A REMARK in NATURE of August 22, p. 493, referring to the use of Moissan's electric furnace for the production of pure substances, and stating that these "rendered possible the practical achievements of Sir Robert Hadfield and other great steel-makers," needs correction for the sake of historical accuracy. Sir Robert Hadfield's epoch-making experiments, which led to the production of his famous manganese steel, were made in 1882, and neither for this nor for the other valuable iron alloys invented by him was he indebted to Moissan's work. It was not until ten years later that Moissan turned his attention to high-temperature research, and by the preparation of chromium, tungsten, molybdenum, uranium, and many other metals in a fused form and high degree of purity enriched our knowledge of the chemical and physical properties of these elements.

IN accordance with its usual practice of late years, the Royal Meteorological Institute of the Netherlands has issued copies of the most disturbed magnetic curves obtained at De Bilt during 1916. The records cover seven sheets, and deal with twelve separate periods, each of thirty hours. There are traces in each case of D (declination), H (horizontal force), and V (vertical force). The D and H scale-values were practically constant throughout, the respective equivalents of 1 mm. of ordinate being 1·06′ and 3·4 γ, but the equivalent of 1 mm. in the V curves varies from 1·14 γ to 3·31 γ. Some of the disturbances were of considerable amplitude, but none at all outstanding. There are several good examples of "sudden commencements." The largest movement of this kind in H occurred on August 26, and was decidedly oscillatory. The usual tendency for the evening hours to be more disturbed than the forenoon is pronounced. Also, in nearly every case the value of V is enhanced in the late afternoon, up to at least 10 or 11 p.m., and depressed in the early morning hours. This is especially well illustrated in the two sets of curves numbered 2 and 3, which cover the sixty consecutive hours commencing at 7 a.m. on March 8. On most occasions short-period oscillations are prominent in the D and H curves during at least part of the storm. On some occasions, notably on November 12, these were of considerable amplitude, especially in H.

OUR ASTRONOMICAL COLUMN.

INFRA-RED STELLAR SPECTRA.—Some interesting experiments on the photography of stellar spectra in the extreme red have been made by Dr. P. W. Merrill, of the Bureau of Standards, Washington (Scientific Papers, No. 318). The actual tests were made at the Harvard College Observatory, where use was made of the 24-in. reflector, combined with objective prisms of different dispersions. The plates were sensitised for the red by staining with dicyanin, and pinaverdol was added when it was desired to photograph the yellow and green in addition. A large number of spectra of typical stars was obtained, with exposures ranging from 5 to 112 minutes, reaching in some cases as far as λ 870, and showing the atmospheric absorption bands B, *a*, and A. Several examples are reproduced, and it is clear that results of considerable value to astronomers and physicists may be obtained in the future by this method. Among other results of interest Dr. Merrill has found a new absorption band in the spectra of the M stars at wave-length 760, which he has proved by laboratory experiments to belong to the titanium oxide series; in Mira there is possibly still another band between 810 and 820. In stars of class N new bands have been found at 692, 708, and 723, and these differ from the characteristic bands of carbon in degenerating towards the less refrangible part of the spectrum; it is suggested that they may possibly be due to cyanogen. The great contrast in energy distribution in the different classes of stars is very strongly emphasised by the extended range of observation. For classes B and A the blue portion is much the stronger; at class K the blue and red are about equal; while for classes M and N the red is the stronger.

MOUNT WILSON OBSERVATORY REPORT.—Although the director has been called upon to devote nearly all his time to the organisation and work of the National Research Council, the research activity at the Mount Wilson Observatory appears to have been so far well maintained. The report for 1917 refers to many subjects of the highest interest and importance, and it is only possible to mention a few developments to which attention has not previously been directed. The 75-ft. spectrograph has been adapted for visual observations in conjunction with the 150-ft. tower telescope, and the magnetic polarities of an average number of forty sun-spots were determined on each day of observation, besides measurements of the strength of field in a large percentage of these spots. Further tests of the presence of free electricity in sun-spots were also made, but, as in previous years, Stark effects were not observed, and the results were negative. The interesting results obtained by stereoscopic combinations of H_α images of the sun have been extended, and the method has been found extremely valuable in the study of prominences projected on the disc, and in showing their connection with the dark flocculi. Systematic work on the solar rotation is being continued with the greatest refinements, and it is hoped eventually to determine whether the suggested variations in the period are real, or depend upon instrumental conditions and personal equation. Stellar and nebular investigations continued to increase in several directions, and work on the parallaxes, proper motions, magnitudes, and distribution of the stars has been very fruitful. Of exceptional significance in the theory of stellar evolution is the definite conclusion that the intrinsically fainter stars move more rapidly than the brighter ones, irrespective of their distances from the sun. To facilitate the experimental work, which is so fundamental for the interpretation of celestial spectra, the physical laboratory in Pasadena has been enlarged to nearly double its former area, and additional equipment has been provided. Good progress was also made with the 100-in. reflector, the dome and mounting having been essentially completed, and the great mirror safely conveyed to the top of the mountain; it is expected that the telescope will be ready for test observations during the autumn.

