the hydrocarbon spectrum; while Young and I observed *no* such coincidence.

9. Comet IV. 1871 (Tuttle), examined only by me, gave a spectrum of three bands. Accurate measurement of their position showed *no* coincidence with the hydrocarbon spectrum.

Of these nine comets, there is only one (I. 1870) for which we have no observations as to the position of the bright bands. Of the remaining eight, the spectra of five (1, 2, 4, 7 and 9) have shown *no* agreement with the hydrocarbon spectrum. As regards the Comet II. 1867 the supposition is offered that its spectrum was similar to the spectrum named; as to Encke's Comet III. 1871, it remains uncertain in which class it is to be reckoned (Huggins' observations being at variance with those of Young and myself). There remains only the Comet II. 1868, for which Huggins' and Secchi's observations assert a probability of coincidence of the lines in its spectrum with those in the spectra of volatile hydrocarbons.

It thus appears a somewhat questionable view, that the comets consist of such matter; and we should, I think, content ourselves with the deduction, that a portion of the light emitted by the comet is its own light, and very probably from glowing gas. Perhaps a brighter comet may enable us to find out their nature more exactly, yet it seems to me extremely difficult to determine the nature of the glowing gas of the comet through a comparison of spectra from the electric spark in Geissler tubes; since there must be, in the comet, circumstances of pressure and temperature, which it is impossible for us to imitate, and through which, it is known, the spectrum undergoes great modifications.

Dr. Zenker has further asserted (*Astr. Nach. loc. cit.*) that "in the spectrum of Brorsen's comet, Huggins has recognised the bright line of nitrogen." This statement is incorrect; the observation having been, that the bright band situated in the green of the spectrum, had *nearly* the same position as the brightest line of the nebulæ, which, it is known, coincides with the double line of nitrogen. The band in the comet spectrum is a little displaced towards the red end; and this displacement could not be due to the motion of the comet, for, as Huggins pointed out, the latter was moving towards the earth, and the line would have been displaced towards the *violet*. At an earlier date, Huggins, observing the Comet I. 1866, gave out the opinion that the material forming it might be nitrogen; the spectrum appeared to consist of only *one* band of light, which nearly coincided with the brightest nitrogen line. But Secchi disproved this view, having observed three bands, and the weaker bands showing no coincidence with those of the nitrogen spectrum. The accurate measurements afterwards made by Huggins with the bright Brorsen comet, are of interest specially because they put it beyond doubt, that there is no connection between the spectrum of nitrogen and that of the comet.

Again, Dr. Zenker arrives at the conclusion that there must be water-vapour in the comets; since they have, according to Schmidt, a yellowish-red colour, and the sun's rays, when they pass through a considerable thickness of aqueous vapour, are coloured thus. But apart from the consideration that sunlight has a yellowish-red colour on passing through other vapours, as well as aqueous, I would remark, that we must take the proper light of the comet, which appears from spectral analytic observations, to be generally more intense than the reflected light, as determining its colour. According to the observations made, we should expect that the comet is, on the whole, of greenish or greenish-blue colour, since all the spectra consist, as we have seen, of two or three bands of light, of which one is in the yellow, the second and brightest in the green, and the weakest in the beginning of the blue. Of the (generally very faint) continuous spectrum, only the brightest part—yellow, green, and commencement of blue—is visible. The entire image, therefore, even where the weak continuous spectrum appears, will seem of greenish colour. Colour-data have been furnished by other observers besides Schmidt; and the head of the Comet 1811, *e.g.* had, according to Herschel, a greenish or bluish-green colour; the nucleus was slightly red. The colour of Halley's comet, at its return in 1825, was a bluish-green (Struve). Winnecke says of the comet of 1862, "The colour of the neck appears to me yellowish; the coma has bluish light."

