intendent. The total number of species included in the Catalogue amounts to 590, of which 276 are found within the Indian Empire, and 314 are exotic.

THE Smithsonian Institution has issued a set of useful directions, by Leonhard Stejneger, for the use of collectors, who, without being herpetological experts, desire to procure for the U.S. National Museum specimens of the reptiles and batrachians which they may be able to gather in the neighbourhood of their residence or while travelling. The same Institution publishes directions for collecting recent and fossil plants, by F. H. Knowlton; and notes on the preparation ot rough skeletons, by F. A. Lucas.

STUDENTS will be glad to welcome the fourth edition of Prof. Milnes Marshall's well-known work on "The Frog: an Introduction to Anatomy, Histology, and Embryology." The author explains that the chapter on embryology has been in great part rewritten, and that some new figures have been added. The entire book has been carefully revised.

THE additions to the Zoological Society's Gardens during the past week include a Dorsal Hyrax (*Hyrax dorsalis*) from Sierra Leone, presented by Mr. Reginald Brett; a Common Polecat (*Mustela putorius*), British, presented by Mr. F. D. Lea Smith; a Ring-necked Parrakeet (*Palæornis torquatus*) from India, presented by Mrs. Bowen; an Australian Thicknee (*Œdicnemus grallarius*) from Australia, presented by Sir Ferdinand von Mueller, C.M.Z.S.; a Manx Shearwater (*Puffinus anglorum*), British, presented by Master Riviere.

OUR ASTRONOMICAL COLUMN.

SOLAR OBSERVATIONS.—In *Comptes rendus* for August 24. Prof. Tacchini gives a *résumé* of the solar observations made at the Observatory of the Roman College during the second quarter of this year. Spots and faculæ have been observed on 73 days, viz. 25 in April, 23 in May, and 25 in June, The following are the results obtained:—

1891.	Relative frequency: of spots.	Relative frequency: of days without spots.	Relative magnitude: of spots.	Relative magnitude: of faculæ.	Number of groups per day.
April	9·24	0·00	24·56	55·60	2·36
May	14·35	0·00	48·14	51·82	4·09
June	16·88	0·00	47·00	89·38	3·80

The distribution and magnitude of the prominences observed are as follow:—

1891.	Number of days of observation.	Mean number.	Mean height. ″	Mean extension. °
April	18	7·50	42·3	1·5
May	21	4·62	37·3	1·4
June	19	5·53	39·4	1·8

It is worthy of remark that there was a secondary maximum in May in the case of spots, whilst a secondary minimum is indicated by the observations of prominences.

CONNECTION BETWEEN TERRESTRIAL MAGNETISM AND RADIANT SUNLIGHT.—Prof. Frank H. Bigelow contributes a note to the *American Journal of Science* for September, on the causes of the variations of the magnetic needle. He finds, from a discussion of magnetic observations made at thirteen stations during the month of June 1883, that "the permanent magnetic condition of the earth may be principally due to the orbital motion of the earth through the radiant field of sunlight. The rotation of the earth on its axis causes a modification of the direction of the axis of polarization, by diminishing the angle between the two axes, and as the result of the annual motion may cause it to rotate in a secular period about the axis of figure, or if the magnetization has already become set in the body of the earth, may cause a succession of secular waves to sweep over it from east to west, as is shown to be the case in the history of the isogonic lines and the long-period deflections of the needle." This interesting identification of the magnetic and light action of solar radiations is in harmony with the results of the investigations of Maxwell and Hertz. And Prof. Bigelow believes that, by the application of similar considerations to Mercury, he will be able to satisfactorily account for the outstanding motion of this planet's perihelion.

TWO NEW ASTEROIDS.—On August 28, Charlois discovered the 313th minor planet; and Palisa found the 314th two days later.

PHYSICS AT THE BRITISH ASSOCIATION.

