Expedition. Mr. Laufer gives a careful analysis of zoomorphic patterns, mainly of the Gold tribe; their decorative art shows distinct traces of Chinese influence, but the designs have been evolved in an original and interesting manner.

THE catalogue of bacteriological and pathological apparatus, just published by Messrs. J. J. Griffin and Sons, contains several new instruments and accessories, and will well repay inspection. Among the apparatus we notice several spirit Bunsen burners, which can be used instead of ordinary Bunsen burners where gas is not available. These are, of course, suitable for any laboratory, and not merely for bacteriological work. Of special interest are a number of new centrifuges for use in the examination of blood, sputum, milk. In water, urine and milk analysis a comparatively low rate of revolution is required, and a hand centrifuge giving up to 2000–3000 revolutions a minute is sufficient. When examining blood or sputum it may be necessary to make upwards of 10,000 revolutions a minute, which rate can be obtained by a water-power centrifuge manufactured by Messrs. Griffin. Another noteworthy addition is a special test-tube possessing characteristics always required for bacteriological work, but rarely found.

THE additions to the Zoological Society's Gardens during the past week include a Javan Mynah (*Gracula javanensis*) from Malacca, presented by Mr. George Smith; an Indian Crow (*Corvus splendens*) from India, presented by Mr. E. A. Williams; a Rose-coloured Pastor (*Pastor roseus*) from India, an Indigo Finch (*Cyanospiza cyanea*), a Nonpareil Finch (*Cyanospiza ciris*) from North America, presented by Mr. L. Ingram Baker; a Raven (*Corvus corax*), European, presented by Mr. G. St. Leger Hopkinson; three Blackish Sternotheres (*Sternothoerus nigricans*) from Madagascar, two Prasine Snakes (*Coluber prasina*) from Upper Burmah, eleven American Box Tortoises (*Cistudo carolina*) from North America, deposited; an Occipital Blue Pie (*Urocissa occipitalis*) from the Western Himalayas, ten Common Chameleons (*Chamaeleon vulgaris*) from North Africa, purchased; a Brush-tailed Kangaroo (*Petrogale penicillata*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN SEPTEMBER.

Sept. 1. 8h. Jupiter in conjunction with the moon. Jupiter, 0° 51′ North.
3. 7h. 16m. to 8h. 11m. Moon occults the planet Saturn.
4. 7h. 35m. to 8h. 50m. Moon occults the star ξ^1 Sagittari (mag. 5·0).
5. 7h. 24m. Transit (ingress) of Jupiter's Sat. III.
12. 12h. 35m. to 13h. 43m. Moon occults π Arietis (mag. 5·6).
12. 16h. 27m. to 17h. 40m. Moon occults ρ^3 Arietis (mag. 5·5).
13. 9h. 43m. to 10h. 34m. Moon occults 13 Tauri (mag. 5·4).
14. 8h. 39m. to 9h. 18m. Moon occults D.M. + 20°, 785 (mag. 5·8).
15. Venus. Illuminated portion of disc = 0·493.
15. Mars. ,, ,, ,, = 0·915.
16. 12h. 8m. Minimum of Algol (β Persei).
17. 6h. Venus at greatest elongation. 46° 1′ West.
18. 14h. 48m. to 15h. 40m. Moon occults 29 Cancri (mag. 5·9).
19. 8h. 57m. Minimum of Algol (β Persei).
23. 0h. Sun enters Libra, autumn commences.
27. Saturn. Outer minor axis of outer ring = 17″·25.
28. 21h. Jupiter in conjunction with the moon. Jupiter, 0° 13′ North.

RING NEBULA IN LYRA.—It is interesting to find in the *Bulletin* de la Société Astronomique de France, August 1900, an account of the first published work done with the great 50-inch refractor of the Paris Exposition while that exhibition is still in progress. M. Eugène Antoniadi, of the Juvisy Observatory, has been for some time making systematic observations of nebulæ with the instrument, and a drawing showing a considerable amount of detail accompanies his paper on the Ring Nebula, the first of the series he has undertaken to study. He mentions that the lens used is the photographic one, the other, specially corrected for the visual rays, not yet being in position. The focal length of this glass is about 186 feet (57 metres).