THE DEVELOPMENT OF NEW INDUSTRIES.

A FACT brought to light at the British Scientific Products Exhibition, organised by the British Science Guild at King's College, is the dependence of industrial development upon the intelligent application of scientific knowledge and method. In most of the industries represented at the exhibition it is shown that the resources exist and that they merely await the application of the results of scientific research for their proper development, and the introduction of patient and persistent effort to turn these industries into successful commercial undertakings. The case of timber furnishes an example of our pre-war dependence upon supplies from abroad, when, in point of fact, the bulk of our demands could have been satisfied by home or Colonial supplies. For a long time it was impossible to make the successive Governments of this country realise that the afforestation of waste lands was a question of national importance. Since the war, however, the attitude of those responsible for the government of the country in regard to this question has changed considerably. The losses due to the submarine, and the shortage of steamship accommodation, have appreciably diminished the imports of timber, with the result that we are now turning to home sources to make up for the deficiences.

The two problems that will have to be solved before we can depend entirely upon our own resources were set out by Mr. E. P. Stebbing in a lecture which he delivered at King's College. The questions are (*a*) where to get the timber we shall require during the next forty years, and (*b*) the immediate afforestation of the waste lands in the United Kingdom. Mr. Stebbing expressed the opinion that we should have to rely upon Canada and Russia for our future supplies of soft woods. He disapproved of small tentative schemes of afforestation. This, in his view, would not enable us to depend upon the major portion of our supplies of home-grown timber, and he expressed the further opinion that unless the afforestation problem is conceived on bold lines, it would result in a useless waste of money.

Just as in the case of timber and other metallic materials the bulk of our supplies can be obtained by the development of the natural resources of the Empire, so in the case of metallic materials can our independence be firmly secured. The example of tungsten furnishes a striking and instructive illustration of the neglect to utilise the resources of the Empire or to work in our own territory the minerals won under the British flag. Under the stress of war conditions the importance of tungsten as an essential ingredient in the manufacture of tool-steel and as a corner-stone of modern engineering is now fully realised in this country. Much still remains to be known about the properties of this element and its uses, and Mr. Julius L. F. Vogel has performed a public service in presenting an account of tungsten at a lecture at King's College, where there are also a number of specimens of the metal to be seen. The problem of preparing pure tungsten, although one of commercial importance, was considered too small to justify a separate establishment for the industry, with the result that it was left to certain German chemical and metallurgical works to deal with the problem. Complete investigation laboratories were equipped, well-fitted works erected, and ample funds provided to develop a suitable process and put it into operation, and before long steel-makers were offered tungsten powder containing 95 to 96 per cent. of pure tungsten practically free from deleterious impurities. In course of time a still higher grade tungsten was supplied, containing up to 99 per cent. of the pure metal. Attempts to establish the manufacture of tungsten in this country resulted in the production of an article of satisfactory quality, but the scale of manufacture, local conditions, and intermittent ore supply made competition with the powerful German producers impossible. If the tungsten industry has at last been permanently established in this country, it is due in no small measure to the efforts of Mr. Vogel, who is prominently connected with the works at Widnes, which have been delivering tungsten since July, 1915, without intermission.