THIS Section, as is unfortunately the custom, was housed in an ecclesiastical edifice in which no provision had been made for the exhibition of apparatus or lantern slides by the readers of papers. No doubt, it is impossible always to provide accommodation equal to that furnished two years ago at Newcastle, when the Physical Lecture Theatre of the Durham College of Science, with its appliances, was placed at the disposal of the Section. Still, it should be possible to provide lantern and screen, and provision should be made, when necessary, for partially darkening the room. If there were a guarantee that lantern slides could always be exhibited, many readers of papers would avail themselves of the opportunity to illustrate their communications much more adequately than is possible at present, when the only appliances are a piece of chalk and a diminutive blackboard; *e.g.* on Monday morning the beautiful photographs of Mr. Clayden and Dr. Copeland had to be passed round from hand to hand instead of being exhibited in a manner which would have done justice to their merits. The contents of many of the papers, too, would be much more easily and pleasantly grasped if such a course were adopted.

Unfortunately, some of the leading physicists, notably Sir William Thomson, Lord Rayleigh, and Prof. Fitzgerald, were unable to be present. Prof. Lodge, however, admirably filled the chair, and spared no exertion in the endeavour to clear up points of obscurity or difficulty that arose during the discussion.

In all, some fifty papers and reports were read. In the limited space at our disposal, we regret that it is only possible to refer to communications of general rather than of special scientific interest.

After the President's address on Thursday morning, Prof. Newton communicated a most interesting account of the action of Jupiter on small bodies passing near the planet, in which he showed that if a comet pass in front of Jupiter, owing to the gravitational attraction between the two bodies the kinetic energy of Jupiter will be increased, while that of the comet will be diminished, and may be diminished to such an extent as to cause it to form (though possibly only temporarily) a member of the solar system. On the other hand, if a comet, already a member of the solar system, pass behind Jupiter, the kinetic energy of the planet will be diminished and that of the comet will be increased, and may conceivably be increased under favourable circumstances to such an extent that the comet may no longer remain as a member of the system. Prof. Newton had calculated that of 1,000,000,000 comets from space crossing, in all directions, a sphere equal in diameter to that of Jupiter's orbit, about 1,200 would come near enough to Jupiter to have their period so much diminished as to be less than that of the planet.

Mr. W. E. Wilson read a paper on the absorption of heat in the solar atmosphere, and exhibited some of the apparatus he had used in the investigation. The method of observation employed consisted in allowing the sun's image to transit across the thermo-electric junction of a Boys radio-micrometer. He finds that the solar radiation from the extreme peripheral portion of the disk is distinctly less than that from the central portions. In this respect the sun's radiation differs entirely from that of the moon, in which there is little or no such difference in the illumination of different parts of the surface. This difference is attributable to the absorption of heat in the solar atmosphere, which will necessarily be much more marked for the peripheral than for the central portions of the disk.

Mr. G. H. Bryan presented an elaborate report on researches relative to the second law of thermodynamics, in which is described an exceedingly simple mechanical representation of Carnot's reversible cycle.

Friday was devoted to papers on electrical subjects. Prof. Andrew Gray read a paper on the electro-magnetic theory of the rotation of the plane of polarized light. Sir William Thomson's explanation of the phenomenon rests on the supposition that the ether has embedded in it a large number of small gyrostats. Prof. Gray showed that the ordinary Maxwellian equations for the phenomenon were obtainable on the supposition of the existence of a closed chain of small magnets embedded in the undisturbed medium, which set themselves with their axes in the direction of propagation of the ray as soon as the medium was magnetized in that direction.

This paper was followed by a most interesting communication from the President, in which he gave an account of preliminary experiments to ascertain if the ether is disturbed in the neighbourhood of a rapidly moving body—in other words, to ascertain whether the ether behaves as a viscous fluid. Allusion was first of all made to the experiments of Arago, in which he endeavoured to determine whether or not the ether was stagnant with respect to the earth by measuring the refractive index of a glass prism at different times of the day, when the ether stream (if it exist) will flow in one direction or the opposite through the prism. Arago found no such shift, indicating that the ether was stagnant with reference to the earth. Fresnel, Fizeau, and Michelson had also studied theoretically or experimentally the ratio of so-called "bound" ether to "free" ether. The problem which Prof. Lodge set himself to determine was whether a disk moving with great rapidity would or would not drag after it the ether in its immediate neighbourhood. Two parallel co-axial disks of steel were arranged to spin at an enormous rate. Rays of light from a single source were allowed to fall on a glass plate feebly silvered so that about half the light was transmitted and half reflected. By means of additional reflectors the two beams passed in opposite directions several times round in the space between the two disks, and were then observed in a common telescope and made to give interference bands. In this way, assuming viscosity of the ether, the one beam would have its velocity increased, the other would have its velocity retarded, with the result that a shift of the interference bands would be produced. So far, however, no such shift has been observed.