OCCULTATION OF SATURN.—On Monday evening next, September 3, there will be an occultation of Saturn by the moon, for which the following particulars for Greenwich may be useful:—

	Sidereal Time.	Mean Time.	Angle from North point.	Angle from Vertex.
	h. m.	h. m.	°	°
Disappearance ...	18 6 ...	7 16 ...	128 ...	126
Reappearance.....	19 1 ...	8 11 ...	217 ...	206

Providing the weather be favourable, this should be an excellent opportunity for observing the occultation of the planet, as the altitude will be almost at its maximum, meridian passage at Greenwich occurring at 7h. 7m. G.M.T. Moreover, from its being such a bright object, observations may be made with instruments of the lowest optical power.

In the *Bulletin* de la Société Astronomique de France for August 1900, M. M. Honorat gives an illustrated description of his observation of the last occultation of Saturn on June 13. He mentions the conspicuous contrast between the slightly yellowish colour of the moon and the greenish tint of the planet. During the occultation the planet appeared separated from the lunar limb by a narrow shadow about 5″ of arc in width, probably a contrast effect.

At the reappearance of Saturn at the terminator, he could not perceive any trace of penumbral shadow cast on the planet's disc.

OPPOSITION OF EROS.—Two additional circulars have been issued by the special committee appointed by the Astrographic Conference to direct the observations of Eros during the coming opposition. Special attention is drawn to the work which may be commenced at once, such as micrometric observations with all equatorials of large aperture, for furnishing definite positions for the theory of the planet's movement, and that these should be published as soon as possible, to perfect the ephemerides for the actual parallax work later. An ephemeris is included from the computations of M. Millosevich, and tables showing the limiting times between which the planet will have an altitude greater than 20° at various latitudes, and also a table indicating the proper regions to be included on the photographs on dates extending from September 19 to January 7.

In the *Astronomische Nachrichten* (Bd. 153, No. 3656), Prof. S. J. Brown, of the U.S. Observatory at Washington, calls attention to the many opportunities for simultaneous micrometer observations at widely separated stations, and as many observatories are not equipped with the photographic instruments necessary for the more general programme contemplated, gives data for assisting micrometer observers to co-operate for this type of work alone. The high declination of the planet makes it possible to secure simultaneous observations at all the Eastern stations west of Pulkowa, and at all the American observatories east of Denver. He also gives a table showing the Greenwich Mean Time at which the planet will be simultaneously visible at the observatories of Pulkowa, Königsberg, Vienna, Evanston, Madison, Yerkes and Denver for intervals of ten days from 1900 October 1–1901 January 19. Careful sketches of the comparison stars in the field should be made to facilitate subsequent identification. Owing to the rapid orbital motion of Eros rendering observations for position angle and distance very troublesome, measures should be made in rectangular co-ordinates referred to the true equatorial position of the fixed micrometer wire.

THE INTERNATIONAL PHYSICAL CONGRESS.

THE first International Congress of Physics, which has just finished its sittings, has been a brilliant success. The number of participators exceeded a thousand, and, in spite of the attractions which Paris always offers, in spite of the simultaneous rivalry of the Universal Exhibition itself, sectional and general meetings were closely followed up to the last day by a great number of visitors.

The cause of this unexpected success must no doubt be sought in the idea underlying the plan of the Congress, worked out as it was with the greatest care by a committee of the Société Française de Physique. That committee deliberately rejected the method of simply presenting personal memoirs, or notes on limited subjects, and concentrated all its efforts upon the preparation of a well-arranged summary of the actual state of physical science, in the branches in which, within the last few years, the greatest progress has been made, and the actual stage of progr ess of which at the end of the nineteenth century it was considered most important to investigate. Once the list of subjects was completed, the work was divided among the physicists who seemed best qualified to give a complete representation of their special subject. This plan gave rise to a series of reports,[1] many of which are works of a very high value, and which, in their entirety, constitute the most complete representation of any science at a given epoch yet made. These reports number about 80. To summarise these here would be, so to speak, repeating the work of the Congress on a small scale, and that could not be thought of. I shall, therefore, confine myself to referring to them by groups which are obviously related and mutually supplement each other.

