written as that in the present number, they should prove of considerable value to those who need an introduction to the subject.

FROM the reports of the behaviour of the recording instruments at a number of magnetic observatories in different parts of the world during the solar eclipse of August 21, 1914, Dr. Bauer and Mr. Fisk, of the Department of Terrestrial Magnetism, Washington, have drawn some preliminary conclusions as to the effects of eclipses on solar terrestrial magnetism, which will be found in the June number of *Terrestrial Magnetism and Atmospheric Electricity*. At stations from which the eclipse was visible it appears to have changed slightly the daily march of the declination needle. At four British and Danish stations for which curves of the daily change of declination are given the normal motion of the needle to the west was arrested, and in some cases reversed, a short time before totality of the eclipse. Outside the region of visibility of the eclipse no magnetic effects were observed. These results appear to justify more extensive preparations for observing the effects of the solar eclipse due June 8, 1918.

MESSRS. KODAK, LIMITED, have issued a new and much improved edition of their "Wratten Light Filters" (1s.), in which they describe some ninety colour screens. Of those previously catalogued eleven are omitted and twenty-nine new filters are introduced, the latter including a series of nine made to equalise the tints of various artificial lights for facilitating photometric work. The transmissions of nearly all the filters are given in very clearly expressed curves, a vast improvement on the reproductions of spectrographs taken with a graduating wedge in front of the slit, as given in the previous editions. For those who need more exact data the actual readings obtained by the use of the spectrophotometer are given in copious tables, and will prove of great value. "The Photography of Coloured Objects," another of Messrs. Kodak's publications, has been revised, and now includes "Orthochromatic Filters," which was until now published separately. For the benefit of any who do not know this volume, we may say that it gives a clear and accurate account of the principles involved, and points out objects of many kinds that are really "coloured," though they do not appear to be.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—Prof. Strömberg reports that Encke's comet was observed by Dr. Max Wolf on September 22. At 9h. 41.5m., Königstuhl mean time, its position was R.A. 22h. 28m. 39s., declination $7^{\circ} 8' 5''$ S. The magnitude of the comet was 16.5.

THE NEBULA H II. 78 LEONIS.—It is interesting to note that Mrs. Isaac Roberts is continuing her detailed studies of nebulae photographed at Crowborough by the late Dr. Isaac Roberts. The subject of a recent paper (Monthly Notices R.A.S., vol. lxxvi., p. 647) is the nebula H II. 78 Leonis (N.G.C. 3367), photographed in 1902. The nebula extends for about $2'$ from north to south, and $2.5'$ in the direction at right angles, and is described as a left-hand spiral with a bright stellar nucleus. The nucleus is encircled twice by the spiral arm, which shows numerous condensations. With the aid of the Roberts "pantograph," measures were made of many of the bright nebulous knots, and of nineteen stars which appear in the neighbourhood of the nebula. All the measured objects are clearly indicated in a key chart, and the tabulated data will doubtless be of considerable value in subsequent investigations of relative motions within the nebula.

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PHOTOGRAPHS OF MARS.—In the September number of the *Observatory* an account of a minute examination of photographs of Mars taken at Flagstaff by Dr. Lowell and his co-workers is given by G. H. Hamilton. The photographs were studied without reference to maps of the planet, and details common to three or more of the images, of which there were sometimes as many as four dozen on a single plate, were inserted in sketches. Subsequent comparisons in all cases showed a very close agreement with the accepted maps in the observatory. One of the sketches, from photographs taken on March 15 of the present year, is reproduced, and shows an abundance of detail, including numerous canals. Mr. Hamilton is of opinion that the linear character of the canals, as represented by Dr. Lowell, is completely confirmed by the photographs. By the use of a finely divided transparent scale, it was found possible to obtain satisfactory measurements of the positions of the principal markings, due allowance being made for halation.

