

Berzelius died in 1848, and the torch of chemistry has been handed on by worthy successors such as Lars Fredrik Nilson (1840-1899) and Per Theodor Cleve (1840-1905), while to-day science in Sweden has no more illustrious name than that of Svante Arrhenius, the originator of the theory of electrolytic dissociation and the director of the Nobel Institute of Physics, who began his career in the old university where Bergmann had taught.

While chemistry in particular has flourished in Sweden, other sciences have by no means been neglected. In all that appertains to the sea and fisheries, to agriculture and forestry, and to exploration, much valuable work has been done. One of the meetings to be held at Gothenburg this summer is the Congress of Scandinavian Naturalists. In astronomy, in physics, and in geology, Sweden has also played her part. Uppsala has possessed an observatory since about 1730, and during the nineteenth century this was directed by Gustav Svanberg (1801-1882), Herman Schultz (1823-1890), known for his micrometrical measurements of nebulae, and by Nils Christoph Duner (1839-1914), who devoted himself to a study of stellar spectra and in 1892 received the Rumford Medal of the Royal Society. Another well-known astronomer was Hugo Gylden (1841-1896), for more than twenty years head of the Stockholm observatory, where Backlund was his pupil. Anders Jonas Ångström (1814-1874) began his career in the Swedish observatories, but his great work on the solar spectrum was done while he held the chair of physics at Uppsala to which he was appointed after the death of Adolph Svanberg (1806-1857). Ångström's successors, Tobias Thalen (1827-1905) and Knut Johan Ångström (1857-1910), were also distinguished workers in spectroscopy, while it was said that Thalen's magnetometer was in use in every iron mine of importance in Sweden.

Geological studies in Sweden may be said to have been begun with the writings of Urban Hiarné (1641-1724), physician to the king, who in 1694 published his views on the history of the earth. Some of the earliest geological maps of Sweden were prepared by Gustav Hermelin (1744-1820) a student of Uppsala and an officer in the Swedish mining service. Geological surveys of Norway and Sweden were inaugurated in 1858. Among the directors have been Otto Torell (1828-1900) and Alfred Törnebohm (1838-1911). In a country possessing rich mineral deposits, the work of these geologists has been of the greatest value.

Apart from agriculture, which still employs about half the population of 6,000,000, the main industries of Sweden depend on the iron mines, the magnificent forests, and the ample water power. The manufacture of wood pulp and the timber trade have grown enormously. At one time Sweden was the principal iron-producing country in the world. Though to-day her position in this respect is much more modest, the quality of her iron is still unrivalled. The steam engine was introduced into Sweden by the Swedish man of letters, Abraham Edclcrantz (1754-1821), while the first marine engine was made by Samuel Owen, whose bust has been placed in the Gothenburg Exhibition together with a model of the engine he built. In the field of shipbuilding Sweden has done much pioneering work, and at one time no writings on naval architecture were more highly esteemed in England than those of Chapman (1721-1808), who was a native of Gothenburg. The famous engineer and naval architect, John Ericsson, was a Swede, and began work on the Göta Canal, which had been first surveyed by Swedenborg, but was built to the plans of the British engineer Telford. Ericsson was in England from 1826 to 1839; he then emigrated to the United States and it was there that he produced the *Monitor* which during the civil war saved the North. After his death in 1889, Ericsson's body was sent to Sweden in an American warship, and it now lies at Filipstad in the beautiful Wermland district.

Many Swedish civil and mechanical engineers have gained a world wide-reputation. Nordenfelt, who died in 1920, was one of the pioneers of the submarine, Goransson, who died in 1900, assisted in perfecting Bessemer's great invention, while Fredrik Kjellin (1872-1910) was a pioneer of the electric steel industry. Of the three brothers Nobel, it was Alfred Bernhard Nobel (1833-1896) who first produced dynamite and afterwards left more than a million sterling to found the Nobel prizes. The list could be lengthened considerably, but few names have stood higher than that of Gustav de Laval (1845-1913), whose cream separators are to be found in use all over the world; he is also widely known as the inventor of the de Laval steam turbine, the first patent for which was taken out in 1884, the same year that the Parsons turbine was patented. De Laval, it may be added, was a student and graduate of Uppsala University, and was thus one of the makers of modern Sweden who laid the foundation of their knowledge in the ancient university where Swedish science had its birth.