For this considerable task, a preface was necessary. M. H. Poincaré provided such a preface, and brought it before the Congress amid great applause, showing how mathematical generalisation could render experimental work infinitely more fertile. Experimental physics is a library. Mathematical physics arranges it and prepares the catalogue. It does not enrich it, but if it is well prepared it enables one to draw a greater profit from the former. The celebrated mathematician then showed how hypotheses have succeeded each other, in the form of physical images or simply mathematical images, where the symbol often remains true even when the mechanism is no longer accepted. Mathematical analysis also alone gives the true sense of the simplicity hidden under complexity, as in the case of Newton's law—which is always rediscovered in the most complicated movements of the heavenly bodies—or the kinetic theory of gases, where the law of large numbers hides the isolated individuals, only permitting the appearance of an aggregate for which the laws of Mariotte-Boyle and Gay-Lussac, long considered simple, are only the destruction of the action of individual molecules. Starting from these now well-known facts, M. Poincaré showed how the same methods and ideas apply to theories now being evolved concerning the interaction of matter and ether. His speech will no doubt be read and studied for a long time to come, and will remain one of the most perfect expressions of the state of mind of the masters of modern science.

To the organisers of the Congress, Lord Kelvin's promise of a personal contribution of work had been a powerful and valued encouragement. But what they hardly dared hope for was to see him, after the fatigues of a voyage, take a very active part in the Congress, and to see him hold spell-bound by the charm of his discourse a respectfully attentive audience bent upon seizing every thought of the great physicist. M. Poincaré's speech gave him an occasion for a brilliant improvisation on the constitution of the ether; and he also dealt with the subject in a paper on the waves produced in an elastic solid by the motion of a body acting upon it by attraction and repulsion. But it was not only in that speech that the illustrious honorary president of the Congress showed the interest he felt in the assembly. Presiding every day at sectional meetings, he clothed both reports and debates with a very special authority.

To facilitate work, the Congress had been divided beforehand into seven sections, the work of which I propose briefly to review.

In the measurement section, presided over by M. Benoit, the chief work was that of determining the actual state of metrology properly so called. After a very complete recapitulation, by the president, of the history of standards and methods employed in the measurement of length and the progress so far made, detailed attention was devoted to the complete metrological definition of standards and their legal definition; the legal status of the electrical units; and some improvements which might conveniently be made in a number of insufficient definitions, or definitions referring to conceptions recently introduced into science, such as the different abscissæ of the spectrum, &c. Some resolutions were passed, such as that recommending the adoption of the mechanical C.G S. units (erg and joule) for the expression of calorimetric quantities, comprising, naturally, the solar constant, to be reduced by the meteorologists to the calorie per minute per sq. cm. Also that in the expression of elastic constants, the C.G.S. unit of pressure, the *barie*, be adopted, of which the multiple by 10^6, the *megabarie*, is sufficiently represented by the pressure exercised by a column of mercury 75 cm. long at 0° and under normal gravity. The Congress further supported the sectional resolution that national laboratories be created in countries which do not as yet possess any.

The interferential methods of measurement brought out an excellent paper by M. Macé de Lépinay; there were also four contributions relating to thermometry of precision (Chappuis), pyrometry (Barus), the mechanical equivalent of heat (Ames), and a special study of the variation of the specific heat of water (Griffiths). All these showed that great progress has been made in these various departments. Thus at present the divergencies among the various gas thermometers are known over a long interval, and it is also known that though the hydrogen and nitrogen thermometers, for instance, may still differ between 0° and 100°, their divergence at the higher temperatures is insignificant if care is taken to slightly correct the mean coefficient of expansion between 0° and 100°. The difficulty of employing hydrogen at high temperatures lends a great importance to this provision. Pyrometry also is rapidly advancing, and as regards the mechanical equivalent, the great divergences which existed a few years ago have disappeared owing to a more complete correction of thermometric values and a better knowledge of electric standards.

Some very fine work has also been done in connection with gravitation. The measurement of the Newtonian constant, admirably expounded by Mr. Boys, whose special work in this department is now classical, and the announcement of anomalies of gravitation by Messrs. Bourgeois and Eötvös, gave rise to very interesting discussions. A few years ago these anomalies were placed beyond a doubt, and it is already possible to study the details with the aid of apparatus which, like that of M. Eötvös or that of Messrs. Threlfall and Pollock, indicates the most minute details, whereas the pendulum formerly employed only gave the more considerable anomalies. The Congress expressed a hope that the study of these anomalies will be pursued by the new methods, not only for the sake of knowing the gravitational acceleration in every place, but also for the better knowledge of the constitution of the globe.