SPECTRUM OF THE NEBULA H IV. 39 ARGÛS.—An account of the spectrum of H IV. 39 Argûs (N.G.C. 2438) has been given by Dr. Max Wolf (*Sitz. Heidelberg Akad. d. Wiss.*, March, 1916). The spectrum was photographed at the Königstuhl Observatory, Heidelberg, on February 20, with an exposure of five hours. The nebula is very faint, and direct photographs show it to be of annular form with an eccentrically situated stellar nucleus; the eastern side of the ring is the brighter, and the nucleus lies nearer the western edge. The spectrum is almost identical with that of the ring nebula in Lyra, but much fainter. In order of brightness the lines are λ 373, 387, 434 (H γ), 469, 501, and 397; there is possibly also a faint line at 352. As in the Lyra nebula, a distribution of the different gases in layers is indicated by the varying distances to which the lines extend. The line 373 reaches furthest outwards, but has a marked minimum in the interior of the ring. The lines 387 and 434 reach further towards the centre; and, in striking contrast with the other lines, 469 (i.e. 4686, of "proto-helium") is brightest within the ring, and extends only a small distance from the nucleus.

THE UNITED STATES NATIONAL RESEARCH COUNCIL.

AN account of the inauguration and organisation of the National Research Council of the United States was published in our issue of August 3 last (vol. xcvi., p. 465), and the article pointed out that from the cordial interest shown by all who had learnt of the work in its early stages, it was evident that so soon as a widespread request for co-operation could be extended it would meet with general acceptance. A preliminary report of the Organising Committee to the president of the U.S. National Academy of Sciences, published in the August issue of its Proceedings, shows that this expectation has been justified, and some of the first instances of co-operation are given. Prof. G. E. Hale, chairman of the committee, has also sent to the *New York Times* an account of what is being done in the United States to mobilise science for industrial progress and military efficiency, and we reprint his letter below. It will be seen that the president of the Throop College of Technology in Pasadena, California, an institution which gives special attention to research, hearing of the plans of the Research Council, offered the assistance and co-operation of the recently endowed research laboratory of chemistry, and secured at once an additional endowment of 20,000*l.* for scientific research. In somewhat similar circumstances a gift of 100,000*l.*

has been made to the Massachusetts Institute of Technology, with the expectation that much of the income will be used for research. A resolution of the New York Engineering Foundation expresses approval of the co-ordination and federation of the research agencies of the United States undertaken by the National Academy, and also willingness to assist. The foundation has offered its entire income for the coming year—including a special gift of 1000*l.*—towards the expenses of organisation and to provide a New York office for the council. Resolutions of a similar kind are to be proposed to other scientific societies in the States.

At its annual meeting in April the National Academy of Sciences volunteered to organise the scientific resources of educational and research institutions in the interest of national preparedness. This offer, which was immediately accepted by President Wilson, has led to the establishment of the National Research Council.

Public welfare and national security depend upon industrial progress and military efficiency; and these, in turn, result from practical applications of scientific knowledge. A superstructure, no matter how perfect, must have firm foundations, and thus the development of our industries must go hand in hand with the advancement of knowledge through research.

It is equally true that the mobilisation of industry, so successfully undertaken by the national engineering societies in co-operation with the Naval Consulting Board, must be accompanied by the mobilisation of science. This necessity has been recognised in England by the establishment of an Advisory Council for Scientific and Industrial Research, and in Australia by the organisation of a National Institute of Science and Industry. Thus it is expected ultimately to overcome the telling advantages, both in war and in peace, which Germany has long enjoyed because of the organisation and development of her scientific resources.

Paul Deschanel has remarked of French men of science: "*Ils pensent que défendre la vérité est le meilleur moyen de servir la patrie.*" Thus the duties of a National Research Council should not be confined to the necessities of war or the development of American industries. We should recognise, with Carty, the engineer, that when adapted to practical uses the "results of the pure men of science become of incalculable value to the industries as a whole." And we should not fail to perceive that every form of scientific research contributes to human progress.

Euclid, working out problems in pure mathematics in Alexandria, prepared the way for the calculations of the engineer. Galileo, discovering the satellites of Jupiter, convinced the world of the truth of the Copernican theory, broke down absurd medieval conceptions which prevented scientific progress, and stimulated exploration and advance in every field. Pasteur, studying the optical properties of certain crystals with no thought of practical result, was led to his investigations of bacteria and his epoch-making discoveries for the benefit of mankind.