Current Topics and Events.

AN important paper by Prof. Georges Dreyer, of Oxford, in the last number of the *British Journal of Experimental Pathology* has been the subject of widespread comment, as, apparently, it is likely to inaugurate a new era in the specific treatment of infective disease, and particularly of tuberculosis. It is a matter of common knowledge that the "tuberculous" hitherto employed have not been completely successful against the highly resistant bacillus of tuberculosis. Dreyer's main thesis—and it is supported by a mass of accurate experimental evidence—is that the relative failure of certain

vaccine preparations is due to the presence in some bacteria of various lipoidal substances which, covering or incorporated with the protoplasm of the microbe, offer a considerable protection to the latter, so that it is able to escape the destructive bactericidal and other antibodies which are evoked by the host in response to the infection. By a process consisting essentially of the extraction of the lipoids, the "defatted" bacteria have been found not only to preserve their antigenic properties, but also the latter are actually enhanced when compared side by side with antigens which still preserve their

lipids. The bulk of Dreyer's work refers to tubercle bacillus, and there can be no doubt that, so far as this microbe is concerned, he has proved his point experimentally. From his protocols he appears to have done what has not been done before, namely, the arrest, clinical and histological, of tubercle in guinea-pigs. It has always been felt that any method which could bring this about offered great hopes in the treatment of tuberculosis. It is necessary, however, at this stage to adopt an attitude of caution as regards the treatment of human pulmonary tuberculosis, for it will be a long time, probably years, before the full value of the method can be assessed.

IN the issue of *Science* for May 18 prominence is given to a communication entitled "Problems in the Field of Animal Nutrition," issued by the sub-committee on Animal Nutrition of the United States National Research Council. The paper is an endeavour to indicate problems and fields of research worthy of study in relation to animal nutrition. It is noteworthy that under this heading are included such diverse subjects as human dietetics, animal and forage husbandry, judging and food requirements of farm animals, and diet in relation to reproduction. There are undoubtedly great advantages in describing and defining the objects of scientific research, but it is, perhaps, permissible to stress the fact that, in the last resort, the organisation of research depends upon the supply, and, what in this connexion may be termed, the "nutrition," of qualified scientific workers! So far as Great Britain is concerned, it would appear that the majority of the problems indicated (with the exception, perhaps, of the scientific judging of farm animals) are the subject of study in one quarter or another. For example, at Cambridge great additions to the knowledge of nutrition continue to be made at the School of Bio-chemistry under Prof. Gowland Hopkins, and at the School of Agriculture, under Prof. T. B. Wood, workers on nutritional calorimetry and the physiology of reproduction continue to make progress. The most prominent consideration, however, before workers on the scientific aspects of nutrition in Great Britain is the need for the careful study of what may be termed the balance of essential food substances, as distinct from the absolute amounts of each of such, and it would appear that a great deal has still to be learned as to the interplay in nutrition between the relative quantity of proteins, carbohydrates, minerals, and even vitamins, which may be contained in diets, both in health and disease. On the applied side of the subject, the ultimate (and most difficult) problem is, undoubtedly, how effectively to introduce science into a subject so much at the mercy of fashion and prejudice as the feeding of animals.

A PAPER by G. McCready Price on "The Fossils as Age-markers in Geology" (*Princeton Theological Review*, vol. 20, p. 585, 1922) affords interesting evidence, even in its place of origin, of the campaign that is being carried on in the United States against the recognition of organic evolution. The author states that he is a geologist, who has convinced him-

self that no true sequence of faunas is traceable in the rocks, and that zoological provinces may have existed in which trilobites, nummulites, and ammonites lived simultaneously in various portions of the globe. The apparent absence of eroded surfaces between stratified series that are judged, by their fossil contents, to differ widely in their age is regarded as a proof that no gap in the sequence has occurred. On this matter the author should study L. F. Noble's paper on the succession in the Grand Cañon of Arizona, which was recently noticed in *NATURE* (April 7, p. 480). It is alleged that thrust-planes and reversals by folding have been called in as explanations by those who still cling to the views put forward by William Smith. It may be noted that the pioneers in the establishment of faunal sequences had no concern with doctrines of evolution; but Mr. Price states that those geologists who are "acquainted with scientific methods" have recently changed their views and accept a "new geology." When we find that the new geology accounts for an imaginary mingling of strata by the occurrence of a universal deluge, we realise that its scientific outlook is not younger than that of the Chaldees.

