has received an enormous development, and whose application appears to offer a rich harvest of results. I refer to the application of photography to astronomical observation.

Your respected member, Mr. De la Rue, is the father of this method. Time does not permit me to dwell on his early endeavours and his successful results, but they are well known to you all. He opened up the field, and he cleared the way for his successors.

The recent strides in the chemistry of photography and the production of dry plates of extreme sensibility have permitted the application of the method to objects that formerly could not be photographed. Here, on the screen, are the spectra of stars photographed directly from the stars by Dr. Huggins, the lines which tell of the chemical constitution and temperature of the star's atmosphere being sharply defined.

Here are photographs of the great comet of 1882, which, with the cooperation of Mr. Allis of Mowbray, I obtained at the Cape, by attaching his ordinary camera to an equatorially mounted telescope, and with its aid following the comet exactly for more than two hours. Each one of the thousands of points of light that you see is the picture of a fixed star. The photograph suggests the desirability of producing star maps by direct photography from the sky.

Here on the screen is a photograph of the great nebula of Orion, or rather a series of photographs of it made by Mr. Common of Ealing. You will note the gradual development of detail by increase of exposure, and the wonderful amount of detail at last arrived at. Here are photographs from drawings of the same, and you will note the discrepancies between them. And here is a photograph of a star cluster also by Mr. Common.

No hand of man has tampered with these pictures. They have a value on this account which gives them a distinct and separate claim to confidence above any work in which the hand of fallible man has had a part.

The standpoint of science is so different from that of art. A picture which is a mere copy of nature, in which we do not recognise somewhat of the soul of the artist, is nothing in an artistic point of view; but in a scientific point of view the more absolutely that the individuality of the artist is suppressed, and the more absolutely a rigid representation of nature is obtained, the better.

Here is a volume compiled by one of the most energetic and able of American astronomers—Prof. Holden. It contains faithful reproductions of all the available drawings that have been made by astronomers of this wonderful nebula of Orion from the year 1656 to recent times.

If now we were to suppose one hundred years to elapse, and no further observation of the nebula of Orion to be made in the interval; if in some extraordinary way all previous observations were lost, but that astronomers were offered the choice of recovering this photograph of Mr. Common's, or of losing it and preserving all the previous observations of the nebula recorded in Prof. Holden's book—how would the choice lie? I venture to say that the decision would be—Give us Mr. Common's photograph.

Is it not therefore now our duty to commence a systematic photographic record of the present aspect of the heavens? Will not coming generations expect this of us? Does not photography offer the only means by which, so far as we know, man will be able to trace out and follow some of the more slowly developing phenomena of sidereal astronomy?

Huggins has shown how the stars may be made to trace in the significant cipher of their spectra the secrets of their constitution and the story of their history. Common has shown us how the nebulæ and clusters may be separately photographed, and it is not difficult to see how that process may be applied, not only to special objects, but piece by piece to the whole sky, till we possess a photographic library of each square half-degree of the heavens. But such a work can only be accomplished by consummate instruments, and with a persistent systematic continuity which the unaided amateur is unable to procure and to employ. It is a work that must be taken up and dealt with on a national scale, on lines which Huggins and Common have so well indicated, and which has already been put in a practical form by a proposal of Norman Lockyer's at a recent meeting of the Royal Astronomical Society.

I would that I had the power to urge with due force our duty as a nation in this matter, but my powers are inadequate to the task.