Finally, M. Leduc presented to the section a report on the electro-chemical equivalent of silver, and M. Gouy another on the standard of E.M.F. It appears from the latter that the cadmium standard is preferable to every other.

The measurement of the velocity of sound, dealt with by M. Violle, forms in a manner the transition between the section of measurement and that of mechanical and molecular physics. In the latter, presided over by M. Violle, after a very complete treatise by M. Amagat on the whole of his work, and an admirable paper by M. van der Waals on the statics of mixed fluids, M. Mathias showed, in a paper well provided with references, how the critical point may be determined by various methods. Specialising further, Prince Galitzine dealt with the refractive index, and, finally, M. Battelli exhibited the relations between the statics of fluids and their calorimetry. Except as regards mixtures, the ideas on these various subjects are well fixed nowadays, and new light can only come from the experimental side. Mixtures are less known, and the paper in which the celebrated Amsterdam physicist condensed our actual knowledge of this question will no doubt powerfully contribute to make them known. Having created the idea of continuity between the liquid and the gaseous states, he has had the satisfaction of seeing it become classical. But it is in another direction that this evolution advances nowadays. Does this continuity also exist between the liquid and the solid state? The diffusion of solids, their flow under pressure, the constitution of alloys, so well studied, notably by M. Spring and Sir W. Roberts-Austen, might lead to that belief, especially since M. Schwedoff has proved the rigidity of liquids. M. Tammann raises some doubts concerning this idea, and recommends a careful distinction between the amorphous and the crystalline states. In any case, the presence at the Congress of the eminent physicists mentioned, with the exception of M. Tammann, who was represented by M. Weinberg, contributed greatly to the interest of the subject and to its future progress.

The study of the permanent or temporary deformations of

[1] These reports presented to the Congress have been translated into French. They were printed for purposes of discussion, and will be shortly published in three volumes.

solids naturally furnishes interesting data. A work by M. Mesnager, and another by the author of the present article, were devoted to these two questions. It is interesting to note that the last experimental researches are all in favour of the chemical theory of temporary deformations.

M. Voigt has devoted a great amount of indefatigable activity to the study of the elasticity of crystals. His summary of this question was a great boon to the second section. It was a considerable piece of work, in which, naturally, the mathematical formula was predominant. This work will serve as a base for all those interested in the elasticity and the piezo-electricity of crystals, as well as in questions of symmetry.

M. van't Hoff was not present at the Congress, but he showed his interest by sending a work on the formation of crystals in a mother-liquor containing a mixture of salts. In this case questions of equilibrium play an important part, the form of the crystals depending, not only upon the solubility of each salt in the mixture, but also upon the quantity of each.

It was very interesting to learn the ideas arrived at by M. van der Mensbrugghe, after a long career devoted to the study of capillarity. The report presented by Joseph Plateau's son-in-law constitutes a precious document on capillarity, a subject which has been somewhat eclipsed by other subjects, but which has formed the object of investigation of the greatest spirits, and continues to do so.

We must be short, and can only mention the report by M. Brillouin on gaseous diffusion, by M. Perrin on osmosis, and by M. Bjerknes on hydrodynamical actions at a distance. The latter derives its interest more especially from the fact that a hydrodynamical model may be constructed which possesses all the characteristics of a world subjected to actions at a distance.

The third section, presided over by M. Lippmann, dealt with optics. The recent researches on the laws of radiation naturally formed part of its programme, opened by those inseparable reports, on the theoretical laws of radiation, by M. W. Wien; on the radiation of solids, by M. Lummer; and on gaseous radiation, by M. Pringsheim. The practical realisation of the black body, the verification of Stefan's law for a large range of temperature, and certain simple relations between the temperature and the position of the maximum in the spectrum, are the salient facts which the experimental work of recent years has brought out. For gases, a doubtful point is the validity of Kirchhoff's law, but according to M. Pringsheim that does no seem to be in any danger if only the purely thermal radiati is considered.