THE Albert Medal of the Royal Society of Arts, which was instituted in 1862 as a memorial of the Prince Consort, and is given annually for "distinguished merit in promoting Arts, Manufactures, or Commerce," has been awarded this year in duplicate by the council, with the approval of the president, H.R.H. the Duke of Connaught, to Sir David Bruce and Sir Ronald Ross, in recognition of the eminent services they have rendered to the economic development of the world by their achievements in biological research and the study of tropical diseases.

At a meeting held recently at the Mansion House, a committee was formed with the object of providing a national memorial to the late Sir Ernest Shackleton. The aim is to establish some suitable memorial of a permanent nature, but the first object of the committee will be to provide for the education of Sir E. Shackleton's children and to take his place in supporting his mother. The balance that remains, after meeting these two obligations, will be devoted to the encouragement of exploration. The hon. treasurer of the memorial fund is Mr. Howard Button, 61/62 Lincoln's Inn Fields, London, W.C.2. Subscriptions may be sent to him or to any branch of the National Provincial and Union Bank of England.

IN order to commemorate the late Dr. W. S. Bruce, the polar explorer, a Bruce Memorial prize has been founded by subscription among his friends and admirers. The prize, which will take the form of a bronze medal and money award, is to be given from time to time for notable contributions to natural science in the nature of new knowledge resulting from personal visits to polar regions. The prize will be open to workers of all nationalities, with a preference for young men at the outset of their careers as investigators. Arrangements are being made to leave the selection of the recipients

of the prize to a representative committee in Edinburgh. Further subscriptions will still be welcomed by the hon. treasurer, Mr. A. N. G. Aitken, 37 Queen Street, Edinburgh.

THE resignation is announced of Sir George Beilby after nearly seven years' voluntary service as director of fuel research and chairman of the Fuel Research Board under the Department of Scientific and Industrial Research, which was established in 1917 to investigate the nature, preparation, and utilisation of fuel of all kinds. Dr. C. H. Lander has been appointed director of fuel research, and Sir Richard Threlfall, a present member of the Board, to be chairman. The Hon. Sir Charles Parsons will continue as a member of the Board for a further period. Sir George Beilby retains his membership of the Advisory Council of the Department, and has consented to act as honorary adviser to the Board. The following have been appointed additional members of the Board: Mr. R. A. Burrows, Sir John Cadman, Dr. Charles Carpenter, Mr. Samuel Tagg, Sir James Walker, and Prof. R. V. Wheeler.

IN his recent presidential address to the Institute of Physics, Sir J. J. Thomson gave some account of the work he saw during his recent visit to America in the research departments of some of the great manufacturing firms. These laboratories were established in the face of considerable opposition, but now the unanimous opinion appears to be that the research department is one of the most profitable in manufacturing concerns, and, however great the necessity for economy, its cost would be the last to be reduced. The scale of the laboratories is far greater than anything in Great Britain, and much of the work carried out is not merely what may be called development work, but is fundamental scientific work, worthy of a university laboratory. On the other hand, the American universities do not seem designed to produce a large number of men qualified to take up advanced research work. For example, few of the science students have the necessary equipment in mathematics, and the stern training which a good honours man in a great English university has to go through appears to be unknown. The system is doubtless good for the average man, but a successful research institute requires something more than the average man: it needs men with high scientific knowledge. In this regard, Great Britain has a distinct advantage which is sorely needed if it is to hold its own in competition.

THE annual conversazione of the Institution of Electrical Engineers will be held at the Natural History Museum, Cromwell Road, S.W., on Thursday, June 28, at 8.30 P.M.

IT is announced in the *Times* that Sir E. Wallis Budge, keeper of Egyptian and Assyrian antiquities at the British Museum, has been elected a foreign correspondent associate of the Lisbon Academy of Sciences.

A REPLICA of the portrait of Benjamin Harrison, painted a short time before his death by Mr. Cyril Chitty of Ightham, has been purchased by private

subscription and presented to the Maidstone Museum. It has been placed in the room in which selected examples of Mr. Harrison's flint implements are exhibited.

