phenomena of recent years. The current issue contains many illustrations, among which are some good reproductions of photographs and drawings of sun-spots, comets, and planetary features observed during 1903. The charts of the sky and the particulars of interesting phenomena, which are given for each month, will be found very useful by all who are engaged in practical astronomy. The "Annuaire" is published by M. Ernest Flammarion, 26 Rue Racine, Paris, at 1.50 francs (about 1*s.* 3*d.*).

The card calendar issued by Mr. Arthur Mee, of Llanishen, under the title "The Heavens at a Glance" contains a very complete set of the tables and a great deal of the information required by an amateur practical astronomer. Being printed on a single stiff card, suitable for hanging on the observatory wall, it is exceedingly handy to use as a source of reference for current astronomical occurrences. Amongst other information the card contains a list of the principal meteor showers, with concise instructions to observers, ephemerides of the planets and lists of double stars, variables and nebulæ. It may be obtained from Mr. Mee, at the above address, for 7*d.* post free.

THE VARIABLE STAR 1921, W AURIGÆ.—In No. 5, vol. xviii., of the *Astrophysical Journal*, Mr. J. A. Parkhurst, of the Yerkes Observatory, gives the details and results of a series of observations of the variable star W Aurigæ, made by him during the period December, 1898–March, 1903. He determined the position of the variable (for 1900) as R.A. = 5h. 20m. 8·6s., $\delta = +36^\circ\ 48'\ 53''$, and found that the magnitude varied from 9·3 at maximum to 13·8 at minimum. The strong colour of this variable is indicated by the fact that when the visual magnitude was 9·5 the photographic magnitude was only 10·9.

The variations are best represented, according to the curves which Mr. Parkhurst has plotted from his observations, by the following elements :—

Max. = J.D. 2414648 + 276 E.
or December 24, 1898 + 276 E.,

the interval, M–m, being 113 days.

LIGHT ECONOMY IN SPECTRUM PHOTOGRAPHY.—In a paper communicated to the current number of the *Astrophysical Journal*, Mr. J. A. Humphreys describes a number of arrangements used by him in photographing spectra for utilising to the full the light obtained from the light source under examination. He has found that the most generally convenient and effective arrangement, when terrestrial light sources are being used, is to place a spherical reflector behind the source so that the focus of the reflected light coincides with the origin. In this way both the reflected and direct light are utilised, and are together focused on the slit by an ordinary condenser. Comparison photographs, which are reproduced in the article, show that the light reflected through the source suffers but little from absorption, and that the net result of using this arrangement is to obtain lines which would otherwise be too weak to photograph, and to strengthen the weaker lines.

Another method, which may be used with any source when a grating is used as analyser, is to place a pair of inclined plane reflectors between the slit and the grating so that the rays from the top and bottom of the slit are reflected on to the centre of the grating, thereby condensing the light from the whole length of the slit into a narrower plane, and so obtaining a stronger spectrum. In another, but somewhat similar, form, the two plane reflectors are placed near to the photographic plate, so that the parallel rays from the top and bottom of the grating are superimposed upon the rays from the centre. It is found that when long-focus gratings are used the slight lengthening of the path of the rays by reflection does not interfere, practically, with the definition. Many other arrangements, including the use of ellipsoidal and paraboloidal reflectors and cylindrical lenses, are explained and illustrated in Mr. Humphreys's article.

INTENSITY OF THE SUN'S LIGHT.—M. Ch. Fabry has communicated to the Paris Academy of Sciences an interesting paper on the candle-power of the sun's light at sea-level. By an ingenious arrangement, wherein the total solar light is diminished in a known ratio by passage through a slit and then through an ammoniacal solution of copper sulphate, he compared the light with a constant standard light of known candle-power, and, after various corrections, found that at sea-level, with the sun at the zenith, the solar light would be 100,000 times more intense than that produced by a decimal candle at a distance of 1 metre. Supposing that the intensity of the light emitted by different parts of the apparent solar surface is the same, this result shows that the intensity of the light received—after atmospheric absorption—from 1 square mm. of the solar disc is equivalent to 1800 candle-power, as compared with 150–200 candle-power per square mm. emitted by the positive pole of the electric arc.