Prof. D. E. Jones gave an account of some experiments made by him at Bonn on electric waves in wires. Measurements of the electrical disturbance at different points of a wire, in which stationary waves are set up, were made quantitatively by putting a thermo-electric junction in the circuit at different points, and noting the deflection of the galvanometer in its circuit. Several curious results were recorded for which no explanations were forthcoming.

A communication was read from Lord Rayleigh, relating to the reflection of polarized light from liquid surfaces. He finds that the light reflected at the polarizing angle, from clean liquid surfaces, is only very slightly elliptically polarized; if, however, the surface be ever so slightly contaminated, the amount of elliptically polarized light in the reflected beam is enormously increased.

Saturday was devoted principally to the consideration of papers on electrolysis. Mr. Shaw's report on the present state of our knowledge in electrolysis and electro-chemistry included a tabular compilation by Mr. Fitzpatrick of the electrical properties of soluble salts at different temperatures, and for different concentrations.

Mr. J. Brown read a paper on Clausius's theory of electrolytic conduction, and on some recent evidence for the dissociation theory of electrolysis, in which he gave an account of experiments with so-called semi-permeable membranes. The explanation of their filtering qualities simply depends on the membrane acting as a conductor.

Mr. Chattock gave an account of some important quantitative experiments which he had made on the discharge of electricity from points from which he finds that it is the air round the point rather than the metal surface itself which offers resistance to the discharge.

On Monday the meteorological and allied subjects were taken. The Reports of various Committees appointed to deal with meteorological subjects were read.

Dr. Johnstone Stoney read an interesting paper on the cause of double lines in the spectra of gases. He assumes that the molecules are vibrating in more or less complex harmonic curves, and he illustrated the simple case of sodium vapour by means of a pendulum oscillating to and fro, but with an apsidal motion. He stated that the application of astronomical methods of calculation to molecular motions of sodium vapour gives rise to a double D line instead of to a broadening of the line as might at first sight be imagined. In the discussion which followed, Mr. Webster stated that Prof. Michelson, who was endeavouring to determine the metre in terms of the wave-length of light emitted by a vibrating atom, had found by the interference method that all the mercury lines are double.

Dr. Copeland exhibited a model to explain the probable nature of the bright streaks on the moon. He attributes the appearance of the streaks to the existence of transparent spheres on the moon's surface, which reflect the light from the posterior surface so as to be only visible in the line of light.

During the morning the President interpolated some observations dealing with the effect of light in modifying the effect of the gravitational attraction of the sun on small particles. When sunlight falls upon a body, a very small repulsive effect is produced, amounting to about 67 dynes per square metre. Thus, for example, during an eclipse of the moon about 1000 tons are suddenly applied, but this small force is incapable of producing any observable effect on the motion of our satellite. The smaller the body, the larger, of course, the surface exposed relatively to the mass, and therefore the greater should be the effect produced. For a certain size of particle (about that of a grain of dust) the gravitational attraction and light repulsion should balance one another. The effect is clearly independent of distance.

On Tuesday, after the Report of the Committee on Electrical Standards, read by Prof. Carey-Foster, and an account of an elaborate research by Mr. Swinburne on the causes of variation of Clark cells, there was arranged a joint discussion with Section G, on "Units and their Nomenclature," which was opened by the President, who suggested that the discussion should, as far as possible, be confined to electrical units, and that the mechanical units should be left to a later period. He discussed at some length the relative advantages and disadvantages of the various names for the unit of self-induction, secohm, quadrant, henry, &c., and expressed himself as of opinion that the quadrant, which was really an angular measure, but which was frequently used as a linear measure, was very objectionable in that it indicated that the unit of self-induction was a length, when it was perfectly well known not to be a length. He was, therefore, of opinion that some name with a less obvious meaning, such as that of a person, was very desirable. He thought also that the secohm was too large for practical purposes, and that some sub-multiple such as $\frac{1}{1000}$ would be preferable.

The President was followed by Mr. Preece, who referred to the work of the British Association Committee on Electrical Standards, which had lasted now for thirty years, and expressed the opinion that it would be undesirable to interfere in any way with the old standards now about to be legalized by the Board of Trade.

