magnetic work has an importance attached to it in the United States to which there is hardly a parallel elsewhere.

A PAPER on the construction and wear of roads, by Mr. H. A. R. Mallock, F.R.S., was read before the Institution of Civil Engineers on March 23. The subject was considered from a theoretical point of view with regard to the foundation of the road, its surface, and the character of the traffic. It was suggested that roads with a hollow cross-section, drained by a central gutter covered by a continuous grating, would be worthy of trial, as tending to prevent the accumulation of mud and water close to the footways, and as giving the greatest facilities for keeping the whole of the roadway clean. The origin of dust and mud on roads is imputed almost entirely to the grinding and crushing action of iron tyres and iron horseshoes. The conclusion drawn from the whole of the evidence is that the chief enemies of good roads are iron tyres and iron-shod horses, or, indeed, any forms of traction which cause very intense local pressure on the road surface. The view was expressed that with soft tyres the wear on any good road is extremely small, and with pneumatic tyres still less, but that so long as iron tyres and iron-shod horses are used for traction, the best means of preserving a clean and unbroken road surface is to be found either in the applications of tar (many of which have already been made with considerable success), or in some other method which will give the same large limits of elasticity and rupture to the upper layer of road material. For roads used exclusively by soft tyres there is a far wider choice of suitable road material than where the surface is exposed to very intense pressure.

A SECOND edition of Dr. M. Abraham's "Elektromagnetische Theorie der Strahlung" has been published by the firm of B. G. Teubner, of Leipzig and Berlin. This work is the second volume of the "Theorie der Elektrizität," reviewed in our issue for August 15, 1907 (vol. lxxvi., p. 377). The price of the present part is 10 marks.

WE note with interest and satisfaction the publication of German editions of two well-known works of science originally published in English. The first is "Habit and Instinct," by Prof. Lloyd Morgan, F.R.S., which has been translated by Maria Semon, and issued by the firm of B. G. Teubner, of Leipzig and Berlin, at the price of 5 marks. The second is Prof. Alexander Smith's "Introduction to General Inorganic Chemistry," translated by Dr. Ernst Stern, and published by the firm of G. Braun, of Karlsruhe.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 1. 22h. Jupiter in conjunction with the Moon (Jupiter 3° 45′ S.).
2. 22h. Saturn in conjunction with the Sun.
3. 9h. 55m. to 11h. 5m. Moon occults ν Virginis (mag. 4·2).
10. 9h. 8m. to 12h. 34m. Transit of Jupiter's Satellite III. (Ganymede).
,, 15h. 52m. to 16h. 32m. Moon occults b Ophiuchi (mag. 4·3).
13. 19h. Mars in conjunction with the Moon (Mars 2° 29′ N.).
15. 10h. 30m. to 14h. 46m. Transit of Jupiter's Satellite IV. (Callisto).
19. 9h. 43m. Minimum of Algol (β Persei).
19–22. Epoch of Lyrid meteors. (Radiant 271°+33°.)
21. Venus. Apparent diameter 9″·8.

THE ROTATION OF THE SUN.—In a paper appearing in the March number of the *Astrophysical Journal* (vol. xxix., No. 2, p. 110) Prof. W. S. Adams gives and discusses the results obtained during 1908 in the spectroscopical investigation of the sun's rotational velocities. In general, these results agree closely with those obtained during the 1906–7 investigation, although for latitudes greater than 50° larger values are now obtained for the velocity; there is no evidence, however, of the existence of a variation of the rate of rotation. Lines of lanthanum and of cyanogen are again found to give low values, as are also two "enhanced" lines investigated. On the other hand, certain lines of manganese and iron indicate high velocities. In general, such abnormal behaviour becomes more marked in the higher latitudes.

The present results were derived from spectrograms taken with the tower telescope and the 30-feet spectroscope, and show a marked increase of probable accuracy over those obtained with the smaller equipment in 1906–7. They also show that Faye's equation for the rotation holds quite good up to within 10° of the poles. Special plates taken with solar vortices in the field show that the vortices may introduce variations of such magnitude as to invalidate any conclusion normally derived from the measures.

