may be safely affirmed that they could not have been presented to the world in the form in which they appear without the co-operation of his remarkable union of technical knowledge and mastery of mathematical analysis with the chemical science of Prof. Abel. His beautiful invention of the Chronoscope, an instrument constructed by him at great cost, by which intervals of time as small as the one-millionth part of a second can be measured, has been of indispensable value in these researches. He is the author of papers which have been translated into most European languages on subjects of gunnery and gunpowder; he is perhaps the highest authority we possess on the higher branches of artillery science, and the best known on the Continent. His great talents and attainments are not more conspicuous than his singular modesty and his indefatigable industry. He has been engaged on these subjects about twenty years, having published the first experiments in this country with Navez' electroballistic apparatus, in 1862.

The Rumford Medal has been awarded to Dr. William Huggins, F.R.S. In 1866 a Royal Medal was awarded to Dr. Huggins for his important researches. Since that time he has been continually engaged in prosecuting the subject of celestial spectroscopy, both in the departments in which he had already done so much, and in others of its branches. One subject of Dr. Huggins' researches relates to the determination of the radial component of the velocity of the heavenly bodies relatively to our earth, by means of the alteration of the refrangibility of certain definite kinds of light which they emit, or which are stopped by their atmospheres. The smallness of the alteration corresponding to a relative velocity comparable with the velocity of the earth in its orbit makes the determination a matter of extreme delicacy. But as early as 1868 he had obtained such trustworthy determinations that he was able to announce before the Royal Society in that year that Sirius was receding from our solar system with a velocity of about 29·94 miles per second.

In a paper presented to the Royal Society in 1872 he has given the results obtained for a large number of stars, and has shown that some are receding and some approaching, and that there seems to be a balance of recession in those parts of the heavens, from which we have reason, from the observed proper motions, which of course can only be transversal, to conclude that the solar system is receding, and a balance in favour of approach in the opposite direction; while yet it does not appear that the motion of the solar system would alone account for the whole of the proper motions of the stars in a radial direction.

The same inquiry was extended to the nebulæ, the spectrum of which consists of bright lines, and in this case it presented greater difficulties. As those nebular lines which appear pretty certainly to be identifiable with hydrogen are too faint to be employed in the investigation, and the others are not at present identified with those of any known element or compound, he was obliged to avail himself of a coincidence between the brightest nebular line and a line of lead. But as the coincidence is probably merely fortuitous, the results give only the *differences* of approach or recess of different nebulæ. The observations seem to show that, so far as has been observed, the nebulæ are objects of greater fixity as regards motion in space, than the stars.

The other subject to which Dr. Huggins has more particularly devoted himself of late, is the mapping of the photographic spectra of stars. This was a research of great delicacy, partly on account of the small quantity of light at the disposal of the observer, partly from the great accuracy with which the comparison had to be made with the spectra of known substances, in order that satisfactory conclusions should be deducible as to the presence or absence of such or such substances in the stars. The results obtained led to a remarkable division of the stars into two great classes, naturally with transition cases, namely, white stars, which showed a group of twelve dark lines belonging, apparently, to the same substance, probably hydrogen, and the group of stars, of which our own sun may be taken as a type.

Besides the researches already mentioned, other papers have been presented by Dr. Huggins to the Royal Society, on the spectra of comets, on the spectrum of Uranus; and in particular one in which he showed that it was possible to detect the heat of the stars, and has given the results obtained for several.

The Davy Medal has been awarded to Prof. Charles Friedel, Member of the Institute of France.

From 1856 to the present time the investigations of M. Charles Friedel, ranging over widely-remote fields of chemical inquiry, have been continuous, numerous, and important. Mineralogical, theoretical, and general chemistry are indebted to him for many valuable contributions; but it is in the department of so-called organic chemistry that he has more especially laboured; and herein he has done much to assist in breaking down the barriers at one time regarded as impassably isolating the chemistry of carbon compounds.

Among the subjects of M. Friedel's successful work may be mentioned more particularly the chemistry of the 3-carbon family of organic bodies, to which belong propionic acid, lactic acid, glycerine, propylene, and acetone. The establishment of the constitution of lactic acid and of acetone, with the determination of the relationships to one another of the various, and in many cases isomeric, members of this large family, constituted for a long time one of the most fiercely-contested, as it was, and is, one of the most fundamental problems of organic chemistry. In the labours effecting the satisfactory solution of this problem M. Friedel bore a large share.

Passing to another branch of investigation, M. Friedel, partly by himself, but largely in conjunction in some parts of the work with Mr. J. M. Crafts, and in other parts with M. A. Ladenburg, made out, or confirmed in a very striking manner, the analogy subsisting between the modes of combination of carbon and of silicon, the most characteristic elements of the organic and inorganic kingdoms respectively.