I employ rather the words of Sir John Herschel, because no words of mine can equal those of him who was the prose-poet of our science, whose glowing language was always as just as it was beautiful, and whose judgment in such matters has never been excelled. They were spoken in the early days of exact sidereal astronomy, when the strongholds of space were but beginning to yield the secret of their dimensions to the untiring labour and skill of Bessel, of Struve, and of Henderson. Think what they would have been *now* when they might have told how Huggins' spectroscope had determined the kinship of the stars with our sun, how it had so far solved the mysteries of the constitution of the nebulæ, and pointed out the means of determining the absolute velocity of the celestial motions in the line of sight. Think what Herschel would have said of those photographs by Common that we have seen to-night of that nebula that Herschel himself had so laboriously studied, and whose mysterious convolutions he had in vain endeavoured adequately to portray; and think of the lessons of opportunity and of duty that he would have drawn from such discoveries, as you listen to his words spoken forty-two years ago:—

"Such results are among the fairest flowers of civilisation. They justify the vast expenditure of time and talent which have led up to them; they justify the language which men of science hold, or ought to hold, when they appeal to the Governments of their respective countries for the liberal devotion of the national means in furtherance of the great objects they propose to accomplish. They enable them not only to hold out but to redeem their promises, when they profess themselves productive labourers in a higher and richer field than that of mere material and physical advantages.

"It is then, when they become (if I may venture on such a figure without irreverence) the messengers from heaven to earth of such stupendous announcements as must strike every one who hears them with almost awful admiration, that they may claim to be listened to when they repeat in every variety of urgent instance that these are not the last of such announcements which they shall have to communicate, that there are yet behind, to search out and to declare, not only secrets of nature which shall increase the wealth or power of man, but TRUTHS which shall ennoble the age and country in which they are divulged, and, by dilating the intellect, react on the moral character of mankind. Such truths are things quite as worthy of struggles and sacrifices as many of the objects for which nations contend, and exhaust their physical and moral energies and resources. They are gems of real and durable glory in the diadems of princes, and conquests which, while they leave no tears behind them, continue for ever unalienable."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following are among the Readers and University Lecturers just now appointed:—Readers—Comparative Philology, Dr. Peill; Botany, Dr. Vines. University Lecturers—Comparative Philology, Mr. E. S. Roberts; Sanskrit, Mr. Neil; Mathematics, for Part 3 of the Tripos, Division A, Mr. Forsyth; Division B, Mr. Hobson; Division C, Mr. Glazebrook; Division D, Mr. J. J. Thomson; Applied Mechanics, Mr. Macaulay; Botany, Mr. F. Darwin; Animal Morphology, Mr. A. Sedgwick; Advanced Physiology, Dr. Gaskell and Mr. Lea; Histology, Mr. Langley; Geology, Mr. D. Roberts; Moral Science, Mr. Keynes.

Prof. Colvin has presented to the Fitzwilliam Museum between eight and nine hundred books on Classical Archæology, on behalf of certain members of the University, to be deposited in the library of the Museum of Classical Archæology.

A warm discussion arose on the 30th ult. in the Arts School, on the Report recommending the erection of new lecture-rooms and work-rooms for Biology and Physiology. Mr. Huddleston said the estimate of 3000*l*. a year ago had grown to 10,000*l*. now. He had hoped that finality was reached last year. Mr. Oscar Browning objected to the proposals that they were reckless and extravagant. Why not ventilate the present lecture-rooms, if they were so much used as was described? The proposal to buy 150 microscopes for 1000*l*. was one of the most ridiculous he ever heard of. Why should not each student bring his own? A science man's library was exceedingly small and inexpensive. Mr. Mayo thought sufficient accommodation might be provided by using the Museum of Zoology as a lecture-room for large classes. Mr. Sedgwick described the inconveniences felt in the late course of Elementary Biology, when 206 men had to pack