Thus scientific research in any field, whether for the advancement of knowledge or for direct industrial or military application, is a most fundamental form of national service, which should be encouraged by every possible means. The work of the Research Council will thus relate to public welfare in times of peace even more truly than to national security in the event of war.

During our Civil War the need of scientific advice was often felt by our Government. Accordingly, the National Academy of Sciences was chartered in 1863

by Act of Congress, which stipulated that "the academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art. . . ." During the war, and frequently in later years, the academy has been consulted by Congress, by the President, and by various members of his Cabinet. It is thus the agency naturally chosen for the organisation of the National Research Council.

The purpose of the council is to bring into co-operation existing governmental, educational, industrial, and other research organisations, with the object of encouraging the investigation of natural phenomena, the increased use of scientific research in the development of American industries, the employment of scientific methods in strengthening the national defence, and such other applications of science as will promote the national security and welfare.

The council will be composed of leading American investigators and engineers, representing the Army, Navy, Smithsonian Institution, and various scientific bureaus of the Government; educational institutions and research foundations, and the research laboratories of industrial and manufacturing establishments.

Research committees of two classes will be appointed:—

Central committees, dealing with various departments of science, comprised of leading authorities in each field, selected in consultation with the president of the corresponding national society.

Local committees in universities, colleges, and other co-operating institutions engaged in scientific research.

The organising committees will recommend to the National Research Council the following plan of procedure, approved by the council of the National Academy, but open to such modification as the Research Council may deem desirable:—

(1) The preparation of a national census of equipment for research, of the men engaged in it, and of the lines of investigation pursued in co-operating Government bureaus, educational institutions, research foundations, and industrial research laboratories; this census to be prepared in harmony with any general plan adopted by the proposed Government Council of National Defence.

(2) The preparation of reports by special committees, suggesting important research problems and favourable opportunities for research in various departments of science.

(3) The promotion of co-operation in research, with the object of securing increased efficiency; but with careful avoidance of any hampering control or interference with individual freedom and initiative.

(4) Co-operation with educational institutions, by supporting their efforts to secure larger funds and more favourable conditions for the pursuit of research and the training of students in the methods and spirit of investigation.

(5) Co-operation with research foundations and other agencies desiring to secure a more effective use of funds available for investigation.

(6) The encouragement in co-operating laboratories of researches designed to strengthen the national defence and to render the United States independent of foreign sources of supply liable to be affected by war.

To meet immediate needs, the following committees have already been completely or partially organised and are at work:—

Nitric Acid Supply, appointed in co-operation with the American Chemical Society, to investigate processes for the fixation of nitrogen, in order to select the best means of preparing the nitric acid required in the manufacture of powder and high explosives.

Preventive Medicine, appointed in co-operation with the Committee of Physicians and Surgeons, to develop

and utilise new methods of preventive medicine for the protection of troops in the field.

Organic Chemicals, appointed in co-operation with the American Chemical Society, to secure co-operation among chemists in researches required for the manufacture of dyestuffs, synthetic medicinals, and other chemicals made scarce by the war.

Communications, appointed in co-operation with the American Physical Society and the American Institute of Electrical Engineers, to develop and apply the most effective devices for military communications, the detection of submarines, and other similar purposes.

Committees for the promotion of research in applied mathematics, astronomy, physics, chemistry, botany, zoology, and various other branches of science will also be organised by the council.

The most cordial spirit of co-operation has been shown by every individual and institution hitherto invited to take part in the work. Universities, research foundations, and industrial laboratories, in the event of war, would place every facility at the disposal of the Government. In times of peace they will co-operate with the council in the advancement of research. The Engineering Foundation, under the auspices of the United Engineering Societies, has passed resolutions commending the purposes of the council, and offering it a New York office in the Engineers' Building and the services of an executive secretary. Substantial contributions to a general expense fund have already been received. It is evident that so soon as a general request for co-operation can be issued it will meet with the widest acceptance.

Throop College of Technology, in Pasadena, Cal., has recently afforded a striking illustration of one way in which the Research Council can secure co-operation and advance scientific investigation. This institution, with its able investigators and excellent research laboratories, could be of great service in any broad scheme of co-operation. President Scherer, hearing of the formation of the council, immediately offered to take part in its work, and with this object he secured within three days an additional research endowment of 100,000 dollars. The spirit of national service and the increased appreciation of the value of science, which have resulted from the European war, should lead to many similar gifts elsewhere.

