

cylinder petrol engine, the mileage per gallon of petrol being seven to eight. The average daily run for each car is about seventy miles. The total cost of car is from 98*5*l. to 1150*l*. The Leyland Motor Company, which built the cars, gave a five years' guarantee that the costs of working, exclusive of wages, upkeep of car body, and administration expenses, should not exceed 3*4*d. per car-mile so long as the price of petrol did not exceed 9d. per gallon. Birmingham, Coventry, and London were also visited, and as the result of the inquiries, the deputation recommends the introduction experimentally of petrol-driven cars in Edinburgh.

AMONG the latest additions to the "Cambridge Manuals of Science and Literature" are five volumes dealing with scientific subjects. Prof. John Cox, under the title "Beyond the Atom," tells the story of discoveries in radio-activity, and his brief summary of the work of Rutherford, Curie, and many others will prove of interest to students and general readers alike. Dr. Gadow's book on "The Wanderings of Animals" gives the main facts of geographical distribution in a readable form. Prof. Fortescue writes on wireless telegraphy for readers with a general scientific knowledge who desire to know something, not only of the accomplishments of wireless, but also of the means by which they are attained. Mr. O. H. Latter's book on "Bees and Wasps" deals with British species of Hymenoptera in a thoroughly practical manner, and Mr. Clement Reid's "Submerged Forests" gives a simply worded account of a very interesting series of geological researches. The "manuals" are one shilling net each, and at the rate the library grows the student will be able soon to secure at this small cost an authoritative account of every branch of modern scientific research.

OWING to the development of their optical business, Messrs. Newton and Co., 72 Wigmore Street, London, W., are unable to find space for their philosophical and physical apparatus department, and are consequently disposing of their stock at low prices. The catalogue of apparatus for sale is comprehensive, and includes particulars of shop-soiled and second-hand instruments used in the study of physics and chemistry, lanterns and lantern apparatus, and microscopes and accessories.

OUR ASTRONOMICAL COLUMN.

THE VARIATION OF SOLAR RADIATION.—With the permission of the secretary of the Smithsonian Institution, a definite and important statement under the names of Messrs. C. G. Abbot, F. E. Fowle, and L. B. Aldrich is published in the *Astronomische Nachrichten*, No. 4656, with the title "The Variation of the Sun." The observations from which the conclusions are drawn were begun in the year 1902, when preliminary experiments were made at Washington to determine the solar constant of radiation. About 700 determinations of it have now been secured, and they depend on observations made at altitudes ranging from sea-level to 4420 metres. The results, some of which are mentioned in this communication, will be published in detail in the *Annals of the Astro-*

physical Observatory of the Smithsonian Institution (vol. iii.) now in the press, and will probably appear next month. The authors nevertheless publish in this statement some of the more important conclusions, which are as follows:—

(1) The mean value of the solar constant of radiation for the epoch 1905–12 is 1.929 cal. per sq. cm. per min. (2) An increase of 0.07 cal. per sq. cm. per min. in the "solar-constant" accompanies an increase of 100 sun-spot numbers (Wolfner). (3) An irregular variation frequently ranging from more than 0.07 cal. per sq. cm. per min. within an interval of ten days is established by numerous nearly simultaneous measurements at Mount Wilson, California, and Bassour, Algeria. (4) Indications of two wholly independent kinds incline the authors to think that these variations of solar radiation are caused within the sun, and not by interposing meteoric or other matter.

The extreme importance of the conclusions here stated cannot be overrated, and students of solar physics in its broadest sense will await with eagerness the publication of the detailed investigation.

PROMINENCES ASSOCIATED WITH SUN-SPOTS.—The discovery of radial motion in sun-spots by Mr. Evershed revealed the fact that there are two opposite movements in the penumbra of every spot, the gases at the level of the reversing layer flowing outwards away from the umbra, while those at the higher levels of hydrogen and calcium flow inwards. It was thought that a study of the higher solar region, namely that of the prominences, might shed some light on these remarkable motions, and with this object Mrs. Evershed undertook a study of the fine prominence photographs taken at the Kodaikanal Observatory. The results of this investigation are described in the current number of the *Monthly Notices of the R.A.S.* (vol. lxxiii., No. 6), and they are accompanied by a series of fine reproductions of numerous types of prominences explained in the paper.

Mrs. Evershed states that the investigation suggests more problems than it solves, yet some preliminary conclusions are nevertheless drawn. The most general result seems to indicate that the movements observed in the prominences situated directly above sun-spot groups are of quite a different kind from those in the penumbrae of spots, being intermittent and variable in direction and amount instead of uniform and constant. Reference is also made to the presence of forces other than those of an eruptive and gravitational nature, which is responsible for such a peculiarity as was observed in some rising prominences which moved with an accelerating velocity into space by a force opposed to gravity.

STUDIES IN STELLAR STATISTICS.—The general question of the distribution and motion of stars in space is perhaps the most important problem of the day, and the attention of astronomers has been turned more and more towards it since the initial investigation of Kapteyn in 1904, who determined for the first time the elements of the two star-streams. Space will only allow here of a list of a few of the more recent papers connected with this subject. Mr. F. W. Dyson has contributed to the two last numbers of the *Monthly Notices of the R.A.S.* (vol. lxxiii., Nos. 5 and 6) two important researches on the distribution in space of the stars in Carrington's circumpolar catalogue, discussing in the first the proper motions in a direction perpendicular to the solar motion, and in the second the proper motions in the direction of the solar motion. In the same publication (No. 6) Mr. H. C. Plummer continues his series of papers on

stellar motions, the title of this contribution being "A Preliminary Discussion of the Galactic Motions of the Bright Stars of Type I., with Some Additional Material." Mr. C. V. L. Charlier, in the *Meddelanden från Lunds Astronomiska Observatorium*, series ii., No. 9, publishes the second of his studies in stellar statistics, entitled "The Motion of the Stars," giving an account of an extensive research into the proper motions of Boss's catalogue based on correlation methods.