Taking the amount of heat received per minute from 1 square cm. of the solar surface as 1·5 calories, M. Fabry calculates that the energy consumed per candle-power is about 0·12 watt, but, as the invisible heat rays suffer more by atmospheric absorption, the actual amount of energy used up is probably between 0·15 and 0·2 watt per candle (*Comptes rendus*, No. 23, vol. cxxxvii.).

PRIZES PROPOSED BY THE PARIS ACADEMY OF SCIENCES FOR 1904.

THE following subjects for prizes are proposed for the year 1904 by the Paris Academy of Sciences :—

In geometry, the grand prize for mathematical science (3000 francs), the subject proposed being to perfect, in some important point, the study of the convergence of continued algebraical fractions; the Bordin prize (3000 francs), to develop and perfect the theory of surfaces applicable to the paraboloid of revolution; the Vaillant prize (4000 francs), to develop and study all displacements of an invariable figure in which different points of the figure describe spherical curves; the Francœur prize (1000 francs) and the Poncelet prize (2000 francs), for discoveries useful to the progress of pure and applied mathematics.

In mechanics, the extraordinary prize of 6000 francs, to recompense progress in the direction of increasing the efficiency of the French naval forces; a Montyon prize (700 francs), for the improvement or invention of instruments useful to the progress of agriculture, or the mechanical arts or sciences; and the Plumey prize (2500 francs), for an improvement or invention relating to steam navigation

In astronomy, the Lalande prize (540 francs), for the most interesting observation or memoir dealing with astronomy; the Valz prize (460 francs), for the most interesting observation made during the current year; and the Janssen prize, a gold medal, for an important work on physical astronomy.

In geography and navigation, the Binoux prize (2000 francs), for a work dealing with either of these subjects.

In physics, the Hébert prize (1000 francs), for the best treatise or discovery useful in the practical application of electricity; the Hughes prize (2500 francs), for work contributing to the progress of physics; and the Kastner-Boursault prize (2000 francs), for the application of electricity to the arts, industry, or commerce.

In statistics, a Montyon prize (500 francs), for the best study in French statistics.

In chemistry, the Jecker prize (10,000 francs), for work in organic chemistry.

In physical geography, the Gay prize (1500 francs), for a study of the existing variations in the relative levels of land and sea, by means of precise observations, pursued over a fixed portion of the coasts of Europe or North America.

In botany, the Desmazières prize (1600 francs), for a work on the cryptogams; the Montagne prize (1500 francs), for work on the anatomy, physiology, development or description of the lower cryptogams; the de la Fons-Mélicocq prize (900 francs), for the best botanical work dealing with the north of France; and the Thore prize (200 francs), for the best work on the cellular cryptogams of Europe.

In anatomy and zoology, the Savigny prize (1300 francs), for the assistance of young zoologists making a special study of the invertebrates of Egypt and Syria; and the Thore prize (200 francs), for a work on the anatomy of a European species of insect.

In medicine and surgery, a Montyon prize (three prizes of 2500 francs, three mentions of 1500 francs), for discoveries useful in the art of healing; the Barbier prize (2000 francs), for a valuable discovery in the surgical, medical or pharma-

ceutical sciences, or in botany in relation to medicine; the Bréant prize (100,000 francs), for the discovery of a specific cure for Asiatic cholera, or for the discovery of its cause, such that the epidemic can be suppressed. If neither of these be forthcoming, the interest on the capital sum will be given for a rigorous demonstration of the presence in the air of substances playing a part in the propagation of epidemic diseases. The Godard prize (1000 francs), for a memoir on the anatomy, physiology, or pathology of the genito-urinary organs; the Lallemand prize (1800 francs), for the encouragement of work relating to the nervous system; the Baron Larrey prize (750 francs), for a work on military medicine, surgery or hygiene; the Bellion prize (1400 francs) and the Mège prize (10,000 francs), for an essay on the causes which have retarded or favoured the progress of medicine from antiquity to the present day.

