inferred from the most subtle differences of light and shade in the colours of objects, in association with previous experience derived through other senses. The picture is always an optical illusion; and this additional illusiveness conferred on the photograph by the method invented by Maxwell on the basis of the three-colour theory of vision, is surely a strong confirmation of that theory.

These results are attained by no new photographic operations. It is necessary to use good orthochromatic plates sensitised into the red, and also to have affixed in the lens an orthochromatic screen cutting of the ultra-violet light in the usual manner. The exposure is somewhat longer than the ordinary exposure, for we can of course only use visible light, and of this a part is stopped by the taking screen. The ordinary backs may be used. The displacement of the sensitive film from accurate register with the ground glass camera screen, owing to the presence of the taking screen in front of it, may be corrected (if thought necessary) by simply reversing the surface of the ground glass camera screen, turning the muffled side outward. This secures that the image will be accurately focussed in the plane of the sensitive surface. Negatives and positives may be used as ordinary negatives or positives till it is desired to recall the original colours. Thus, for those who wander with the camera, the possession of but the one seeing screen to test results is sufficient, and of course the one taking screen suffices to take an indefinite number of plates.

These considerations lead us naturally to observe that the registration of colour being really carried in the silver image, which with very little care in manipulation may be made permanent, secures that the colours are permanent. A faded screen may at any time be made good by a fresh screen; the colours in all cases being spectroscopically chosen, we are assured of the reproduction of the original colour. In this aspect the necessity of the detached colour screen is no disadvantage, but rather a necessary safeguard against the inevitable fading attending most pigment colours.

COMET MAGNITUDES.

DR. HOLETSCHEK, of the Vienna Observatory, has recently communicated to the Imperial Academy of Sciences a paper on the magnitude and brilliancy of comets and their tails, with the view of arranging them in "magnitudes" or orders of brilliancy in a manner similar to that in which stars are arranged according to their lucidity. Further, from the data given as to the apparent length of the tail, the true length of the tail has been computed, and an inquiry instituted as to the possibility of tail formation and its probable length, based on the resulting magnitude of the comet and its perihelion distance.

If it be true that the brilliancy of a comet varies as the squares of the distances from the sun (r), and from the earth (Δ), then from observations made at various points of the orbit, the same "magnitude" ought to result for the values $r = \Delta = 1$. This magnitude Dr. Holetschek has deduced, where sufficient data existed, and the results can be practically arranged in two classes: one, in which the deduced magnitudes derived from various values of r and Δ so nearly agree that a mean can be taken; the other, in which is shown a regular progress, and always in the direction that the deduced magnitudes with small radii vectures, therefore when the comet is near perihelion, are greater than when at large distances from the sun. The origin of this is due to the fact that the second power of the radius vector does not fully represent the variations occurring in comets as they approach the sun, at which time their brilliancy is more increased than is shown by the ratio $1 : r^2\Delta^2$. The first case, it is suggested, is only a special case of the second, arising through insufficiency of description. This is most clearly shown when the time covered by the observations is short, or the details so wanting in accuracy that the deviation from the ratio $1 : r^2\Delta^2$ cannot be known with certainty. The conclusion drawn is that the formula so generally used can represent the brilliancy of a comet at different distances from the sun for a short time only, and is inapplicable for long periods.

Dr. Holetschek uses the deduced magnitude in the neighbourhood of the perihelion, valuable as showing the greatest brilliancy attainable in a particular comet, as the data for forming the comets into orders of magnitude, and inquires how far the tail formation is connected with this magnitude and the perihelion distance. He decides from his material, that when the deduced magnitude is 6 or lower than 6, only a short and feeble tail, or one not visible to the naked eye, is possible. Comets with a deduced magnitude of 4, or still brighter, have a tail well visible, which is the greater, the smaller the perihelion distance, and the smaller, the greater this distance. Within the limits between 4 and 5 magnitude, if we exclude very great perihelion distances, lie the possibilities of a considerable tail development.

Dr. Holetschek has also considered the diameters of comets, and sought to introduce order by reducing the apparent diameter to that corresponding to a distance of the comet from the earth equal to unity. In the case of Halley's comet, no diminution or variability is to be detected in either its brilliancy or the length of its tail. The same values serve from 1456 to 1835. As, however, on account of the continual development of the tail, a diminution of the mass is probable, it cannot be decided whether the approximate constancy, shown in the investigation, arises from inadequacy in the observations themselves, or is produced by certain processes existing in cometary bodies.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The delegates of the Common University Fund have elected Mr. Edwin Stephen Goodrich, Merton College, to the Biological Scholarship at Naples for the year 1895-96.