THE annual general meeting of the Institution of Gas Engineers is to be held on June 26-28 in the City Hall, Belfast. At the first session of the meeting the Birmingham medal will be presented to Mr. W. Doig Gibb, and Mr. J. D. Smith, engineer and manager of the Corporation Gas Works, Belfast, will deliver his presidential address. A number of reports and papers will be presented to the meeting and discussed.

"NATIONAL Baby Week" will be observed on July 1-7, and we have received from the National Baby Week Council (117 Piccadilly, W.1) pamphlets explaining the object of baby week and how to organise a baby week celebration, and dealing with the activities of the Council. The Council desires to promote in the widest sense the safeguarding of infant life.

IT is stated in the *British Medical Journal* that Dr. Kleiweg de Zwaar, of Amsterdam, has instituted a triennial prize of the value of 2500 francs, which will be awarded for the first time in 1924 for the best work in physical or prehistoric anthropology during the preceding three years. Candidates should apply before November 1 to the Secretary, École d'Anthropologie, 15 rue de l'École de Médecine, Paris.

THE Society of Glass Technology has issued a provisional programme for its visit to France on June 30-July 6. The details of the meeting are being arranged by M. Delloye, of the Glaceries de St. Gobain, Chauny, and Cirey, and visits to a number of glass factories in and near Paris are promised. On July 2 there will be a joint meeting for the presentation and discussion of papers with the French Society of Civil Engineers, and it is hoped that Prof. H. le Chatelier will address the meeting.

THE centenary of the death of the famous horologist, Abraham Louis Bréguet, will be celebrated in Paris on October 22-27, by an exhibition of his works at the Musée Galliera, a special meeting at the Sorbonne, and a reception at the Hôtel de Ville. The Congrès National de Chronométrie will also meet in Paris in October, under the honorary presidency of M. Baillaud, director of the Paris Observatory, and of General Sebert. Besides discussing general questions relating to chronometry, the congress will aim at the formation of a Chronometric Union under the direction of the International Research Council.

THROUGH the great generosity of Mr. Charles Heape, of Rochdale, the Manchester Museum will shortly come into possession of a fine collection of native implements, ornaments, and weapons, which will add greatly to the value of the ethnological collection that it already possesses. The bulk of the specimens are drawn from the Pacific, but the collection also contains some objects from the Eskimo and from Egypt. The collection has been catalogued

by Messrs. Heape and Edge-Partington, and the catalogue was printed some time ago, and issued privately. It would be of great advantage to ethnology if, some day, this invaluable source of information should be reissued, if necessary by subscription. The collection contains a representative set of Polynesian weapons. There are also many examples of shell-work, especially of mother-of-pearl, which should be of great interest, and much that will be of considerable use to the student of ornament. When the exhibits are classified and exhibited they will form an excellent foundation for the study of the material culture of Oceania.

At a recent meeting of the council of the Royal Agricultural Society, some account was given of the work in hand by the Society's Research Committee. Experiments are in progress in Leicestershire to test the value of basic slags and other fertilisers as measured by the increase in weight of cattle and sheep. Silage is to be made in clamps or pits at Cambridge and tower ensilage in East Suffolk, and the products are to be used next winter as feed for dairy cows; the effects of the silage on the yield and quality of the milk will be watched. Pig-feeding is also being investigated at Cambridge, where experiments will be made on the effects of grinding, soaking, and cooking on the nutritive value of maize, and on feeding with barley and potatoes, while similar trials will be made at the Harper-Adams Agricultural College on the value of home-grown products; in each case, the weight of flesh produced as well as its quality, will be investigated. The Research Committee of the Royal Agricultural Society is doing valuable work in thus supplementing the investigations carried out at research institutes and aiding in bridging the gap between the research worker and the practical farmer.

THE Société Française de Physique celebrates this year the fiftieth anniversary of its foundation, and to mark the event the Société is organising a National Physical and Wireless Exhibition which will be held in the Grand Palais, Paris, on November 30–December 17, concurrently with the Aeronautical Exhibition. The list of patrons, headed by the president of the Republic and the chiefs of the various ministries, includes leading personalities of the French scientific and industrial world. A guarantee fund of one million francs has been subscribed by eighty-two firms and individuals. The exhibition, which will embrace the principal scientific and industrial applications of physics, is to be divided into the following sections: Experimental physics; retrospective display of physical apparatus; radio-telegraphy and telephony; vacuum, X-ray and thermionic tubes; biological physics, physiology; telegraphy, telephony, signalling; various industrial and domestic applications of electricity; electro-chemistry; electric cables; glass, porcelain and other insulating materials; optics; photography, cinematography; illumination; rarefied and compressed gases; heating; metallurgy; acoustics; measuring and control apparatus; and instruction, books, reviews.

