THE SPECTRUM OF η CARINÆ (η ARGUS).—The study of the spectrum of the well-known variable η Carinæ, or as perhaps known better under the name of η Argus, has been undertaken by numerous workers, but the latest research on this star forms No. 252 of the Lick Observatory Bulletin, and is contributed by Messrs. J. H. Moore and R. F. Sanford. The spectrograms here described and studied were secured with the one-prism spectrograph of the D. O. Mills Expedition, at Santiago, Chili. The iron arc was used as a comparison spectrum, and the spectrograph was provided with a constant temperature case. The authors reproduce a plate showing the spectrum secured on March 28, 1913, and give tables of wave-length determinations, with comparisons with the chromosphere, laboratory spectra, and Nova Aurigæ. A brief summary of their results is as follows:—The spectrum is essentially a bright-line spectrum, a number of these lines being identified with the enhanced lines of iron, titanium, and chromium. The titanium and chromium lines show a greater displacement towards the violet than do the iron lines, the latter indicating a velocity of approach of 28 km. a second. The iron lines are in general the stronger lines, those of titanium and chromium being classed among the weaker lines. The origins of several strong lines are still unknown, and notable absentees are the lines of helium, the nebular lines, and 4481 Å magnesium. Some evidence suggests the doubling of the hydrogen lines. The authors conclude that the spectrum of η Carinæ is closely associated with that of novæ at an early stage, and that possibly η Carinæ is a nova. Its position in a great nebula further supports this conclusion.

SCOTTISH FISHERY INVESTIGATIONS.¹

THE Fifth Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters" is the last of a series of reports, issued by H.M. Stationery Office during recent years, which have contained the detailed accounts of work done in this country in connection with the international fishery investigations. The whole series appearing under the above general title comprises five Blue-books dealing with the northern area (Cd. 2612, 3358, 4350, 4893, and 6950), where the work has been carried out by the Fishery Board for Scotland, and five dealing with the southern area (Cd. 2670, 3837, 4641, 5546, and 6125), where the work was done by the Marine Biological Association of the United Kingdom. Other reports dealing with the English statistical side of the international work have been published by the Board of Agriculture and Fisheries (Cd. 4227, 4738, 5362, and 5686).

In the introductory statement to the volume under review the Scottish Fishery Board announces that the results of future investigations will find publication among the Board's ordinary scientific reports. As the southern work is now entirely conducted by the Board of Agriculture and Fisheries, it is to be presumed that the reports dealing with it will be issued in a similar way by that Board. It may therefore be hoped that this change in the mode of publication marks the establishment of the investigations upon a permanent footing instead of their being regarded as merely temporary as heretofore. From the commencement it has been obvious that such work could only accomplish its full purpose when continued over a long series of years, and the Scottish Fishery Board, and especially Prof. D'Arcy Thompson, its scientific member, under whose superintendence the northern investigations have been carried out, are to be congratulated not only

upon the completion of the five volumes of the present series of reports, but still more upon the future prospects of the undertaking.

The first four volumes issued under the direction of the Scottish Board dealt chiefly with hydrographical and statistical researches. In this fifth report, in addition to these subjects, we have accounts of some of the results of the more biological investigations carried out by the research steamer *Goldseeker*. Prof. D'Arcy Thompson is responsible for the first memoir, in which he deals chiefly with the sizes and the distribution of plaice on the basis of the hauls of the research steamer and on the Aberdeen market statistics. A further report on the plaice and other flat fishes, by Dr. T. W. Fulton, based on special statistics of individual catches of Aberdeen trawlers extending over a period of ten years (1901–10) treats of the distribution and seasonal abundance of these fishes in the different areas of the North Sea fished by the trawlers. Dr. Fulton also divides the statistics into two periods of five years, 1901–5 and 1906–10, and contrasts the quantities of fish yielded in a hundred hours' fishing in the first and second periods. It is shown that in the case of plaice the weight landed per unit of fishing is less in the second period than in the first, but that whilst this decrease is marked in the case of large and medium-sized fish, there is an actual increase in the weight of small plaice landed during the second period as compared with the first.

The same feature is also brought out by the Aberdeen market statistics for the years 1905–11, which show a progressive decrease in the average catch per voyage of large and medium plaice, but a progressive increase in the catch of small. In dealing with the question of the increased landing of very small plaice, Prof. D'Arcy Thompson expresses the opinion that their destruction is detrimental to the fishery, and that it yields no commensurate benefit to the trade, a view which supports the recommendation of Prof. Heincke, which will come under the consideration of the International Council, that an international size limit of 10 in. should be enforced for plaice.

A second memoir by Dr. Fulton deals with the plaice-marking experiments. Unfortunately the number of fish marked in Scottish waters has not been large; indeed, it has not been sufficiently large to give results of a very definite kind. There can be no doubt that such experiments, when carried out upon a sufficiently extensive scale, are capable of yielding information of quite exceptional value, and we are glad to learn from the Board's introductory statement that since the period covered by the experiments here dealt with, others have been conducted upon a much larger scale.

The volume concludes with a memoir by Dr. A. J. Robertson on the hydrographical investigations for 1909–10. No new features of a striking character were found during the two years dealt with, but the work has now been carried on over a sufficient period to show what is the ordinary, normal distribution of salinities and temperatures in the area dealt with, and a useful summary of these conditions is given.

E. J. A.

THIRTEEN YEARS' MEASUREMENTS OF SOLAR RADIATION.