Recently, the spectrum has been greatly extended in the infra-red. M. Rubens, to whom the greatest progress in this direction is due, had undertaken to give a summary of this question, showing how the dispersion formulæ agreed with experiment, and demonstrating experimentally the connection between long light waves and electrical waves. This work again called forth a discussion on the formulæ and theories of dispersion opened by M. Carvallo.

The kinematics of the spectrum has also made great progress since Balmer showed for the first time that the hydrogen rays are represented by a very simple formula. The researches of Kayser and Runge and other physicists, Rydberg among them, have shown that the distribution of the spectrum lines is governed by laws, some of which are clearly established, while others are as yet unknown. Of all this work, M. Rydberg gave an excellent summary.

The velocity of light has, as we know, given rise to metrological work of the first rank, and of extreme difficulty. It fell to the distinguished president of the Congress, M. Cornu, to give a review of this subject, and during the remarkable speech which he delivered at the École Polytechnique, the physicists from all parts had the privilege of seeing the original apparatus of Fizeau and of Foucault, who were the first to give an approximate value of that velocity by measurements confined to the earth.

It is this characteristic velocity which for Maxwell was the touchstone of the theory involving the identity of luminous and electrical oscillations. As the instruments become more perfect, and the sources of error disappear, this identity is more and more emphasised. It was very interesting to co-ordinate the numbers furnished by light proper with those furnished by the comparison of units and the direct measurement of the velocity of electric waves. M. Abraham undertook the first part of this work, and MM. Blondlot and Gutton the second. This brings us to the electrical section, presided over by M. Potier, and in his absence by M. Bouty. The line of demarcation, however, is becoming more and more difficult to draw. The extremely interesting work of M. Lebedef on the pressure produced by radiations, has its origin in the great work of Maxwell; but it might also arise from pure thermodynamics, as shown by Bartoli and Boltzmann. As regards Hertzian waves, treated in a masterly manner by M. Righi, they approach so closely to the work of M. Rubens, that the small interval which still separates them is probably the only reason—and a very artificial one—for keeping them separate at all. In a supplementary note, M. Branly gave an account of some of his own researches on coherers. The reports just mentioned furnished the experimental side of an idea, the theoretical aspect of which was treated of in a paper by Prof. Poynting on the propagation of electrical energy.

We encounter another group of questions in the gaseous dielectrics, studied by M. Bouty, as well as electrolysis and ionisation, which have made such vast progress during the last decade, and which were dealt with by M. Arrhenius, one of the promoters of the new ideas, in a paper which will remain a model of clearness. Finally, we have M. Christiansen's theories of contact electricity, M. L. Poincaré's theories of the electric cell, and the exposition of Nernst's ideas, which had not been contemplated in the programme of the Congress, but which enabled their founder to give to the meeting a review admirably completing this group of questions.

The presentation of present ideas on magnetism had been excellently prepared by two fundamental reports, one, by M. du Bois, on the general magnetic properties of bodies, and another, by M. Warburg, on hysteresis, which he was the first to observe, and which, in the hands of Ewing, Hopkinson and others, attained such great importance. Two particular aspects of magnetism, viz. magneto-striction and the E.M.F. of magnetisation, which could not form part of the general reports, were treated separately by M. Nagaoka and M. Hurmuzescu.

Although the applications of electricity are almost entirely beyond the subject-matter of the Congress, there are some which are connected so closely with general physics that it seemed very desirable to have them dealt with. This was done by M. von Lang, whose work on the electric arc is well known, while M. Potier gave an exhaustive paper on the theory of polyphase currents, and M. Blondel the description of apparatus for tracing the curves of rapidly varying currents.

In a few years' time the work of the fifth section—ionisation and magneto-optics, presided over by M. Becquerel—will no doubt fall naturally into one of the preceding sections. But at the present moment they are still so undefined, they open up such new horizons, that it appeared well to collect them in a special section. The idea proved very fruitful, for the section was largely attended, and the discussions at it proved very fascinating.

M. Lorentz had prepared an admirable report on magneto-optics, with special reference to the Zeeman phenomenon. He expounded both his own ideas and those of M. Voigt. The presence of the latter gave the section the privilege of an exposition at first hand of his latest ideas.