Special studies were also made of the behaviour of the calcium line at λ 4227 and of the Hα line, and it was found that both give high rotational velocities; such abnormalities are explained by the greater height reached by the matter producing these lines. The former line was found to be indubitably double, although the separation of the components is extremely small. The study of Hα gave some very interesting results, among which we may mention that at different distances from the limb this line indicates very different velocities; it also shows only a slight equatorial acceleration.

COMMON MOTIONS OF THE PRINCIPAL URSÆ MAJORIS STARS.—A number of investigators have discovered evidence of a probable physical connection between the seven principal stars of the constellation Ursa Major, and in Nos. 4313–4 of the *Astronomische Nachrichten* Dr. Ludendorff again discusses the question on the basis of radial velocities determined at Potsdam.

The radial velocities of β, ϵ, and ζ Ursæ Majoris were investigated. In the case of β, the measures indicate a variable velocity with a period of about 27·16 days. The absolute values found for ϵ can only be looked upon as approximate, but they indicate a variability of restricted range and long period, the variation being between −8 km. and −18 km., with a period of about 2·1 years. The centre of gravity of the system of ζ Ursæ Majoris is shown to have a large range (269 km.) of velocity, with a period of 20·536 days.

Considering together the proper motions and parallaxes of the seven stars, it is found that there are probably two connected systems, system i. including β, γ δ, ϵ, and ζ, and system ii. including α and η, both of which have approximately the same parallax and the same velocity relative to the sun, but the angle between the directions of the two systems is about 101°.

THE SURFACE OF ROTATING MERCURY AS A REFLECTING TELESCOPE.—Having made a striking series of experiments on the possibilities of the paraboloidal surface of rotating mercury as a reflecting telescope, Prof. R. W. Wood describes and illustrates his results in No. 2, vol. xxix., of the *Astrophysical Journal* (p. 164, March).

Prof. Wood succeeded, by very finely adjusting the motion of his rotating tank, in producing mercury surfaces on which the disturbances were negligible, and for which a constancy of focus could be maintained for some time. Although the experiments appear, at first glance, to be merely of theoretical interest, Prof. Wood is so gratified with the results that he suggests methods whereby results of practical interest might be obtained. One of these is the possibility of taking casts, in some easily fusible material, of sufficient rigidity when solidified to bear electrotypes being made from it. These electrotypes, suitably mounted and silvered, might then be used in reflecting telescopes.

PHOTOGRAPHS OF THE EARTHSHINE ON THE MOON.—Two excellent photographs, showing the greater part of the

lunar surface illuminated by the light reflected from the earth, are reproduced in the March number of the *Bulletin de la Société astronomique de France*.

Whilst most people are familiar with the appearance of the moon thus partially illuminated, it is not an easy matter to photograph the phenomenon successfully, but on these photographs many lunar details are shown quite well, except in the sunlit crescent, which is, of course, much over-exposed.

The photographs were taken by M. Quénisset at the Juvisy Observatory, using the Viennet objective of 16 cm. aperture and 2·90 m. focal length, with ten minutes' exposure on a fast plate at the focus.

COSMICAL MATTER IN SPACE.—In his address as retiring president of the Royal Astronomical Society, Prof. Newall directed attention to, and briefly discussed, the possibility that the chief characteristic spectroscopic phenomena of the sun and the stars are mainly produced by matter streaming into these bodies from without rather than by matter brought from their interior layers to their radiating surfaces.

Appealing to various solar, cometary, and physical phenomena, Mr. Newall educed evidence that this view of astrophysics is not an obviously impossible one, and would, if found acceptable, account for several outstanding anomalies (Monthly Notices, R.A.S., vol. lxix., No. 4, February).

OBSERVATIONS OF VARIABLE STARS.—During 1908 Prof. Nijland observed, at the Utrecht Observatory, twenty-one Algol variables, six short-period variables, three variables of the U Geminorum type, SS Cygni, and forty-five long-period variable stars. The results of these observations now appear in No. 4309 of the *Astronomische Nachrichten*, together with a series of notes dealing with any special features observed.

THE CARNEGIE INSTITUTION OF WASHINGTON.

THE seventh year-book of the Carnegie Institution of Washington, for 1908, has just been received, and consists of reports of the president and the executive committee, and of directors of departments and other grantees who, with the assistance of the institution, have been carrying on investigations during the year.