With regard, lastly, to Dr. Zenker's proposition that "every gas belonging to the solar system, as soon as it is visible on the dark ground of the heavens, must appear with the same lines of the spectrum, as, according to its nature, it absorbs out of the sunlight," I may be permitted to remark that I am not quite convinced of this; there is not yet furnished a satisfactory experimental basis for the assertion. But to seek to explain the line spectrum of a nebula thus, and by saying that the nebula is shone upon by a fixed star in its "near neighbourhood," is doubtful, inasmuch as it is a very rare case that bright stars are situated in such nearness to nebulæ (especially the planetary, which best show the gas spectrum), that one can suppose a physical connection between them and the nebulæ.

I have been prompted to the foregoing remarks by the observation that in recent speculations on the constitution of the universe, the value of perceptions of sense, on which these speculations rest, has been greatly over-estimated. The principles on which the edifice of an hypothesis is raised must, above all, be secure, and observations not sufficiently confirmed, or even denoted as uncertain by those who have made them, should preliminarily be disregarded, if it is desired that the hypothesis have a stimulating and furthering influence on the progress of scientific research.

SCIENTIFIC SERIALS

Justus Liebig's Annalen der Chemie. Band 169, Heft 3.—This number of the Annalen contains the following papers:—On the decomposition of nitric acid by heat, by L. Cairus. This paper, upwards of seventy pages in length, deals exhaustively with the subject. Very numerous tables of the results of various conditions of temperature, &c., are given, and the paper is illustrated with two plates.—On the chlorides of molybdenum, by Dr. L. P. Liechti and B. Kempe.—Chlorides of the formulæ $MoCl_2$, $MoCl_3$, $MoCl_4$, and $MoCl_5$ are described. The authors point out the parallelism shown by these bodies to the Tungsten chlorides, where, however, Tungsten wants the corresponding trichloride, while molybdenum wants the hexachloride. In both these series the colours of the salts become darker as the chlorine increases in quantity.—On the atomic weight of molybdenum, by L. Meyer. The author from sixteen results deduces the atomic weight 95·86 for molybdenum, chlorine being taken as 35·37 and silver 107·66. This agrees very well with the result obtained by Dumas 96, and by Debray 95·94. The author also points out the following relations in three groups of elements:—

V	51·2	Cr	52·4	Cu	63·3
Plus	43		43·2		44·4
Nb	94	Mo	95·6	Ag	107·7
Plus	88		88·4		88·5
Ta	182	W	184·0	Au	196·2

On chromic dioxide, by E. Hintz. The author describes the preparation, &c., of this body.—The number concludes with a paper on sulpho-ortho-toluidinic acid, by F. Gerver, and one on the specific heat of zirconium silicon, and boron, by W. G. Mixter and E. S. Dand.

THE new number of the *Quarterly Journal of Microscopical Science* contains many papers of interest. Prof. Allman commences by giving an account of Kleinenberg's researches on the anatomy and development of Hydra, in which, while he has confirmed many of the statements of former observers, he has shown the incorrectness of others, and has discovered several important points in its anatomy, specially in connection with the structure of the ectodermic layer, and the subject of development.—Prof. Martin Duncan records some observations on the method of development in *Fucus vesiculosus*, in which, after suggesting that they obtain their nutrition in part at least, from the organic matter always present in sea-water, he describes the growth of the terminal cells of two sets of finger-shaped processes; showing that by in-growths from the lateral walls, membranous septa are formed at the apices of the processes, an active mass of protoplasm occupying the extreme end.—Following this is a translation, with a plate illustrating it, of George O. Sars' paper on the anatomy of that aberrant form *Rhabdopleura mirabilis* (M. Sars), so peculiar in combining a creeping stem in which is an axial cord; lateral cells in which the somites are free, except that a contractile cord binds each to the axial cord; a pair of tentacular arms; a differentiated alimentary canal, and a foot-like process between the alimentary orifices. Mr. E. R. Lankester, in a separate paper, very clearly shows, with the aid of some excellent diagrams, that this animal is a true molluscan form, intermediate between the Polyzoa and Mollusca, and not in reality related to the Hydrozoa as imagined by M. M. Sars.—Mr. Tomes' observations on the development of the teeth of the Armadillo are referred to in our Notes.—A translation follows of the researches of Ph. van Tieghem and G. Le Monnier, on the *Mucorini*, condensed from their memoirs in the