To mention but one more subject of M. Friedel's research, he has, in conjunction with Mr. J. M. Crafts, made out and defined a simple method of wide application for effecting the synthesis of organic compounds. This method consists in bringing together a hydrocarbon and an organic chloride in presence of chloride of aluminum, whereby the residues of the two compounds enter into combination to form a more complex, frequently a highly complex, body. Independently of its utility, this process of synthesis is of remarkable interest from the part taken in it by the chloride of aluminum, which, though essential to the reaction, is found unaltered at the end, and seems to act by suffering continuously, little by little, a correlative transformation and regeneration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The statutes made by the new Commissioners for the different colleges are appearing in their final shape. The statutes of six colleges are already printed and in the hands of Members of Convocation. They resemble each other closely in several respects. Ordinary Fellows are to be elected by examination, all the branches of learning recognised in the final schools of the University being taken from time to time as the subject of examination. These Fellowships are tenable for seven years. Tutorial Fellows are elected without examination, but the colleges may require two years' college work from an ordinary Fellow, having given notice of such requirement before the examination. The colleges may elect persons distinguished in literary or scientific work to Fellowships tenable for a term of years, during which the Fellows shall devote themselves to a definite research specified in the resolution appointing them.

Several meetings of the Professors and College Tutors engaged in teaching different branches of Physics in the University have been held during the last fortnight at the instance of Prof. Clifton. The object was to prepare a scheme of lectures for next term, such that the lecturers would cover most of the ground without clashing with each other or with the lecturers in other branches of science. It may be mentioned that this is the first time such an arrangement has been arrived at in the Natural Science School at Oxford. The following plan of lectures has been agreed upon for next Lent Term:—

Optics (treated Mathematically), Prof. Price, Tuesday, Thursday, and Saturday, at 12; Magnetism (treated experimentally), Prof. Clifton, Wednesday and Saturday, at 12; Practical Physics, Prof. Clifton, Mr. Stocker, Mr. Jones, daily, 11 a.m. to 4 p.m. Thermodynamics and Electrodynamics (treated mathematically), Mr. Baynes, Monday, Wednesday, and Friday, at 10; Electrostatics (treated mathematically), Mr. Hayes, Saturday at 11; Elementary Mechanics (treated experimentally), Mr. Stocker, Monday and Wednesday, at 10; Problems in Elementary Mechanics and Physics, Mr. Jones, Friday, at 10; Elementary Physics (treated experimentally), Mr. Dixon, Monday, Wednes-

day, and Friday, at 11. The last three courses of lectures are intended to meet the requirements of candidates for the Preliminary Honour Examination.

SOCIETIES AND ACADEMIES

LONDON

Geological Society, November 17.—Robert Etheridge, F.R.S., president, in the chair.—Prof. Joseph Henry Thompson, Auckland, New Zealand, was elected a Fellow of the Society.—The President called attention to the portrait of Dr. William Smith, presented to the Society by his grand-nephew, Mr. W. Smith of Cheltenham, which was then suspended behind the chair, and expressed his great satisfaction at this most interesting picture being in possession of the Society. Mr. W. W. Smyth expressed the satisfaction which all must feel in possessing a genuine relic of this eminent stratigraphical geologist. Now this one, which had been so liberally presented to the Society, was a most indubitable portrait of the most conspicuous founder of English geology. That portrait was painted by M. Fourau in 1837, and was certainly an admirable likeness. The Society was deeply indebted to the donor, Mr. W. Smith, the cousin of the valued Prof. Phillips. The portrait now hanging on the wall was engraved in Prof. Phillips' "Life" of his uncle. He proposed a hearty vote of thanks to the donor. Mr. Evans rose with great pleasure to second the vote of thanks proposed by Mr. Warington Smyth. The portrait was indeed replete with interest, not only to English geologists, but to all geologists in the world. An additional interest attaching to the portrait was that we had the whole history of it from Dr. Smith's own hand, an extract from which Mr. Evans read. The portrait was an admirable one. He hoped that in the future Mr. Smith's example would be followed, and that we should see many other portraits of eminent geologists on the Society's walls. The Society was also deeply indebted to the president for the interest which he had taken in the matter. The vote of thanks was carried by acclamation.—The following communications were read:—On abnormal geological deposits in the Bristol district, by Charles Moore, F.G.S.—Interglacial deposits of West Cumberland and North Lancashire, by J. D. Kendall, C.E., F.G.S.

Royal Microscopical Society, November 10.—Dr. Beale, F.R.S., president, in the chair.—Photographs of *P. angulatum* and *Frustulia saxonica* were exhibited by Herr O. Brandt; the Tolles-Blackham and eight other microscopes by Mr. Crisp; "Calotte" diaphragms by Mr. Swift; Hyde's illuminator by Mr. J. Mayall, jun.; and Dr. Carpenter, C.B., described Wale's "working microscope" with Iris diaphragm, which he highly commended as combining many novel and excellent points for a student's microscope.—Mr. Lettsom described Abbe's "stereoscopic ocular," and Dr. Maddox his apparatus for collecting particles from the air.—Notes were read on monobromide of naphthaline (for mounting diatoms to increase their "index of visibility").—On ebonite for microscopical appliances, and on aperture exceeding 180° in air; also papers by Mr. Stewart on the echinometridæ, and by Dr. Royston Pigott on testing object-glasses.