THE forthcoming meeting in London of the International Association of Navigation Congresses is an event of outstanding importance in shipping and port circles. The Congress will be held on July 2–July 6, and will be attended by numerous and influential delegates from all over the world, many of whom are contributing reports on matters of which they have expert knowledge. It is the thirteenth meeting of the Association; normally a congress is held every third year, but the regular sequence was broken by the War. The last meeting was at Philadelphia in 1912; consequently much interest and importance attaches to the revival of the gatherings after a lapse of more than ten years. The King has graciously accepted the position of patron; Lord Desborough is president, and there is a strong and influential British organisation committee. The subjects to be discussed include the following: (a) Inland navigation: the utilisation of waterways for the production of power and its consequences and applications; the influence of surface waters and subterranean sheets of water on the flow of rivers; and estimation of the water consumed for navigation and irrigation purposes, and the portion returned to the subterranean sheet of water. (b) Ocean navigation: the accommodation to be provided for ships in order to satisfy the future dimensions of vessels; mechanical equipment of ports; concrete and reinforced concrete: their applications to hydraulic works; means to assure their preservation and their water-tightness; the use of liquid fuel for navigation and its consequences; the utilisation of tides for the production of power for the working and lighting of ports; and the principal advances made recently in lighting, beaconing, and signalling of coasts, and standardisation (unification) of the languages of maritime signals.

THE Museums Association will meet at the Guildhall, Hull, on July 9–13. On Tuesday morning, July 10, there will be an official welcome by the Lord Mayor, and the president, Mr. T. Sheppard, will give an address on "The Place of the Small Museum." Later, at the Hull Luncheon Club, the delegates will be entertained, and the president will give an address on "The Evolution of a Yorkshireman." A number of papers will be read upon various aspects of museum work, and there will be numerous social functions and visits to places of interest. On Friday morning, July 13, there will be an address on "American Museums" by a delegate from the American Museum of Natural History, New York, and also cinematograph exhibitions. In the afternoon one section will visit York and will be entertained by the Yorkshire Philosophical Society in the grounds there; another party will sail for Copenhagen on the s.s. *Spero*, and from a preliminary programme received from Dr. C. M. C. Mackeprang, of the National Museum at Copenhagen, it appears that the members will be received on Monday morning, July 16, at the National Museum and inspect the National Collections; they will be then entertained to lunch in the Museum. In the afternoon they will visit Rosenborg Castle and later will attend a reception at the Town Hall. On

Tuesday, visits will be paid to Thorvaldsen's Museum and the Museum of Applied Art. In the afternoon the National Art Gallery and the Zoological Museum will be visited, and later there will be a trip in the Danish Expeditionary ship *Dana*, which is under the charge of Dr. Petersen. On Wednesday, July 18, there will be a visit to the Open-Air Museum at Lyngby, a visit to the Natural History Museum in Frederiksborg Castle, where the members will be entertained to lunch, and later a visit to the famous castle at Elsinore. On the following day the members will visit the Glyptothek, returning to Hull by the s.s. *Spero* on the same evening.

MR. I. H. N. EVANS, of the Federated Malay States Museums, Taiping, has written, for appearance with the Cambridge University Press, "Studies in Religion, Folk-lore, and Custom in British North Borneo and the Malay Peninsula," giving the results of research

carried out in the years 1910-21. The same house will publish in the summer "The Banyankole," by the Rev. J. Roscoe. It will form the second part of the report of the Mackie Ethnological Expedition to Central Africa.

IN the chairman's report of the National Illumination Committee for 1922, now issued in pamphlet form, it is stated that the provisional definitions of photometric terms and units have now been adopted, and form the basis of a series to be issued shortly by the British Engineering Standards Association. The latter body has been invited to form a sectional committee on illumination. Reference is also made to the committee which is investigating the subject of motor-headlights, and, as a preliminary to suggestions, is considering the recommendations already made in other countries. The pamphlet contains an official translation of the French text of the photometric definitions.

Our Astronomical Column.