Annales des Sciences Naturelles. It will well repay the study of microscopists.—Rev. E. O'Meare continues his researches on the Diatomaceæ, describing the *Achnantheæ*, *Gomphonemeæ*, *Amphipleureæ* and their allies.—Dr. Bowditch, of Harvard University, gives a new method of injecting the Lymph Spaces in fasciæ, by stretching fascia over the neck of a bottle; and injecting in several places a turpentine solution of alcannine with the point of the syringe partially perforating the fascia; allowing the whole to dry, during which process the fluid penetrates the finest lymph spaces.

SOCIETIES AND ACADEMIES

London

Royal Society, Dec. 18, 1873.—"On the Nervous System of *Actinia*," Part I., by Prof. P. Martin Duncan, F.R.S.

After noticing the investigations of previous anatomists in the histology of the chromatophores, the work of Schneider and Rötteken on these supposed organs of special sense is examined and criticised.

Agreeing with Rötteken in his description, some further information is given respecting the nature of the bacillary layer and the minute anatomy of the elongated cells called "cones" by that author. The position and nature of the pigment-cells is pointed out, and the peculiarities of the tissues they environ also. It is shown that the large refractile cells, which, according to Rötteken, are situated between the bacilli and the cones, are not invariably in that position, but that bacilli, cones, and cells are often found separate. They are parts of the ectothelium, and when conjoined enable light to affect the nervous system more readily than when they are separate. Further information is given respecting the fusiform nerve-cells and small fibres noticed by Rötteken in the tissue beneath the cones, and the discovery of united ganglion-like cells, and a diffused plexiform arrangement of nerve is asserted. The probability of a continuous plexus round the *Actinia* and beneath each chromatophore is suggested, and the nature of the physiology of the structures in relation to light is explained.

The nature of the minute construction of the muscular fibres and their attached fibrous tissue in the base of *Actinia* is noticed; and the nervous system in that region is asserted to consist of a plexus beneath the endothelium, in which are fusiform cells and fibres like sympathetic nerve-fibrils. Moreover, between the muscular layers there is a continuation of this plexus, whose ultimate fibrils pass obliquely over the muscular fibres, and either dip between or are lost on them.

The other parts of the *Actinia* are under the examination of the author, but their details are not sufficiently advanced for publication. The nervous system, so far as it is examined, consists of isolated fusiform cells with small ends (Rötteken), and of fusiform and spherical cells which communicate with each other and with a diffused plexus. The plexus at the base is areolar, and its ultimate fibres are swollen here and there, the whole being of a pale grey colour.

Anthropological Institute, Dec. 30, 1873.—Prof. Busk, F.R.S., president, in the chair.—The following paper was read:—"Ethnological Data from the Annals of the Elder Han," Part I. Translated by A. Wylie, of Shanghai, with an introduction by H. H. Howorth. The Imperial Chinese Annals of the various Dynasties which are as yet almost untouched are distinguished by the extreme accuracy of their details, and in them is to be found a minute account of the intercourse of China with its neighbours, reaching back in contemporary annals to at least the second century B.C. The series of Chinese annals begins properly with those of the Han dynasty which reigned from about 202 B.C. to about 220 A.D. That was the golden prime of Chinese history, when the empire reached its furthest limits, when Buddhism was introduced and when a great literature flourished. During the dynasty of Cheou, the old imperial unity had been invaded by the creation of various feudatories who became almost independent. It was the aim of the immediate predecessors of the Han dynasty to destroy those feudatories and to restore the unity of the empire; and to effect that purpose all the ancient books and histories were ordered to be burnt. The annals, in the present communication, contain an account of the numerous conquests from the date of the Elder Han and embrace the history and migrations of a large portion of the peoples of Central and Eastern Asia. Mr. H. H. Howorth communicated the twelfth and concluding paper on the Westerly Drifting of Nomades: the Huns.