RECENT OBSERVATIONS OF NOVÆ.—The results of a valuable piece of work are recorded by Prof. E. E. Barnard in *Astronomische Nachrichten*, No. 4655. They relate to the present appearance of many of the novæ which have been discovered from time to time. The following is a very brief digest of some of the notes he gives, but reference should be made to the original paper for further details of each star:—

Nova	Discovered	Max. recorded mag.	Present mag.	Remarks
T Coronæ ...	1866 ...	2 ...	9 ...	Colourless
Cygni ...	1876 ...	3-4 ...	15'0 ...	Hazy
Andromedæ ...	1885 ...	6 ...	Invisible...	—
Aurigæ ...	1891 ...	4'5 ...	14 ...	Ill-defined
Sagittarii ...	1898 ...	4'7 ...	15 ...	Hazy and ill-defined
Persei ...	1901 ...	<1'0 ...	12'05 ...	Colourless
Geminorum (1) ...	1903 ...	8'16 ...	16'3 ...	—
Aquilæ ...	1905 ...	5 ...	<17 ...	—
Lacertæ ...	1910 ...	5'0 ...	12'5 ...	Nebula bluish-white
Geminorum (2) ...	1912 ...	4 ...	8± ...	—

(fluctuating)

With regard to the last nova, Prof. Barnard writes: "On February 8, 1913, with good seeing and at the proper focus the H α image of Nova Geminorum No. 2 was clearly seen. It was small and sharp and intensely crimson, and was surrounded by a greenish-blue halo some 3"-4" in diameter. The normal focus, however, was not different from that of an ordinary star."

THE NATIONAL PHYSICAL LABORATORY DURING 1912.

THE annual report of the National Physical Laboratory, Teddington, was presented to the meeting of the general board on April 25, and marks another milestone of steady progress. The birth of the laboratory but some ten years ago is fresh in the minds of most of us, but many may not realise the extent of its development; few institutions can indeed parallel it in rapidity of growth.

As a nation we were late in starting a national laboratory, but we have been unusually quick in making use of the facilities and advantages which it affords. To it from all parts of the Empire come requests for advice and assistance—requests increasingly exacting and ever-widening in scope; the National Physical Laboratory is fast taking its place as the Imperial laboratory. Its staff, formerly fewer than half a dozen, now numbers 150 of all grades; its history recounts an uninterrupted succession of new buildings. Progress such as this bears witness to the labour and devotion which the director, Dr. Glazebrook, has showered on the laboratory, to the loyal cooperation of his staff, and to the wise administration of the Royal Society.

The National Physical Laboratory is steadily gaining in the nation's appreciation; in common fairness the nation should put itself in the position of being able to say that it has provided for the laboratory in such fashion that financial cares need not distract its administrators from their proper sphere. The

laboratory should be able to attract and keep on its staff brilliant young men who are keen to work at research for the profit of the nation and the advancement of learning. The men are not wanting; it is for the country to see that their remuneration is commensurate, and that they are adequately housed and equipped for their work.

The laboratory is being increasingly consulted by the different Government Departments. During the year various matters have been carried out for the Admiralty, the War Office, the Foreign Office, the Home Office, the Board of Trade, the Local Government Board, the India Office, &c. Last year the expenditure amounted to more than 32,000*l.*; the Treasury grant was only 7000*l.* The remaining 25,000*l.* had to be raised by payments for work done and by donations.

A new building designed to accommodate the administration offices and the optics division is approaching completion; this will satisfy a most imperative need. Generous donors have supplemented the special Treasury grant of 15,000*l.* for the purpose; these include the 1851 Commissioners (5000*l.*) and a number of the City Companies. But further funds for equipping these and other departments are urgently needed. The new buildings are to be opened by the Right Hon. A. J. Balfour on the day of the annual visitation, Thursday, June 26.

Turning now to the work of the year, its comprehensive nature is at once evident. The National Physical Laboratory is a physical laboratory in the widest sense, and accordingly we find in its yearly record papers on almost every branch of physics and technology. Some forty original communications were published during the year; it is possible now to touch on only a few of these.

Taking first the work on the fundamental electric units, the Lorenz apparatus for the determination of the ohm in absolute measure was completed during the early part of the year, and a large number of experiments have already been carried out by Mr. F. E. Smith. Some idea of the precision attained may be gathered from the fact that the estimated probable error of any single measurement is of the order of two parts in 100,000. The final result of the measurements is not yet available, but it may perhaps be said that the value will probably be somewhat less than has been generally supposed. Comparisons with the resistance-standards of the Bureau of Standards, the Reichsansalt, and the Laboratoire Central d'Electricité have been made during the year, with the result that the English and German values were found to agree within one part in a million; the American value was ten parts in a million greater.

Mr. Campbell has evaluated the ohm in absolute units by two alternating-current methods, remarkable for their ingenuity. The testing of wavemeters is becoming an important feature of the work in the electrical department.

The British Radium Standard, consisting of 21 milligrammes of extremely pure radium-chloride, is now deposited at the laboratory. Dr. G. T. Beilby provided the funds for the purchase of the standard, which has been compared with the international standard at Sèvres, and will shortly be available for standardising radium preparations.

An important paper dealing with the discharge of electricity from carbon at high temperatures was presented to the Royal Society by Dr. Harker and Dr. Kaye. By reason of the conditions and magnitude of the experiments, ionisation currents amounting to several amperes were obtained.

The thermometry division is investigating the thermal conductivities of the various heat insulators used