In physiology, a Montyon prize (750 francs), for a work in experimental physiology; the Philipeaux prize (900 francs); the Pourat prize (1000 francs), for a study of the physical and chemical changes in respiration induced by high altitudes; and the Martin-Damourette prize (1400 francs), for a work on therapeutical physiology.

Among the general prizes are the Arago medal; the Lavoisier medal and the Berthelot medal; the Montyon prizes (unhealthy trades, 2500 francs and 1500 francs), for a discovery ameliorating the condition of an unhealthy trade; the Wilde prizes (4000 francs, or two of 2000 francs), for a discovery in astronomy, physics, mineralogy, geology or experimental mechanics; the Tchihatchef prize (3000 francs), for exploration in Asia; the Leconte prize (50,000 francs), for a capital discovery in mathematics, physics, chemistry, natural history or medicine; the Jean-Jacques Berger prize (15,000 francs), for a work on Paris; the Delalande-Guérineau prize (1000 francs); the Jerome Ponti prize (3500 francs); the Houllevique prize (5000 francs); the Cahours prize (3000 francs), for researches in chemistry; the Saintour prize (3000 francs); the Trémont prize (3000 francs); the Gegner prize (3800 francs); and the Lannelongue prize (1200 francs).

Among these, the prizes bearing the names of Lalande, Desmazières, Lavoisier, Wilde, Tchihatchef, and Leconte will be awarded without distinction of nationality.

RESEARCH GRANTS OF THE CARNEGIE INSTITUTION.

A LIST of the grants in aid of scientific investigations made by the Carnegie Institution during the fiscal year 1903 is given below. The amount set apart as grants for research during that period was 40,000*l.* From the beginning of the Institution to the end of October, 1903, the number of applications for grants was 1042, and the total sum asked for by the 406 applicants who stated the amount desired was more than 440,000*l.* In addition, the advisory committees recommended grants amounting to 182,300*l.*, so that the total sum asked for was about 622,300*l.* It will be evident from this that the present income of the Carnegie Institution can only provide for a small part of the grants requested. The grants made are as follows:—

Anthropology.—For ethnological investigation among the Pawnees, Dr. G. A. Dorsey, Field Columbian Museum, Chicago, Ill., 500*l.*; for obtaining evidence relative to the early history of man in America, Dr. Wm. H. Holmes, director Bureau of American Ethnology, Washington, D.C., 400*l.*; to investigate the precious stones and minerals used in ancient Babylonia in connection with the investigation of Mr. William Hayes Ward, Mr. George F. Kunz, New York City, 100*l.*; for study of oriental art recorded on seals, &c., from western Asia, Dr. William Hayes Ward, New York City, 300*l.*

Astronomy.—For astronomical observations and computations, Prof. Lewis Boss, Dudley Observatory, Albany, N.Y., 1000*l.*; for investigating proposal for a southern and a solar observatory, Profs. Boss, Hale and Campbell, 1000*l.*; for pay of assistants to take part in researches at the Lick Observatory, Prof. W. W. Campbell, Lick Observatory, Mt. Hamilton, Cal., 800*l.*; for a new reduction of Piazzi's star observations, Prof. Herman S. Davis, Gaithersburg, Md., 100*l.*; for measurements of stellar parallaxes, solar photographs, &c., Prof. George E. Hale, Yerkes Observatory, Williams Bay, Wis., 800*l.*; for determining the elements of the moon's motion and testing the law of gravity, Prof. Simon Newcomb, Washington, D.C., 600*l.*; for study of the astronomical photographs in the collection of Harvard University, Prof. E. C. Pickering, Harvard University, Cambridge, Mass., 500*l.*; for pay of two assistants to observe variable stars, Prof. Wm. M. Reed, Princeton Observatory, Princeton, N.J., 200*l.*; for measurement of astronomical photographs, &c., Miss Mary W. Whitney, Vassar College, Poughkeepsie, N.Y., 200*l.*