PARIS

Academy of Sciences, November 22.—M. Edm. Becquerel in the chair.—The following papers were read:—Meridian observations of small planets at the Greenwich and Paris Observatories, communicated by M. Mouchez.—The thermal springs of the coast chain of Venezuela (South America), by M. Boussingault. The most important are those of Onoto (alt. 696 m.), Mariara (533m.), and Trincheras, near Nueva Valencia (300 to 350m.). The respective temperatures are 44°·5, 64°·0, and 96°·9, showing an increase proportional to the decrease in altitude, 1° for a difference of level of 6m. to 7m. After the springs of Urijino, Japan (100°), those of Trincheras are probably the hottest. The author gives an analysis of their water; also general descriptions of the others.—*Reconnaissance* of the Napo (Equatorial America), by M. de Lesseps. This important affluent of the Amazon has been scientifically explored by M. Wiener, who in seven months has crossed South America in its greatest width, Quito to Para. The river is navigable a thousand miles from its entrance to the Amazon. He indicates a region larger than France well suited for colonisation.—On the treatment of vines with sulphide of carbon, by M. de Lafitte.—On the simultaneous reduction of a quadratic form and of a linear form, by M. Poincaré.—On Leverrier's tables of the motion of Saturn, by M. Gaillot.—On a property of the polynômes X_n of Legendre, by M. Laguerre.—New tables for calculating heights by means of barometric observations, by M. Angot. These tables give directly the height of each station above the level where the pressure is 760mm.; this is near the true altitude, an idea of which may thus be had without comparing results from two stations. The exactness is at least as great as with the best formulæ proposed. The heights calculated differ always from the real height in a sense that can be known *à priori*.—Researches on sulphide of nitrogen, by M. Demarcay.—On phytolaccic acid, by M. Terreil. This new organic acid exists in the state of a salt of potash in the fruit of *Phytolacca Kæmpferi*. (Its properties are described.)—Measurement of the toxical dose of carbonic oxide in different animals, by M. Gréhant. Great differences were observed: a mixture of $\frac{1}{300}$ strength was the poisonous dose for one dog, $\frac{1}{250}$ for another (the animals being made to breathe 200 litres). A rabbit required $\frac{1}{60}$ (breathing 50 litres). The smallest sufficing dose was that for a sparrow, $\frac{1}{500}$.—On a new species of *Poroxylon*, by M. Renault. This plant is named *P. Edwardsii*. The *Poroxyleæ* are found in the Upper Coal and Permian formations.—Transformation of a fructiferous ramification, resulting from fertilisation, into a prothalliform vegetation, by M. Sirodot. This was observed in *Batrachospermum vagum* (Roth).—Influence of light on the respiration of seeds during germination, by M. Pauchon. These experiments were made on the castor-oil plant (as being oleaginous and albuminous) and on the haricot bean (feculent and without albumen). As in previous experiments, a good deal more O was observed in light than in darkness. The castor-oil seeds exhale slightly more CO_2 in darkness than in light, but the opposite was the case with the seed of *Phaseolus*. In darkness the ratio of CO_2 to O was for the haricot at least $\frac{1}{3}$ superior to that for the castor-oil plant, but prolongation of the experiment tends to bring the relation equal to unity, whatever the original value. For a given quantity of oxygen absorbed the seed placed in darkness exhales more CO_2 than that kept in light. While in light there is always less CO_2 exhaled than O absorbed, the contrary occurs in darkness. These facts explain the transformation of legumin into asparagin.—Observations on the *rôle* attributed to maize, used as food, in the production of pellagra, by M. Fua. He considers M. Faye's opinion, that pellagra may be caused by the large use of unfermented maize, to be in contradiction with facts. Maize is always eaten in the unfermented state. It forms the chief food of a large population in Central Africa, where pellagra does not occur; and similarly in Naples and in Hungary. He refers to certain alterations of maize (by fungi and oxidation).

VIENNA

Imperial Academy of Sciences, December 2. Dr. L. A. Fitzinger in the chair.—On the theory of so-called electric expansion or electrostriction; Part ii., by Dr. Boltzmann.—Calculation of the absolute value and determination of the general equation of electrostriction, by the same.—On some properties of bromide of ammonium, by Dr. Eder.—Observations on contact-electricity (sealed packet), by Herr Schulze-Berge.—Results of an investigation of the identity of the comets 1880 *e* and 1869 III., by Herr Zelber and Dr. Hepperger.—On graphic formulæ of hydrocarbons with condensed benzol-nuclei, by Herr Wegscheider.

CONTENTS