The absence of Prof. J. J. Thomson could not but be severely felt. But the work which he had sent in, concerning the ratio of the electric charges to the masses carrying them, was read amid great interest after the general exposition made by M. Villard of the state of our knowledge of kathode rays.

The phenomena of actino-electricity, somewhat forgotten now, though much studied ten years ago, gave rise to a report by MM. Bichat and Swyngedauw. Perhaps increased attention will be devoted to them now that the researches of M. Becquerel and those of M. and Mme. Curie have proved so fertile in the examination of new bodies.

The speeches in which first M. Becquerel and then M. Curie expounded the disconcerting properties of uranium, polonium and radium rays, were for many a revelation. These extraordinary bodies, discovered by their radio-active properties, which were first announced by M. Becquerel, and then followed up with such startling success by M. and Mme. Curie, were known to the majority of those present, but only a few had seen those few decigrammes of material extracted from several tons of the mineral richest in it, pitchblende, and certainly the effects produced surprised by their intensity those who saw them for the first time.

Several hundred persons at a time could see this light, which appears everlasting, radiated perpetually by radium, the clear

patch which it produces even across a sheet of metal on a screen of barium platino-cyanide, the instantaneous discharge of an electrified body brought near to the substance, and the sparks passing when radium is brought within a few centimetres of the spark gap. The magnetic deflection of the rays could, of course, not be made evident to such a large audience. But the original negatives could be projected, and they showed the curvilinear propagation of the rays in a magnetic field.

The new bodies constantly project matter endowed with a great velocity. Neighbouring bodies are impregnated with it, and become radio-active in turn. These particles attach themselves, not only to objects, but to persons as well, so that M. Curie will be condemned for some time to abandon every kind of electrostatic research. No electrometer remains charged in his neighbourhood, and it is certain that if radium had only been as plentiful as gold, static electricity would never have been discovered.

In the same domain, important generalisations have been made, such as the theory of dispersion in metals, founded by M. Drude upon the electron theory, of which the author gave an account to the section.

The sixth section, under the presidency of M. Mascart, occupied itself with cosmical physics. Terrestrial magnetism should undoubtedly have formed part of the work of this section, but the Meteorological Congress which will shortly meet intends to make that the principal object of its studies, and it was evidently necessary to leave it aside.

Yet the work of this section was very fruitful. Here, naturally, observation still holds a predominant place, as in the work of the Swiss physicists, with M. Hagenbach at their head, on glaciers; and the detailed study of oscillations of lakes by MM. Sarasin and Forel, who brought their results before the Congress.

In the department of atmospheric electricity, a very good account was given by M. F. Exner, and Mr. Paulsen gave an account of the Danish expedition to Iceland for the study of the aurora. The evaluation of the solar constant by M. Crova, according to recent researches, and a very ingenious theory of suns-pots established by M. Birkeland after troublesome calculations, were heard with much interest. Finally, M. C. Dufour showed how, without the help of any laboratory apparatus, the approximate brightness of the stars could be determined.

It had seemed useful to collect in a seventh section some works relating to biology. In the absence of M. d'Arsonval, this section, presided over by M. Charpentier, did a great deal of good work, and justified the idea of the organisers of the Congress. The application of physical and mathematical methods to the transmission of energy in organisms, to which M. Broca has devoted attention for a considerable time, and the curious retina phenomena studied by M. Charpentier, gave this section a vast field of discussion. Finally, the new theory of accommodation established by M. Tscherning received the sanction of a very largely attended meeting, while M. Hénocque spoke of the spectroscopic methods used in biology.

The proceedings of the Congress were not confined to sectional work and general meetings. A visit to the laboratories of the Sorbonne and the Ecole Polytechnique showed many experiments in progress, installed by the professors of these establishments or their provincial and foreign colleagues. These could only be properly appreciated by observing them closely and in small groups.