Even in the development of sources of energy for our industry there is immense scope for the application of scientific knowledge and method. We know, for example, that one cubic foot of water per second falling 11 ft. will develop one horse-power in any modern turbine. What use can be made of this energy? Mr. A. Newlands, engineer-in-chief of the Highland Railway, showed in the course of a paper read at the exhibition not only that the development of our water resources will provide us with the energy that we require, but also that its proper development is to some extent bound up with the reorganisation of our industrial life. Cheap power and a greatly extended use of it are imperative necessities, and the continued neglect of the water-power possibilities of this country is a very serious economic waste. In the latest Census of Production Report it is shown that while the total horse-power of industrial engines in the United Kingdom is approximately ten and a half millions, of this only 178,000 h.p., or 1·6 per cent., is represented by water-power. In the opinion of Mr. Newlands, we could easily draw upon water for one to one and a half million horse-power, or more than 10 per cent. of our requirements. A comparison of the percentage of available water-power utilised in Great Britain with that of other countries furnishes a very impressive reminder of the undeveloped state of that industry here. Germany utilises 43·4 per cent. of the water available and capable of development; the United States, 24·9 per cent.; France, 11·6 per cent.; Great Britain, only 8·3 per cent. It is estimated that while there is available for development from water-power in Great Britain 10·9 h.p. per square mile of area, only 0·91 h.p. is actually used.

Mr. Newlands is of the opinion that the place of water-power in industry lies in the utilisation of it so far as possible in territory where industrial activity can be re-created or where none has existed hitherto. This raises a very important sociological problem which it is desirable that our men of science and engineers should consider seriously. The energy derived from water-power can be transmitted electrically over large areas, and made available where practicable for the varied requirements of agriculture, both in field operations and in farm buildings. Here it would help to eliminate much of the drudgery of this important industry, while at the same time coming into service for the purpose of rural transport. As to industries, it is only necessary to mention the manufacture of aluminium, the electro-chemical industries, and the fixation of nitrogen to show what enormous possibilities exist in the development of these industries by the application of large power supplies which would be made available by the utilisation of water. The saving of coal, too, through the development of our water-power resources is an item the importance of which cannot be over-estimated. But this is not the only consideration, for it has distinct and far-reaching possibilities and advantages of its own; and if, as is generally believed, we must enormously increase our national production to re-establish our national position, the utilisation of water-power will be necessary.

While considering the development of resources in this country, attention must be given at the same time to the development of the resources of other parts of the Empire. We have already mentioned the case of tungsten, but there is another example of a field which awaits the application of science, and that is in the resources of West Africa. A comparison of recent statistics presented by Mr. R. E. Dennett in a lecture delivered at the exhibition does not make very cheerful reading. Up to the first six months of 1914 nearly all West African copra went to Germany. From the same territory Germany took nearly half the production of cocoa, more than two-thirds of the palm kernels, about one-eighth of the palm-oil, half of the hides, one-third of the mahogany, more than half of the ground-nuts, more than one-third of the shea-nuts, and the whole of the palm-kernel cake; in all, nearly half of the total exports from the West African Union went to Germany. The explanation of this is simple. In addition to enterprise, the Germans investigated scientifically the best methods of converting these articles into foodstuffs, etc., and, as Mr. Dennett has pointed out, "we should be greater fools than even the Germans now consider us to be if we did not take every precaution in the future to deprive the German Government of the power to procure West African products with the view of making war upon us again." For it must be remembered that not only are many of these products suitable as foodstuffs; they are also absolutely essential for the manufacture of war material. Of the many instances given by Mr. Dennett of the utilisation of these materials, a good example of the advantage of science is shown by the utilisation of waste cotton-seed as a driving power. He said:—

"In the centre of Africa, where cotton-seed is of little value owing to costly transport, the obtaining of power for driving a ginnery or any other machinery is of great importance, as the further you get into the interior, the more costly coal becomes. On the other hand, cotton-seed is, to all intents and purposes, a waste product in such places, and may well take the place of coal. The power is obtained, not from the oil, but from the seed itself, which is composed of carbonaceous matter. Cotton-seed cake or damaged cotton-seed unfit for crushing purposes is equally good material.

"Cotton-seed gas plants are composed of a brick-lined furnace, in which the seed is burnt on a grate. The air is drawn through the fire and CO_2 is produced, this afterwards being reduced to CO. The gas is then cooled and cleaned and the tar extracted by means of a centrifugal device, which causes all heavy matter to be expelled. A plentiful supply of water is needed for the cleaning process. A suction-gas plant produces exactly the amount that the engine requires. Compared with the steam-engine, the fuel used per b.h.p. is about one-half, the actual amount of coal being in the region of about 1·5 lb. per b.h.p. per hour, and cotton-seed about 4 lb. per b.h.p., including stand-by losses. The labour required to operate a gas plant is also considerably less than that required for a steam-engine of similar size."