Edinburgh

Royal Society, Jan. 5.—Prof. Sir William Thomson, president, in the chair.—The following communications were read:—A New Method of Determining the Material and Thermal Diffusivities of Fluids, by Sir William Thomson.—Continuants: A New Special Class of Determinants, by Thomas Muir, M.A.—Remarks upon the Foot-Prints of the Dinornis on the Sand Rock of Poverty Bay, New Zealand, and upon its recent Extinction, by T. H. Cockburn Hood.

Dublin

Royal Irish Academy, Nov. 29, 1873.—Prof. Jellett, president, in the chair.—Samuel Ferguson, LL.D., read a paper on "The completion of the biliteral key to the values of the Letters in the South British Ogham Alphabet."—The president read a paper on "The question of Chemical Equilibrium," the determination of the law, according to which an acid divides itself between two bases which are present in the same solution, has been long known to be one of the obscure questions of chemistry, it is generally admitted by chemists that there is a division, and that the relative masses of the two bases exercise an important influence upon the law which governs it, but the law itself remains unknown, and the object of Prof. Jellett's paper was to give at least a partial, possibly a final, solution to the problem, treating the question as one of chemical equilibrium, and defining these terms as follows:—Two or more substances may be said to be in chemical equilibrium if they can be brought into chemical presence of each other, without the formation of any new compound or change in the amount of any of the substances which are thus brought together. If an acid be added to a mixture of two bases, four substances will be present, *i.e.* two salts and two portions of bases remaining uncombined, these four are in chemical equilibrium—the question is why—and the author showed that there can be but one equation of equilibrium, inasmuch as the quantities of the four substances which are present in the solution, are functions of three independent variables, namely:—the original quantities of each base (2) and the original quantity of acid (1) denoting by b_1 b_2 the quantities of free base, and by s_1 s_2 the quantities of each salt respectively, the equation of equilibrium is necessarily of the form $U = F(b_1, s_1, b_2, s_2) = 0$, and the object of the author's investigations was to determine the form of the function F. The bases selected for experiment were quinia and brucia. In quinia the rotatory power of any of its salts exceeds the rotatory power of the base. In quinia the reverse is the case, and as the result of careful and long continued experiments, it was proved that equilibrium is not troubled by dilution, for a disturbance could not arise without altering the rotation—there was no alteration, and the equilibrium, therefore, depended only on the ratios of the four substances, hence:—

$$U = F\left(\frac{1}{s_1},\ \frac{b_2}{s_2},\ \frac{b_1}{b_2}\right)$$

By a second series of experiments it was proved—putting $r_1 =$ rotatory power of brucia, $\rho_1 =$ rotatory power of hydrochlorate of quinia, $r_2 =$ rotatory power of brucia, $\rho_2 =$ rotatory power of hydrochlorate of brucia, $r =$ actual rotation for acidulated mixture, $a =$ total amount of acid corresponding to the unit of bulk of solution, $x =$ amount which combines with the quinia, it is easily seen that

$$r = \left(\frac{\beta_1 x}{\alpha}\rho_1 + (b) - \frac{\beta_1 x}{\alpha}\right) r_1 + \frac{\beta_2 (a - x)}{\alpha}\rho_2 + \left(b_2 - \frac{\beta_2 (a - x)}{\alpha}\right) r_2$$

where β_1, β_2, α are the atomic weights of the two bases and the acid respectively, and $b_1 b_2$ are the quantities of each base contained in the bulk of the solution. Solving this equation for x, we have

$$x = A\,a + B\,(r - b_1 r_1 - b_2 r_2), \text{ where}$$

$$A = \frac{\beta_2 (r_2 - \rho_2)}{\beta_1 (\rho_1 - r_1) + \beta_2 (r_2 - \rho_2)}$$

$$B = \frac{\alpha}{\beta_1 (\rho_1 - r_1) + \beta_2 (r_2 - \rho_2)}$$

If r_o be the actual rotation caused by the unacidulated mixture, it is evident that $r_o = b_1 r_1 + b_2 r_2$. The foregoing may therefore be written

$$x = A\,a + B\,(r - r_o)$$

By a third series of experiments it was seen that if a solution of