Bibliography.—For preparing and publishing the "Index Medicus," Dr. Robert Fletcher, Army Medical Museum, Washington, D.C., 2000*l.*; for preparing and publishing a "Handbook of Learned Societies," Mr. Herbert Putnam, Librarian of Congress, Washington, D.C., 1000*l.*

Botany.—For investigation of plant hybrids, Mr. W. A. Cannon, New York Botanical Garden, N.Y., 100*l.*; for study of types of water-lilies in European herbaria, Mr. H. S. Conard, University of Pennsylvania, Philadelphia, 60*l.*; Desert Botanical Laboratory (Mr. F. V. Coville and Mr. D. T. MacDougal, Washington, D.C.), 1600*l.*; researches on the cytological relations of the Amœbæ, Acrasieæ and Myxomycetes, Mr. E. W. Olive, Crawfordsville, Ind., 200*l.*; for preliminary studies on the Philippine flora, Dr. Janet Perkins, working at the Royal Botanical Gardens, Berlin, Germany, 380*l.*

Chemistry.—For a systematic chemical study of alloys, beginning with the bronzes and brasses, Prof. W. D. Bancroft, Cornell University, Ithaca, N.Y., 100*l.*; for investigation of the rare earths, Prof. L. M. Dennis, Cornell University, Ithaca, N.Y., 200*l.*; for investigations in physical chemistry, Prof. H. C. Jones, Johns Hopkins University, Baltimore, Md., 200*l.*; for researches on osmotic pressure, Prof. H. N. Morse, Johns Hopkins University, Baltimore, Md., 300*l.*; for certain chemical investigations, Prof. A. A. Noyes, Massachusetts Institute of Technology, Boston, Mass., 400*l.*; for investigation of values of atomic weights, &c., Prof. Theo. W. Richards, Harvard University, 500*l.*; for continuing investigations on the derivatives of camphor and allied bodies, Mr. J. Bishop Tingle, Illinois College, Jacksonville, Ill., 100*l.*

Engineering.—For experiments on ship resistance and propulsion, Prof. W. F. Durand, Cornell University, Ithaca, N.Y., 824*l.*; for study of aluminium bronzes, Mr. Leonard Waldo, New York City, 900*l.*

Exploration.—For preliminary examination of the trans-Caspian region, Mr. Raphael Pumpelly, Newport, R.I., 1300*l.*

Geophysics.—For investigating the flow of rocks, Prof. Frank D. Adams, McGill University, Montreal, 500*l.*; for investigating the subject of geophysical research, &c., Prof. C. R. Van Hise, University of Wisconsin, Madison, Wis., 500*l.*

Geology.—For study of the fundamental principles of geology, Prof. T. C. Chamberlin, University of Chicago Chicago, Ill., 1200*l.*; for geological exploration in eastern China, Mr. Bailey Willis, U.S. Geological Survey, Washington, D.C., 2400*l.*

History.—For an examination of the historical archives of Washington, Mr. Worthington C. Ford, Library of Congress, Washington, D.C., 400*l.*

Palaeontology.—For continuation of work on the morphology of Permian reptiles, Prof. E. C. Case, State Normal School, Milwaukee, Wis., 100*l.*; for monographing the fossil Chelonia of North America, Dr. O. P. Hay, American Museum of Natural History, 440*l.*; for continuation of his researches on living and fossil cycads, Dr. G. R. Wieland, Yale University, New Haven, Conn., 300*l.*; for preparing a monograph on the Plesiosaurian group, Prof. S. W. Williston, University of Chicago, Chicago, Ill., 160*l.*

Physics.—For study of certain arc spectra, Prof. Henry Crew, Evanston, Ill., 200*l.*; for aid in ruling diffraction gratings, Prof. A. A. Michelson, University of Chicago, Ill., 300*l.*; for experiments on the magnetic effect of electrical convection, Dr. Harold Pender, Johns Hopkins University, Baltimore, Md., 150*l.*; for research, chiefly on the theory of light, Prof. R. W. Wood, Johns Hopkins University, Baltimore, Md., 200*l.*