Prof. Stroud read a paper on some revolutionary suggestions on the nomenclature of electrical and mechanical units, in which he advocated selecting 10^9 cm. as the unit of length, 10^{-9} gm. as the unit of mass, and 1 sec. as the unit of time to form the basis of a new practical system of units. He also explained the details of a system of automatic nomenclature for C.G.S. and other units, which he thought should be taken into consideration before any fresh names were authorized. The special feature of the system is that every label is self-explanatory.

Dr. Johnstone Stoney thought the old system should remain intact, and that the proper way to deal with the subject of nomenclature was to indicate sub-multiples by numerical prefixes; *e.g.* he would call a microfarad a sixth farad, and the capacity of a Leyden jar would be about a tenth farad. He suggested that the name for the unit of magnetism should be a Gilbert, and that of the unit magnetic field a Gauss.

Prof. Carey Foster thought that if the volt and ampere were made ten times as great, fresh names, such *e.g.* as "gal," from Galvani, should be introduced.

Prof. Rücker laid stress on the importance of recognizing the fact that we possessed at present no definite knowledge as to the absolute dimensions of any electrical or magnetic unit, and therefore it was undesirable to introduce names (such *e.g.* as quadrant) implying the possession of such knowledge.

Prof. S. P. Thompson drew attention to the desirability of distinguishing between scalar and vector quantities in our dimensions.

Prof. Gray disapproved of the term electromotive force, but thought it was a term which could scarcely be eradicated now.

Each speaker, in fact, discussed the subject from his own point of view, with the result, as the President remarked, that the time allotted had only served to open the discussion, but he hoped that it would be continued in the technical journals during the year, so that some definite conclusions might be arrived at in 1892.

Wednesday morning was devoted to clearing off arrears.

Prof. S. P. Thompson read two optical papers, one on the measurement of lenses, and a second on a new polarizer. In this instrument the polarization is effected by reflection from black glass, but to avoid the angling of the beam a reflecting prism is used in addition. This arrangement has the disadvantage that the axis of the beam undergoes a translational shift, so that rotation of the polarizer is out of the question. To get over this difficulty two more reflectors are introduced, or two quarter-wave plates may be used, one of which converts the plane polarized light into circularly polarized light, while the other reconverts it into light plane polarized in any azimuth.

Dr. Webster then gave an account of some experiments on a new method for determining *v*. The method is similar in some respects to Ayrton and Perry's, and gave as a result in the preliminary experiments $2{\cdot}987 \times 10^{10}$.

Prof. Rücker then gave an account of some experiments made by Prof. Ayrton and himself, on the magnetic field near the South London Electrical Railway. The experiments were made in a house in Kennington Park Road with ordinary galvanometers, and showed conclusively that the magnetic disturbances on delicately suspended needles would be perceptible at considerable distances.

Prof. J. V. Jones, in describing some experiments on the periodic time of tuning-forks, maintained in vibration electrically, stated that dry platinum-platinum contacts do not work satisfactorily, whereas the results obtained with mercury contacts are much better, at all events when changes of temperature are carefully guarded against.

Mr. F. T. Trouton described some interesting experiments to determine the rate of propagation of magnetization in iron. A large coil of iron wire, from 8 to 12 feet in diameter, was supplied with one fixed coil wound on it, and through which the alternating current passed. A second exploring coil was connected up with a telephone, and one experiment consisted in endeavouring to find out the positions of nodes and internodes in the magnetized material from which it might have been possible to have determined the length of the wave of magnetization for a definite period of alternation. Nodes were observed in the half of the ring remote from the magnetizing coil, but these were easily ascertained not to be the ones sought for, because their position was not found to depend on the period of alternation.

The President attributed the effects to mechanical vibrations excited by magnetization.

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE proceedings of Section B at Cardiff were not felt to be as interesting as on some previous occasions. Several well-known chemists were not present, and no set discussions on subjects of general chemical interest, which have been special features at other times, took place. Still, in the course of the meeting several papers of very considerable importance were read, and provoked valuable comments. The President's Address was listened to by an enthusiastic audience, and his remarks, together with several of the papers contributed during the meeting, should give a fresh impetus to the study of the metals.

