr. Blakesley described the tube used by Puluj, in which a mica screen coated with green calcium sulphide is placed between the kathode and the anode. Mr. Gardner said that there seemed to be some confusion, for when a concave kathode is employed, the kathode rays are brought to a focus and then again diverge. The phosphorescence on the inside of the glass had been shown by Lenard to be due to electricity travelling round the inside surface of the glass. Mr. Pidgeon asked if any one had tried the effect of mounting the photographic film on a metal plate. The Chairman said that Captain Abney had found that if the film was

mounted on a ferrotype plate no action took place. Prof. Perry said that he, for one, was of opinion that the Röntgen rays were undulatory. Prof. Larmor has given an explanation which seems to agree with the observed facts. This explanation supposes that the intermolecular spaces respond to vibrations of a certain frequency. The reason no refraction or diffraction effects had been observed was probably because of the extreme smallness of the wave-length of the undulation.—After a few further remarks by some of the members, the Society adjourned till March 27.

PARIS.

Academy of Sciences, March 9.—M. A. Cornu in the chair.—On the divergence of trigonometrical series, by M. H. Poincaré. A reply to some remarks by M. Hill.—On some new properties of the invisible radiations emitted by some phosphorescent bodies, by M. Henri Becquerel. The rays emitted by potassium uranyl sulphate, which has been kept in the dark for some days, are capable of discharging a gold leaf electroscope even after passing through a plate of aluminium 2 mm. in thickness. Clear evidence was obtained that these invisible rays are capable of reflection and refraction.—On the use of artificial hexagonal blende in the place of a Crookes' tube, by M. Troost. By means of the light given off by a crystal of artificial blende, rendered phosphorescent by exposure to burning magnesium ribbon, good images of metallic objects upon a sensitised plate were obtained, the rays passing through blackened paper readily. The effects produced are the same as with a Ruhmkorff coil and Crookes' tube. The time of exposure is not given.—On some conditions which govern gaseous combinations. The combination of oxygen and hydrogen at low temperatures, by MM. A. Gautier and H. Helier. By circulating the gaseous mixture through a porcelain tube packed with porcelain rods, kept at a constant temperature, and then passing the products over tubes containing phosphoric anhydride, combination can be shown to occur at as low a temperature as 180° C., explosions not occurring until about 840° C.—On the carbides of yttrium and thorium, by MM. H. Moissan and Étard. Yttrium carbide, prepared in the electric furnace, is attacked readily by the halogens, with difficulty by acids. With water the carbide yields a mixture of acetylene (72 per cent.), methane, ethylene, and hydrogen, together with a small quantity of liquid hydrocarbons. Thorium carbide, produced by a similar method, forms a crystalline transparent mass, and gives a mixture of hydrocarbons on treatment with water of the same qualitative composition as that obtained from yttrium carbide.—Aberration and regression of the lymphatics in the course of development, by M. L. Ranvier. The growth of the lymphatics at the time of their formation is often so active that they appear in organs in which they have no functional significance, from which they have to be reabsorbed. Hence occasionally long vessels, closed at both ends, are found, corresponding to portions of the lymphatic system isolated by the atrophy of the intermediate parts. These small cysts may give rise to large cystic tumours.—On malformations of the hip, by M. Lannelongue.—Influence of vaccinal exanthema on microbial localisations, by M. S. Arloing.—Remarks on communication to M. Hermite, by M. Hugo Gyldén. A correction of a previous paper.—Observations of the comets. Perrine (1895, *c*), and Perrine-Lamp (1896, *a*), made with the large equatorial at the Observatory of Bordeaux, by M. L. Picart.—Observations of the sun, made at the Observatory of Lyons, during the last quarter of 1895, by M. J. Guillaume.—On asymptotic lines, by M. E. Goursat.—On the determination of the mass of the cubic decimetre of distilled water, free from air, and at its maximum density, by M. J. Macé de Lépinay. As the final result of a series of weighings in water of a quartz cube, the mass of a cubic decimetre of pure water at 4° C. is 0·999954 kilograms with a possible error of six units in the last figure.—*Rôle* of the different forms of energy in photography through opaque bodies, by M. R. Colson. The actions capable of affecting a sensitised plate are classified as mechanical, chemical, thermal, the infra-red rays, and the X-rays.—Electric effects of the Röntgen rays, by M. A. Righi. The X-rays are capable of producing the dispersion of electric charges upon dielectrics. By dusting a mixture of sulphur and red lead, or better, of talc and manganese peroxide over the plate of ebonite, images of interposed objects resembling photographs can be produced.—On some facts relative to the Röntgen rays, by MM. A. Battelli and A. Garbasso.—On some specimens of glass submitted to the action of the X-rays, by M. V. Chabaud.—On the Röntgen rays, by MM. C. Girard and F. Bordas. An experiment tending to show that the Röntgen rays proceed from both anode and kathode, and that the fluorescence produced on the walls of the Crookes' tube has only a slight effect upon a sensitive plate.—On the technique of photography by the X-rays, by MM. A. Imbert and H. Bertin-Sans.—Remarks added by M. d'Arsonval on the same.—On the centres of emission of the X-rays, by Prince B. Galitzine and M. de Karnojitzky.—On the direction of the X-rays, by M. A. Buguet.—Photography in colours; substitution of organic colours for reduced silver in photographic prints, by M. G. A. Richard.—Action of nitrogen peroxide and air upon the chloride of bismuth, by M. V. Thomas.—On the modifications of the grisometer and on the accuracy obtainable with it, by M. J. Coquillion.—On argon in the gas from the swimming bladder of fishes, by MM. T. Schlœsing, jun., and J. Richard.—Thermochemical study of the amides and ammonium salts of some chlorinated acids, by M. P. Rivals.—On the determination of the acidity of pyroligneous products, by M. Scheurer-Kestner.—On a new series of sulphophosphides, the thiophosphites, by M. Ferrand.—On some derivatives of triphenyl-silico-protane, by M. C. Combes.—On Russian essence of aniseed, by MM. G. Bouchardat and Tardy. This essence contains a large quantity of anethol, together with small quantities of anisic aldehyde, anisic acid, fenchone, and hydrocarbons of the composition $C_{15}H_{24}$.—On a case of lumbar *spina bifida*, by M. V. Ménard.—Influence of franklinisation upon menstruation, by M. E. Doumer.—Explanation of the flowers of the Fumariaceæ from their anatomy, by M. O. Lignier.—On an old schistous synclinal, forming the heart of Mount Blanc, by MM. J. Vallot and L. Duparc.—On the eruptive rocks of the Belledonne chain, by M. Louis Duparc.—On the mode of formation of the auriferous conglomerates, by M. A. Lodin.—Examination of the meteorite that fell at Madrid on February 10, 1896, by M. S. Meunier. The substance of the meteorite appears to be identical with the mineral chantonnite.—On mathematical synthesis, by M. L. Mirinny.—On a point in the kinetic theory of gases, by M. Chapel.—On photography through substances by electric currents, by M. Vaysse.—Remarks by M. Armagnac confirming the preceding.—On a probable cause of the explosion of meteors in the terrestrial atmosphere, by M. E. Hauser.

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