Shall I speak of the reception in the Jardin de l'Elysée, whither the President of the Republic invited several Congresses to witness a theatrical performance? Or of the charming *soirée* for which Prince Roland Bonaparte had placed at the disposal of the organisers his vast and magnificent library for a number of interesting experiments? This *soirée*, which will leave in the minds of all who were present the most agreeable memories, would itself deserve a lengthy description. But I cannot conclude this already lengthy article without saying how much the French physicists have been touched by the sympathetic action of the foreign secretaries of the Congress, who deposited a magnificent crown on the modest tomb of the great Fresnel, of which the Société Francaise de Physique has constituted itself the guardian. A moving speech by M. Warburg, and a warm expression of thanks by M. Cornu, president both of the Congress and of the Society, referring in a few words to the life of that great physicist, ended this first Congress, where so many new thoughts have been born, and so many friendships made or consolidated.

CH. ED. GUILLAUME.

ORIENTATION OF THE FIELD OF VIEW OF THE SIDEROSTAT AND COELOSTAT.

OBSERVERS who have practical acquaintance with the siderostat and heliostat are familiar with the fact that while the reflected image of a star may be kept stationary, the images of surrounding stars have a rotation around it; while if the sun is the object viewed in the mirror, the image will rotate about the axial ray. It is on account of this rotation of the field that neither the siderostat nor the heliostat can be used with a fixed telescope for celestial photography, except for objects which can be photographed with short exposures.

Certain unexpected peculiarities of this motion have recently led Prof. Cornu to investigate the general laws governing the rotation of the field in both instruments (*Comptes rendus*, vol. cxxx. No. 9, 1900; *Bulletin Astronomique*, February 1900). Some of the results at which he has arrived are of great interest, and we believe attention has not been previously drawn to them, although they could have doubtless been derived from Orbinsky's formula for the orientation of the field ("Die totale Sonnenfinsternisse am 9 Aug. 1896"), or from other formulæ which have been employed by observers as occasion required.

Prof. Cornu first discusses the general question of the orientation of the field, irrespective of the mechanical means of retaining the reflected image in a fixed position. In Fig. 1, NESW represents the horizon, Z the zenith, P the pole, PD the hour circle of the star D, and D′ the point of the horizon towards which the rays are reflected. PN is equal to the latitude of the

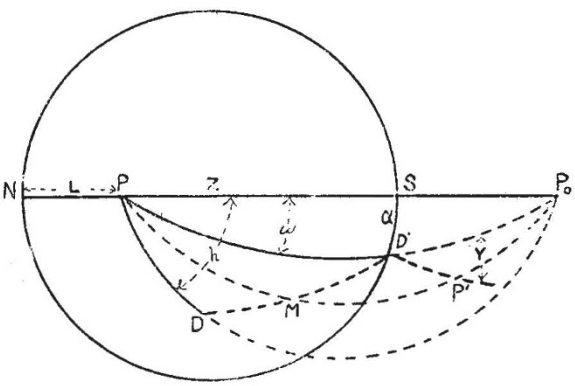

FIG. 1.—Orientation of field of siderostat.

place, = L; PD is the polar distance of the star, = δ; SPD is the hour angle of the star, = *h*. For the purposes of calculation the point D′ is defined by its polar distance PD′ = ρ, and by the angle SPD′ = ω which the plane PD′ makes with the meridian; ρ and ω can be determined in terms of the azimuth of D′ (= SD′ = α, reckoned positive towards the west) and the latitude, by solving the right-angled triangle PSD′, in which PS = 180° − L; thus

$$\cos\rho = \cos\alpha\cos L;\ \tan\omega = \frac{\tan\alpha}{\sin L}.$$

The normal to the mirror must always bisect the arc DD′ of a great circle, at M, so that the position of the reflected ray from any part of the sphere can be easily determined. Thus the image of P is at P′ in the continuation of the hour circle PM, MP′ being equal to PM. To determine the orientation of the field, it is most convenient to ascertain the direction, after reflection, of the point P, since it is a fixed point on the sphere. Taking the plane of PD′P₀ as the reference plane, and its trace on the sphere as a fixed direction, the orientation of the reflected pole is conveniently defined by the angle P₀D′P′ = Y, which can be readily calculated, as also D′P′, the distance of the reflected pole from the centre of the field.

Applying this in the first place to the siderostat, where the reflected rays are south or nearly so, and the angle α consequently small, Prof. Cornu obtains the following results:—

(1) The reflected image of the pole describes a circle round the centre of the field, with a radius equal to the polar distance of the star observed.