CAMBRIDGE.—The report to the Senate of the Engineering Laboratory Syndicate, dated November 9, 1895, is a very satisfactory record of energetic work. The University was unable to provide more than £1000 for the building and equipment of the laboratory, which was estimated to cost about £6000. By steady and enthusiastic efforts Prof. Ewing and his colleagues succeeded in collecting from many sources, within and without the University, the £5000 that were needed; and what is still more to their credit, have completed the work in hand with a small balance to the good. The continued growth of the department, in which there are now eighty-five students under instruction, makes a further extension of the buildings urgently necessary. A site has been provided for the purpose, but further funds are needed for construction. The workshops, never intended to be other than temporary, must soon be rebuilt, and more lecture-room accommodation must be provided. The department has certainly justified its existence, and the Syndicate have proved themselves to be worthy stewards of the funds placed at their disposal. It is to be hoped that, with these guarantees that they will be well used, the needful moneys may ere long be forthcoming. The valuable services of Mr. Dalby and Mr. Lamb, the demonstrators of mechanism and engineering, in the work of organising the laboratory, are mentioned with cordial appreciation in the report. Among the donors of contributions of over £100 are the Duke of Devonshire, the late Earl of Derby, Mr. Frank McClean, and Dr. John Hopkinson, and eleven benefactors have given £100 each. Valuable donations of apparatus and of books have helped greatly towards the furnishing of the laboratory.

The amount, clear of all expenses, available for the Robertson Smith memorial, is £1450. It has been agreed by the subscribers that sufficient of this amount should be invested to produce an annual income of £30, such income to be employed on the continuance and extension of Prof. Robertson Smith's library, which he bequeathed to Christ's College. It was also resolved that the remainder of the amount collected, after all expenses have been paid, be handed over to the University for the purchase of Oriental MSS. for the University Library, which shall be marked as having been acquired by means of the fund. It is estimated that about £300 will be handed over to the Syndics of the Library.

IT is reported that Mr. P. N. Russell has given the sum of £50,000 to endow a school of engineering in connection with the Sydney University.

AN address on the present state and position of technical instruction in this country, delivered by Major-General Sir John Donnelly before the Society of Arts on Wednesday, November 20, is printed in full in the current *Journal* of the Society.

THE annual meeting of the National Association for the Promotion of Technical and Secondary Education, and the Conference of Representatives of Technical Education Committees, will be held on Tuesday, December 10, at the Royal United Service Institution, Whitehall.

THE following announcements are made in the *Johns Hopkins University Circular* (No. 121):—Sir Archibald Geikie has accepted the invitation of the President and Board of Trustees of the Johns Hopkins University to inaugurate the George Huntington Williams Memorial Lectureship, and has selected October, 1896, as the time for delivering his lectures.—Prof. Cleveland Abbe, of the United States Weather Bureau, will, during January next, give four lectures upon Climatology in its relations to Physiography.—Mr. G. K. Gilbert, of the U.S. Geological Survey, will begin a course of lectures upon Physiographic Geology the second week in January, and will lecture four times weekly until about the end of February.—Mr. Bailey Willis, of the U.S. Geological Survey, will commence his lectures upon Stratigraphic and Structural Geology, as soon as Mr. Gilbert has completed his course, and will lecture twice weekly until the middle of May.—Dr. R. M. Bagg has been appointed assistant in Geology.

SIR JOHN GORST, in a speech delivered last Thursday at the annual meeting of the London Society for the Extension of University Teaching, remarked that "though they were all anxious that the scientific education of the country should be fully developed, it would be a great mistake if that development were to take place at the expense of the literary side of education. A proper liberal education is fairly balanced on all sides, and no system which extends one branch of education at the expense of others can be productive of anything in the long run but mischief." Just so. We have always urged that science should receive as large a share of attention as literature in our colleges and universities; but no one can say that it does. Some of Sir John Gorst's hearers took his remarks to indicate a reaction against the increased facilities now being offered for instruction in science; but if the remarks are taken literally, they mean that scientific education should be fostered, and placed upon the same footing as the humanities.

SCIENTIFIC SERIALS.

American Meteorological Journal, November.—Relations of the Weather Bureau to the science and industry of the country, by Prof. W. L. Moore, Chief of the Weather Bureau. It is satisfactory to find that the change of Chief will not affect the scientific activity of the U.S. Weather Office, as many people supposed. Prof. Moore quotes the Act of Congress of October 1, 1890, which prescribes the duties of the Chief, from which it is seen that the main object of the Bureau is to give warning of the approach of storms, and therefore that the proper line of investigation should be relative to their mechanism. Systematic exploration of the upper air, with a continuation of the studies of terrestrial magnetic forces, begun by Prof. Bigelow, will be the line of investigation prosecuted during the next two years. With regard to estimating the probability or severity of frost, Prof. Moore thinks that sufficient weight has not yet been given to the dryness or wetness of the soil, and he calls for special attention to this point.—The meteorological observatory on Monte Cimone, Italy, by A. L. Rotch. Monte Cimone is the culminating point of the Northern Apennines, attaining a height of 7100 feet above the sea, and it is the only summit station in Italy, the observatories of Vesuvius and Etna being both situated on the flanks of these volcanoes. Both the summit and base stations are provided with self-recording instruments, and are dependent upon the Central Meteorological Office at Rome, with which there is telegraphic communication.—Physiological effects of high altitudes, by A. L. Rotch. The author points out the importance of the effect of the rarefaction of the air on the human system, which is, as yet, but imperfectly understood, and refers to his own experiences at great heights in the Alps and Andes.