ANNOUNCEMENT OF A NEW COMET.—Mr. W. N. Abbot, the British schoolboy in Athens who recently announced the brightening of Beta Ceti, now reports the discovery of a comet on June 12. The Right Ascension is given as $15^{\text{h}} 13^{\text{m}} 4^{\text{s}}$, and the Declination $53^{\circ} 26' \text{N.}$, in the constellation Draco. As the telegram is not quite in the regular form, there is some doubt whether the Declination may not be the complement of the above, that is, $36^{\circ} 34'$. No further information is at present to hand.

PROPOSED SOLAR OBSERVATORY IN AUSTRALIA.—This observatory has now been planned for several years; a message, dated April 17, from Melbourne to the *Times* indicates that the arrangements are making considerable progress. The site has been chosen at Mount Stromlo, near Canberra, the federal capital.

Prof. Duffield, of University College, Reading, was then in Australia and was being consulted, together with the Astronomer Royal and Prof. Turner, on the question of the selection of a director. It was proposed that the new director, when selected, should be given an opportunity of visiting, among other observatories, the solar observatory on Mount Wilson. As that observatory takes the leading place in researches on solar physics, it is obvious that the director of the new observatory should be intimately acquainted with its methods, and should arrange a programme of work that would supplement the results obtained there. As the two observatories are some 90° apart in longitude, the Australian station could continue the record of interesting outbursts after sunset in California.

PHOTOMETRIC OBSERVATIONS OF THE PLANET MERCURY.—It is of considerable importance to measure the brightness of this elusive little planet, since the result has a considerable bearing on the estimate we form of the condition of its surface. The conditions for doing so are much easier in the tropics, owing to the shorter twilight, the prevalence of clearer skies, and the greater altitude of the planet. Mr. J. Hopmann, who visited Christmas Island for the recent eclipse, utilised the occasion to compare Mercury with neighbouring stars (Arcturus, Spica, Procyon, Regulus, Deneb, Denebola, etc.) and the planets Saturn and Jupiter. On September 5 it was brighter than Saturn by a whole magnitude, on November 5 even brighter than Jupiter, which was, however, lower down. It was seen at Malta on November 15 when only 12° from the sun.

Mr. Hopmann has reduced his observations to distance of Mercury from the sun 0.3871 , from the earth 1.0 , and obtains the formula $-0.711 \text{ mag.} + 0.03582 \text{ mag.} (a - 50^{\circ})$, a being the phase angle sun-Mercury-earth. The first term was given as -0.998 mag. by Müller and Jost, their second term being practically the same as his. In other words, he makes the planet a quarter of a magnitude fainter, thus indicating a still lower albedo, and a condition of surface probably approximating to that of the moon (*Astr. Nachr.* 5220).

PHOTOGRAPHIC STUDIES OF NEBULÆ.—Mr. J. C. Duncan contributes his third paper on the studies of the form and structure of nebulae from photographs made with the 100-inch and 60-inch reflectors and the 10-inch Cooke refractor in the years 1920 to 1922 to the *Astrophysical Journal* (vol. 57, No. 3). The previous papers appeared in volumes 51, p. 4, and 53, p. 392, of the same journal. The present communication is accompanied by eleven excellently reproduced plates. Evidence of the existence of dark nebulosity is found in N.G.C. 1977, M 78, the Trifid nebula, the dark objects Barnard 72, 92, 93, and 133, and the American nebula. Of great interest is N.G.C. 4038-4039, a bright spiral of unique form with faint extensions of extraordinary appearance. In a field the size of the full moon in Coma Berenices, the 100-inch telescope photographs no less than 319 small nebulae. The object N.G.C. 6822 is found to be a mixture of stars and small nebulae resembling the magellanic clouds.

In examining these reproductions taken with the great 100-inch mirror, one cannot but recall and admire the fine photographs which Dr. Isaac Roberts took with his small mirror of only 20-inches aperture. To take a case in point, it is interesting to compare the reproduction of the nebula N.G.C. 1977 in Orion taken with the 100-inch mirror with Roberts's reproduction in plate 17 in his volume of "Photographs of stars, star-clusters and nebulae," taken in 1889 and published in 1893. The exposure for Roberts's photograph was 3 hours 25 minutes, while that with the 100-inch was 5 hours 40 minutes. There is very little difference between these photographs except the sharpness of the details and the greater contrast in light and shade, which in the 100-inch reproduction has been secured purposely by repeated copying.