The following letter from the President shows his approval of the council's plans and his active assistance in completing its organisation:—

"Dr. William H. Welch, President of the National Academy of Sciences, 807 St. Paul Street, Baltimore, Md. :—

"My Dear Dr. Welch,—I want to tell you with what gratification I have received the preliminary report of the National Research Council, which was formed at my request under the National Academy of Sciences. The outline of work there set forth and the evidences of remarkable progress toward the accomplishment of the object of the council are indeed gratifying. May I not take this occasion to say that the departments of the Government are ready to co-operate in every way that may be required, and that the heads of the departments most immediately concerned are now, at my request, actively engaged in considering the best methods of co-operation? Representatives of Government bureaus will be appointed as members of the Research Council as the council desires.

"Cordially and sincerely yours,

"(Signed) WOODROW WILSON."

Arrangements will be made to hold a meeting of the council soon after the appointment of the representatives of Government bureaus.

GEORGE ELLERY HALE.

THE GOVERNMENT CINCHONA PLANTATIONS IN BENGAL.

THE fifty-fourth annual report of the Government Cinchona Plantations and Factory in Bengal for the year 1915-16 is as interesting and valuable a document as that for 1914-15 noticed in these columns last year. In the previous report the scientific side of the work for the past ten years was reviewed, while in that now under notice a review of the financial side of the operations for the past sixteen years is given. Since April, 1900, to March, 1916, the total expenditure amounted to 42,65,600 rupees and total receipts to 39,30,000 rupees. The deficit of 3,35,600 rupees is, however, not a sign of financial mismanagement, but is an indication of remarkable and highly successful administrative ability. The deficit was incurred within the period 1905-14, during which time the department was being greatly improved. The explanation, which is simple, is given in the words of the report, as the excellent work which is being done by Major Gage and his staff is deserving of wider recognition.

"About the beginning of the 1905-15 period it was seen that the demand for quinine—since 1892 in excess of the yield from plantation bark—was exceeding the factory output capacity, and that as more than 90 per cent. of the world's supply of bark and quinine was in the hands respectively of Java planters and about a dozen manufacturers, the risk of the formation of a 'Trust' and the abolition of an open market was not to be taken lightly. It was foreseen that, if while there was still an open market large quantities of bark and quinine were purchased at the lowest rates ever touched, it would allow the formation of a reserve of quinine large enough to meet the increase in demand and to serve as a stand-by in case of a severe malarial epidemic, what time the plantations were being extended on a scale large enough to render the department independent of external supplies and prices.

"So during 1908-14 large sums were expended on purchase of bark and quinine at very low rates and on extra extensive plantations. Subsequent developments have thoroughly justified the then heavy expenditure. For instance, if the annual quinine yield from the plantations had remained at its 1905 figure of 9000 lb., Government would have had to pay during 1913-15 at least 7,74,000 rupees in purchase of enough bark or quinine to make up the quantity (74,000 lb.) distributed during these years, whereas it cost Government to make the quantity required above the 1905 output level less than 3,08,000 rupees. In those two years alone Government saved at least 4,66,000 rupees, which exceeds the deficit for a period of sixteen years. The deficit will speedily be replaced by a surplus yearly increasing, and meanwhile it is covered many times over by readily realisable assets."

These assets include (1) additions to factory and machinery that have quintupled its 1900 output capacity; (2) 2418 acres afforested with timber and fuel trees; (3) 2295 acres planted with cinchona 7,69,085 rupees in value; (4) a reserve of 165,000 lb. of quinine valued at 18,97,500 rupees, and other manufactured products, bark, etc., valued at 2,05,055 rupees—a total of 29,18,000 rupees. The total return for the 42,65,600 rupees expenditure is therefore in cash and assets 68,48,000 rupees. Nothing is claimed for value of factory, etc., in the estimate.

From this explanation, with conditions of presentment as stringent as few companies would think of adopting, the financial side of the department's work is seen to be as satisfactory as the scientific.