Prof. Dunstan read the Report of the Committee on the Formation of Haloid Salts. It has been found by Mr. Shenstone that chlorine, prepared by the action of hydrogen chloride on manganese dioxide, attacks mercury readily, even when both substances are pure and dry, while that obtained by heating platinous chloride only attacks mercury extremely slowly. Incidentally it has been discovered that pure platinous chloride is a very difficult substance to prepare, an oxychloride being formed at the same time. The results so far obtained are to be regarded as preliminary.

Prof. Vivian B. Lewes read a paper on the spontaneous ignition of coal. His experiments lead him to reject the explanation of Berzelius, which attributes spontaneous ignition to the oxidation of pyrites contained in the coal. The heat given off by the combustion of the pyrites present in the most dangerous kind of coal, even if localized, would not be sufficient to raise the temperature of the adjacent coal to the ignition point. The cause of spontaneous ignition of coal is to be found, rather, in its power, especially when finely divided, of absorbing oxygen, which causes the slow combustion of some of the hydrocarbon constituents even at the ordinary temperature. The action may increase under favourable conditions until ignition of the coal results. The risk is greatest with large masses of coal, and with the ordinary air supply on board ships. The oxidation increases rapidly with the initial temperature of the coal, so that coal fires are found to occur most often on ships frequenting tropical climates. It may be roughly estimated that the absorbing power of a coal for oxygen is proportional to its power of taking up moisture.

In the discussion which followed, Prof. Bedson mentioned his experiments on the heating of coal-dust at various temperatures up to 140° C. He had noticed that in some cases combustible gases were given off by the coal.

A feature of special interest was the exhibition by Ludwig Mond of specimens of nickel-carbon-oxide and metallic nickel obtained therefrom. In the paper read in conjunction with this exhibit an account was given of the discovery and properties of the above compound. The physical properties have been described in the *Journal für physikalische Chemie*. Chemically, nickel carbonyl is most inactive, numerous experiments made to introduce the carbonyl group into organic substances by its means having been uniformly unsuccessful. Experiments were described having for their object the direct extraction of nickel from its ores by means of carbon monoxide. It was found that, as long as the nickel is combined with arsenic or sulphur, the process is entirely successful on a laboratory scale. Such ore, or matte, or speiss, is calcined, reduced by water gas at 450°, cooled down to a suitable temperature, and treated with carbon monoxide in a suitable apparatus. On exposing a heated surface to the gas containing nickel-carbon-oxide, it is possible to produce, direct from such gas, articles of solid nickel, or goods plated with nickel, resembling in every way those obtained by galvanic deposition of metals, and reproducing with the same exactitude and fineness any design upon such articles. This result can also be obtained by immersing heated articles in a solution of nickel-carbon-oxide in such solvents as benzole, petroleum, tar oils, &c., or by applying such solution to the heated articles with a brush or otherwise.

A specimen of iron-carbon-oxide was exhibited, which Messrs. Mond and Langer have obtained as an amber-coloured liquid, which, on standing, deposits tabular crystals of a darker colour, and solidifies entirely below − 21° C. to a mass of needle-shaped crystals. It boils at 102° C., but leaves a small quantity of green-coloured oil behind. Several analyses and vapour-density determinations have been made, but it is not yet certain whether a pure substance has been obtained or a mixture of several iron carbonyls. The authors hope shortly to publish a full account of this interesting substance, which differs considerably in its chemical behaviour from nickel-carbon-oxide.

Mr. Crookes described his experiments on the electrical evaporation of metals and alloys. If a brush of gold is placed in a vacuum tube and connected with the negative pole of an induction coil at ordinary temperature, and if a piece of glass be placed underneath the gold in the tube, on passing the current a metallic mirror appears on the glass, increasing in thickness to a leaf, which can be peeled off, and which is perfectly homogeneous. Films of silver and platinum can also be obtained. It is found that different metals thus treated evaporate at different rates, one or two, such as aluminium and magnesium, being apparently non-volatile. It is thus possible, in the case of the aluminium-gold alloy discovered by Prof. Roberts-Austen, to separate a large portion of the gold from the aluminium by electrical evaporation.

T. Turner gave an account of experiments which he had made to discover the cause of the red blotches which often appear on the surface of brass sheets on rolling, and which are a great source of annoyance to Birmingham manufacturers. They are