The president's report gives the following facts and figures indicating the growth and extent of the work so far undertaken and accomplished by the institution. Since its organisation, in 1902, about 1000 individuals have been engaged in investigations under the auspices of the institution, and there are at present nearly 500 so engaged. Ten independent departments, each with its staff of investigators and assistants, have been established. In addition to these larger departments of work, organised by the institution itself, numerous special researches carried on by individuals have been subsidised. Six laboratories, for as many different fields of investigation and in widely separated localities, have been constructed and equipped. Work in almost every field of research, from archæology and astronomy to thermodynamics and zoology, has been undertaken, and the geographical range of this work has extended to more than thirty different countries.

At the end of the fiscal year, October 31, 1908, 120 volumes of researches in nineteen different fields of research, with a total of more than 30,000 pages, had been published, and twenty-seven volumes of researches were in the press. In addition to these publications issued by the institution, about 1000 shorter papers have been published in the current journals of the world by departmental investigators, by associates, and by assistants. The total amount of funds allocated for expenditure to November 1, 1908, was 737,000*l*., which included 59,000*l*. reverted and afterwards re-appropriated. The total amount expended was 672,000*l*.

During the past year the Nutrition Laboratory in Boston has been equipped, and systematic investigations are already in progress.

The construction of a building in Washington, D.C., at the south-east corner of Sixteenth and P Streets, N.W., was begun a year ago. This building is for administrative offices and the storage of records and publications, and when completed will cost about 44,000*l*.

The plans and specifications for the construction of a specially designed ship for ocean magnetic work have recently been completed. These plans require a non-magnetic sailing vessel with auxiliary propulsion. She will be classified as a yacht, will be called the *Carnegie*, and will, upon completion, proceed upon a magnetic survey of the Atlantic Ocean under the direction of the department of terrestrial magnetism of the institution. The grant for the construction of this vessel is 8000*l*.

A temporary observatory for supplementary measures of the positions of the fixed stars of the southern hemisphere is now being built at San Luis, Argentina, under the direction of Prof. Lewis Boss, head of the department of meridian astronomy of the institution. Prof. R. H. Tucker will be resident astronomer in charge of the work of observing and computing in South America, which will require three to five years for completion. The meridian instrument of the Dudley Observatory, the constants of which have been thoroughly investigated, will be transferred to San Luis and used in securing the desired measurements of the positions of stars in both hemispheres.

Work in the other departments of the institution has progressed rapidly and successfully. The investigations of Dr. G. E. Hale, director of the Solar Observatory on Mount Wilson, California, are of great interest. During the year, with the aid of his exceptional equipment, the discoveries which have been made with regard to sun-spots will probably prove of as great importance to terrestrial and molecular physics as to solar physics. The progress inaugurated may be confidently expected to lead rapidly to definite and important results. The expenditure on account of the site, buildings, instruments, and other appliances of the observatory was, up to September 30, 1908, 71,631*l*.

Under the direction of the department of historical research, work upon manuscript materials for American history has been pursued in France, Italy, and England, and next year will be extended to Germany. Many remarkable experiments and investigations are in progress under the department of botanical research at the Desert Laboratory at Tucson, Arizona.

In addition to the work carried on in the departments of the institution during the year, thirty-one grants were made to individuals and organisations in aid of researches conducted by them, and many other researches begun in former years have been carried forward. The publication of twenty volumes was authorised, and twenty-seven volumes and an atlas have been published. The latter include the report upon the California earthquake of April 18, 1906, a handbook of learned societies and institutions of North and South America, and a reproduction of the "Old Yellow Book," the source of Browning's "The Ring and the Book." These volumes and others issued by the institution are offered for sale at the cost of printing and transportation to purchasers.

At the annual meeting of the board of trustees on December 8, 1908, the sum of 127,260*l*. was allocated to carry on work of investigation, publication, and administration during the year 1909.

RECENT PAPERS ON DARWINISM.

THE *Fortnightly Review* for March contains an admirable article, by Dr. A. Russel Wallace, on "The World of Life, as Visualised and Interpreted by Darwinism." The veteran author argues with all his old vigour and eloquence in favour of the theory of the origin of species by natural selection, bringing out the facts of extensive and independent variation under natural conditions, emphasising the reality of the struggle for life, and insisting on the facts of adaptation as inexplicable under any other hypothesis than that of Darwin. He