Wiedemann's Annalen der Physik und Chemie, No. 10.—The practical use of Wheatstone's bridge, by F. Kohlrausch. The meter bridge is greatly improved and made more sensitive by introducing two resistances, 4·5 times the resistance of the wire, at one or both ends of it. The wire may also be rolled on a roller of marble or wood boiled in paraffin, with a flat spiral groove. With an enlarged scale reading to thousandths the author claims to have attained a limit of error of 1 in 25,000.—Density measurements of extremely dilute solutions, by the same author. These were made, as before, by weighing a glass sphere immersed in the liquid. But as the sphere used was heavier in this case, the cocoon fibre suspending it had to be replaced by a fine wire of dull platinum. The accuracy was then carried to the seventh decimal place, the only limit being the accuracy of temperature measurements.—Luminescence of solids and solid solutions, by E. Wiedemann and G. C. Schmidt. This is a continuation of previous researches on photo-luminescence and cathodo-luminescence, or the phosphorescence produced by the impact of light and cathode rays respectively on certain bodies, such as sulphates. A list of the most brilliantly luminescent substances is given, including "solid solutions," in van 't Hoff's sense, of $MnSO_4$ in other sulphates. The kind of luminescence of the latter depends only little upon the concentration, but much upon the kind of solvent. The lower the temperature the brighter the light. But the sulphates of copper, iron, and nickel extinguish it altogether, even in small quantities. The spectrum of the rays emitted is in every case a continuous spectrum consisting of one band.—On the absorption of cathode rays, by P. Lenard. The ratio between the absorptive power and the density is the same for all media, whatever their state of aggregation, provided the cathode rays are of the same kind.—Cathode rays and continuous discharges in gases, by O. Lehmann. This paper deals with the question of the actual nature of gas discharges.—The cooling effects of air currents, by A. Oberbeck. These are measured by finding what velocity of air is required to prevent the glowing of a platinum wire conveying a current. It is proposed to use this as a sensitive anemometer.—Anomalous dispersion curves, by A. Pflüger. Cyanine and Hofmann's violet have refractive indices below 1 for rays between F and G, and fuchsine, magdala red, and malachite green all show an increase of refrangibility with increase of wave-length in certain portions of the spectrum.

Bulletin de la Société des Naturalistes de Moscou, 1894, Nos. 3 and 4.—On the Ostracodes fauna of the neighbourhoods of Moscow, by A. Croneberg (in German). Twenty-three species are described, of which *Cyclocypris pygmæa* and *Erpetocypris peregrina* are new (with plates).—On the slates of Megalo-Aialo, near Balaklava, by D. P. Stremoukhoff (Russian, summed up in French). The presence of a number of Amonites, characteristic of the Bath and Kelloway strata, settles their age.—The birds of the government of Moscow, by Th. Lorenz. A list (in French) continued from a previous number.—The development of the tarsus in *Pelobatus fuscus*, by M. Chomiakoff (in German).—Two new Aphides from South Russia (*Stomaphis Graffii* and *St. macrohyncha*), by N. Cholodkovsky (in German) The microscopical structure of the electrical organ of the torpedo, by N. Iwanzoff, a large detailed work (in German), with plates in both numbers.—Yearly report of the Society.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, November 22.—Special meeting.—Captain W. de W. Abney, President, in the chair.—The following resolution, with reference to the articles of association, was passed. In Article 33, to strike out the words "by the payment of £10 in one sum," and in place of this to insert the words "the composition fee shall be, for every member who shall not have paid ten annual subscriptions, fifteen times the amount of the annual subscription payable by such member, and for any member who shall have already paid ten or more annual subscriptions, ten times the amount of the annual subscription payable by such member."—The ordinary meeting then took place.—Dr. G. Johnstone Stoney exhibited a print of Profs. Runge and Paschen's photograph of the spectrum of the gas obtained from clevite, together with a diagram illustrating the manner in which these observers have arranged *all* the lines obtained in two sets, each set containing three series of lines. Dr. Stoney also drew attention to the resemblance between each of these sets of three series of lines and the similar triple series obtained in the case of the metals of Mendelejeff's first group. The lines of the different series in the case of the gas obtained from cleveite have certain definite peculiarities which permit of their identification and selection. The two gases, to the presence of which the two sets of lines are presumably due, can be partly separated by diffusion through a plug of asbestos. Prof. Ramsay's observation that by suitably altering the pressure of the gas the predominance of the lines in either of the two sets can be increased is, however, against the