themselves where only 140 could properly sit. Many sat on the stairs, and in positions where they could not see the blackboard. Mr. Trotter urged that the medical students could not be expected to provide capital sums for buildings. The large class in Elementary Biology this year would want to attend Physiology next year. It was impossible that finality could be attained. Prof. Foster explained the serious inconveniences of requiring every student to bring his own microscope to these classes; they ought to belong to and remain in the laboratory. The difficulties that now arose had occurred because of past under-estimates. He had been laughed at a few years ago for suggesting that space for one hundred students of Physiology would be wanted soon. He had no lecture-room under his control, and no room in which he could give demonstrations to a large class, yet so important did he deem the practical work of the class in Elementary Biology that, if no new accommodation could be given to it, he should feel compelled to close the practical work of his own large class, and simply give lectures in Physiology, and give up his laboratory for the class in Elementary Biology.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, No. 700, April.—Prof. Coleman Sellers, mechanics: introductory. Abstract report of a public lecture exposing various fallacies.—W. Dennis Marks, initial condensation of steam cylinders.—W. E. H. Jobbins, an investigation locating the strongest of the bronzes. The tests were made with Thurston's recording testing-machine, and gave for the two strongest bronzes the following:—Cu57, Zn42, Sn1, and Cu56, Zn42, Sn2.—J. C. Hoadley, a tilting water-meter.—S. Lloyd Wiegand, cast-iron in steam-boilers.—G. M. Bond, standards of length and their subdivision. W. Dennis Marks, economy of compound engines. Final agreement cannot be reached until "a more complete and rational set of experiments are made on the compound engine than now exist."—Dr. P. Frazer, reply to T. D. Rand's paper on the geology of Chester Valley, &c.

No. 701, May.—De Volson Wood, the most economical point of cut-off, a dialogue criticising Prof. Marks' paper.—J. P. Church, alleged remarkable error in the theory of the turbine water-wheel.—N. B. Clark, petroleum as a source of emergency power for war-ships. Proposes to employ furnaces into which petroleum is sprayed along with superheated steam and heated air.—S. L. Wiegand, cast-iron in steam-boilers.—R. Grimshaw, hanging the levers for indication.—R. Grimshaw, doctoring indicator cards.—Pliny Earle Chase, the sun-earth balance. This paper briefly expounds the author's views about harmonic relations in the solar system, and deduces values from them for the earth's mean radius of orbit, and for the weight of the sun.—G. M. Bond, standards of length and their subdivision.

Annalen der Physik und Chemie, Band xxi. No. 4, April, 1884.—G. Hansemann, on the diffusion of gases through a porous partition. The author concludes that Stefan's theory is not confirmed, but finds that the gaseous molecules within the pores offer a much greater mutual resistance than Stefan supposed.—G. Kirchhoff, on the theory of the diffusion of gases through a porous partition; a mathematical discussion of Stefan's theory.—Oskar Rother, on capillarity-measurements of salt solutions and their mixtures.—H. C. Vogel, remarks on Dr. O. Frölich's paper on the measurement of sun-temperature.—E. Warburg, on the electrolysis of solid glass. He concludes that in this obscure phenomenon the silica is not affected, and that the sodium only is moved electrically through the mass.—Emil Cohn, on the validity of Ohm's law for electrolytes.—A. Oberbeck, on electric oscillations: their magnetising action (part v.). The author concludes that undulatory currents exercise magnetising effects on iron and steel cores entirely as theory would indicate, provided account be taken of the internally induced currents.—L. Grunmach, absolute barometric measurements under a control of the vacuum by means of phenomena of electric illumination. The refusal of induction sparks to pass, or the phosphorescing of the glass surface, are chosen as indices of the exact state of the barometric vacuum.—W. Voigt, on the history of the Nobili-Guebhardt rings.