Regarding cotton-seed as a possible edible oil to compete with coconut or palm-kernel oil, Mr. Dennett said:—"Cotton-seed oil can now be treated with hydrogen and so converted into a solid fat, and thus hardened it is already largely used to make compound lard, which in some cases contains no lard properly so-called. In this way many of the twenty-three West African oils may also possibly be used in the manufacture of margarine."

THE BRITISH GLASS INDUSTRY.

GLASS is prominent in many parts of the British Science Guild's Exhibition at King's College. It is one of those commodities to which little thought was given while 80 per cent. of our requirements were imported from abroad; but we learn to appreciate things which we have to make for ourselves, and we are learning also something of the extraordinary range of the varieties of glass and the multiplicity of uses to which it is put. In some form or other we find it in use in nearly every section of the exhibition, and we read about it in the admirable "Articles on Recent Developments" in the catalogue. In the first—referring to "Key Industries," by Prof. Gregory—we learn of the vital national importance of glass for optical and scientific purposes; and in that on "Optical Instruments," by Mr. S. D. Chalmers, that most of the types of optical glass which were formerly imported are now made in this country. Dr. Turner contributes an encouraging account of the recent development of "The British Glass Industry" generally, showing how the initial impulse came from our chemists, and how it was followed by the establishment of the Department of Optical Munitions and Glassware Supply of the Ministry of Munitions; by the foundation of the Department of Glass Technology in the University of Sheffield, with the assistance of the Department of Scientific and Industrial Research, the Ministry of Munitions, and the manufacturers; and, finally, by the formation of the Society of Glass Technology—now an important and thriving industrial association. Mr. Chapman Jones, in his contribution on "Photography," tells us of the efficiency of the cameras employed by the Air Force; and Prof. Boswell deals with the all-important subject of "Glass-making and Refractory Sands," relating how optical glasses and laboratory ware are being made successfully from British deposits.

The exhibition includes the productions of many enterprising firms which have taken up new branches of the industry. We may note especially the remarkable range of glass apparatus for chemical and bacteriological work, of which the manufacturers' associations have combined to make a most creditable display. These are practically all productions undertaken during the war, in the face of very adverse and discouraging conditions, and they bear evidence of steady improvement in both quality and technique. In optical glass Messrs. Chance Bros., Ltd., who have, most fortunately for us, kept the industry alive in the country for seventy years, present a striking exhibit of interesting specimens; while the Derby Crown Glass Co. has also entered the field in this essential "key" industry, and shows samples for various purposes. In a separate room the members of the British Lampblown Scientific Glassware Manufacturers' Association exhibit nicely finished thermometers of many kinds, as well as other graduated scientific apparatus. Messrs. Ackroyd and Best and Messrs. Moncrieff show miners' safety-lamp glasses, and the latter firm also gauge-glasses and other important requirements for acid-plant and munition purposes. We must not omit to mention the exhibits of "Vitreosil" plant of the Thermal Syndicate, and the models of transparent quartz-glass apparatus shown by the Silica Syndicate, both excellent examples of industry thoroughly British from their inception.

In connection with the revival of the British glass industry represented in the exhibition, the following quaintly worded passage from a little volume on "The Arts and Manufactures," by William Enfield, "assisted by eminent professional gentlemen" (London: Printed for Thomas Tegg, No. 111, opposite Bow Church, Cheapside, 1809), is of interest:—

"It is to be greatly regretted, that the very important manufacture of glass, should not be so cultivated and encouraged in Great Britain as to prevent totally the importation of foreign; whereas, from the production of sand, lead, and coals, in our own country, we may make the best sorts of glass much cheaper than can be done elsewhere; we yet, however, take looking-glass plates of France, to the amount of a very considerable sum; some window-glass of the Dutch; and the German drinking-glasses for water, with gilt edges and ornaments, are now coming again extremely into fashion. The causes of this demand for foreign commodities, which are, or might be better, and cheaper manufactured here, are various; and the displaying of them not being a proper part of our business at present, we shall wave [*sic*] it, and only intimate, that the tax laid upon glass (against all the principles of good policy) has greatly corroborated