No. 5, May.—A. Winkelmann, on the diffusion of gases and vapours. This paper discusses the bearing of the formulæ of Meyer on certain changes in the coefficient of diffusion observed by Stefan's method.—L. Boltzmann, on a relation discovered by Bartoli between heat-radiation and the second law of thermodynamics.—L. Boltzmann on the quantity of work which can be obtained in chemical combinations. An important discussion of formulæ, and bears on dissociation heat.—A. Overbeck, on electric oscillations, especially on their magnetising effect, and on the propagation of magnetic oscillations. Describes a method of experiment employing an electro-dynamometer, and concludes that the magnetic oscillations propagated along an iron rod decrease in amplitude at points successively distant from the origin of the oscillations, but that the magnitude of the decrement depends only on the quality of the iron, and is independent of its cross-section.—W. Hallwachs, on the electromotive force, the resistance, and the efficiency of secondary batteries. This paper, reprinted from the *Elektrotechnische Zeitschrift*, recounts researches by the author, and gives a summary of others by Tresca and Ayrton and Perry.—J. Stephan, on the calculation of induction-coefficients of wire coils. This paper re-discusses the formulæ used by Maxwell and by Lord Rayleigh for the cofficients of the coils used in the determination of the ohm.—J. Fröhlich, notice on the calculation of the potential of coils. This paper concludes with two convenient approximate formulæ for controlling more elaborate calculations.—S. Wleügel and S. Henrichsen, on the magnetism of organic bodies. Gives values for a number of alcohols.—J. Elster and H. Geitel, on the electricity of flame; a reply to J. Kollert.—H. Merczyng, on Fresnel's measurement of wave-length. The author contends that Fresnel never made his well-known determination with the well-known "Fresnel's mirrors," but by diffraction.—J. L. Andreæ, Boyle's law: a lecture-experiment. A thread of mercury is introduced into a long narrow vertical glass tube closed at the top, and hangs inclosing a certain volume of air permanently.—Carl Kirn, on a mercury interrupter with which the oxidation of the mercury is obviated. The contact is broken in a closed vacuous vessel.—G. Krebs, three ozone apparatus.—V. Pierre, apparatus for demonstration of the laws of elasticity of traction; apparatus for demonstration of the constitution of a longitudinal wave; galvanoscope for lecture-demonstration; apparatus for freezing water quickly under the air-pump. There is nothing very new in the first two of these. The galvanoscope is a simple modification of the vertical Bourbouze instrument. The air-pump apparatus is identical with forms often used in this country.

Bulletins de la Société d'Anthropologie de Paris, tome vi., série iii., 1883.—The conclusion of M. Ujfalvy's notes on the so-called Kaffir-Giapochs of Hindoo-Koosh, based on his own observations and those of Biddulph, Elphinstone, and other English authorities.—Communications from M. Ten Kate, on the results of his anthropometric observations of the Yaquis Indians of Sonora and Arizona; from M. Errington de la Croix, on the fish-eating modern cave-dwellers of the Island of Socotra; from M. Hamy, on the dental mutilations of the modern Huaxtecs; and from M. Manouvrier, on the force of the flexible muscles of the fingers in men and women, having reference to the weight of the brain at different anatomical and physiological periods.—On the Japanese races, by M. de Quatrefages.—Reports of the Commissions appointed to examine the Cinghalese Araucarians and Kalmuks who have been brought to the Jardin d'Acclimatation for purposes of ethnographic investigation. The reports on the two latter have been drawn up by M. Deniker, whose intimate acquaintance with the language and homes of the Kalmucks gives special value to his comprehensive exposition of the ethnological and social characteristics of these people.—Recollections of Paul Broca as a student, by M. Eschenauer.—On the "Tzompantli," or sacrificial cranium, exposed in Aztek temples, by M. Hamy.—On the cranial differences observable in men and women, by M. Manouvrier, who considers that while the parietal is less developed in the latter, the occipital is generally larger in women than in men.—On the microscopical characters of the blood in the principal races, by Dr. Maurel, whose investigations do not appear to have demonstrated any very precise ethnic difference in the relations of the red and white corpuscles, unless we may accept as such his observation that the red globules of different races show different degrees of resistance to different artificial reagents.—On the use of iron in Egypt, by M. E. Soldi; and on the use of iron in China, by M. Milloué.—A *résumé*, by M. G. Hervé, of the various medical and other reports of the dimensions of Cuvier's brain. M. Hervé, basing his remarks on Dr. E. Rousseau's report of the autopsy in which the latter took part, gives the weight as 1830 grm., and the horizontal circumference as 60·45 cm. He denies that Cuvier had ever suffered from any malady capable of affect-