IN a paper entitled "Valeurs Pyrhéliométriques et les sommes d'insolation à Varsovie," Dr. Ladislas Górczynski discusses the measurements which he has made at Warsaw with actinometers and pyrheliometers during the thirteen years 1901–1913. The results are to some extent of a provisional character, and they have been published chiefly with a view of assisting the Commission on Solar Radiation in its

¹ Fishery Board for Scotland. Fifth Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1908–11. Cd. 6950.

inquiry into the exceptional character of the latter half of the year 1912. During that period the intensity of solar radiation appeared generally to be considerably below the values previously found; the decrease was indeed so marked that it could be detected in the records from the Campbell-Stokes instrument which is designed primarily for the registration of duration of sunshine. The diminution has been attributed to the presence in the atmosphere of an exceptional amount of fine dust arising from the volcanic eruption of Katmai, in Alaska, at the end of June, 1912.

An ingenious explanation of the way in which the dust may stop the solar radiation without keeping in the earth's radiation to anything like the same degree has been put forward by Humphreys, in the Bulletin of the Mount Weather Observatory. The particles of dust have a diameter almost certainly greater than the wave-lengths of the most intense solar radiation, and smaller than the wave-lengths of terrestrial or atmospheric radiation, so that they would reflect the former but merely scatter the latter; and Humphrey's calculations show that the reflection would be much more effective than the scattering. Thus the effect on the temperature at the earth's surface is the reverse of that due to an increase in the *absorbing* power of the atmosphere, such as would be produced by increasing the water vapour or carbon dioxide in it. The theory is both novel and important; it indicates a method by which purely terrestrial agencies may profoundly affect the mean temperature of the globe, which may be sufficient justification for this digression.

The measurements at Warsaw bear out those found at other places; the intensity of radiation was slightly above the average for the earlier months of 1912, but from July to the end of the year it was nearly 20 per cent. below the average. The amount of the deficiency decreased in the first three months of 1913, and thenceforward the radiation appears to have been about normal. The latest values given are those for July, 1913.

The only other year in the period during which the records show a deficiency comparable with that for 1912 was 1903 (and the last two months of 1902), after the eruptions of Mont Pelée, Santa Maria, and Colima. It will be remembered that 1903 was a year remarkable in this country for its excessive rainfall and its disturbance of meteorological statistics and theories of periodicity.

The results of the whole series of measurements are discussed very fully for different altitudes of the sun, different times of day, and different conditions of the atmosphere, especially as regards humidity. The main text is in Polish, but the headings of the tables are given also in French, and there is a summary in French at the end of the paper.

E. GOLD.

AMERICAN RESEARCH ON CLAYS.¹

A CONSIDERABLE amount of interesting work in connection with clays and the clay industries has been done in recent years in Germany and in America, and no one has worked more enthusiastically than Messrs. Ashley and Bleining. In Germany, too, Drs. Rieke and Endell are doing really fine work. The untimely death of the writer of the first-named pamphlet—Mr. H. E. Ashley—was a sad loss which must have considerably retarded subsequent developments. The clay industries the world over owe the Bureau of Standards, etc., in the United States a debt

¹ H. E. Ashley, Technical Control of the Colloidal Matter of Clays; G. H. Brown, The Function of Time in the Vitrification of Clays; A. V. Bleining and E. T. Montgomery, Effect of Overfiring upon the Structure of Clays. Three Technological Papers of the Bureau of Standards, (Washington, D.C., U.S.A., 1913.)

of gratitude for having set aside such men as Messrs. Ashley and Bleining to devote their whole time to this work, and the results must be a source of satisfaction to the authorities responsible for the innovation.

The posthumous pamphlet by Mr. Ashley, together with his "The Colloidal Matter of Clay and its Measurement" (1909), form a kind of monograph, or rather a brief advocating the colloidal theory as an explanation of the many curious properties of clays. Mr. Ashley was an extremist, and in consequence we have here probably the best possible statement of the theory without those doubts and difficulties which perplex and hamper less enthusiastic temperaments. For that reason, Mr. Ashley's brief is particularly valuable, even though it is certain that some of the applications of the colloidal theory will not be able to stand, in their present form, before adverse criticism.

The colloidal theory has been mainly directed to explaining the plasticity of clays. The argument appears to run somewhat as follows:—The plasticity of clays is determined by the contained colloidal matter (and also by the degree of fineness of the constituent particles of the clay). The greater the plasticity, the greater the proportion of colloids. Colloids are always present in clays in unknown quantities, and the proportion of colloids in clays of different plasticity varies in accord with theoretical requirements! The amount of colloidal matter in a clay is assumed to be proportional to the dye-absorptive power of the clay, and this, in turn, is stated to be proportional to the plasticity.

As a matter of fact, the real plasticity of a clay is not so easily measured. The potter's thumb is the ultimate test, and any process of measurement must express by number those complex sensations which the potter "feels" when he estimates the plasticity of a clay. If measurements of the dye-absorptive power and of the fineness of the grain of a clay will do this, then the problem is solved in a most simple and interesting manner. Unfortunately, the method breaks down completely in practice. Consequently, we cannot really go further than this: the known facts favour the colloidal theory as the best qualitative explanation of plasticity yet suggested, but no one has succeeded in satisfactorily demonstrating the theory quantitatively. Thus we return to the view held by a writer in the eighteenth century, who stated that "the plasticity is due to the presence of a greasy medium between the particles of the clay." It is difficult to see how the plasticity of clays can be measured unless it be treated as a mechanical problem; and to the present writer, Zschokke's analysis of plasticity is far and away the greatest advance that has yet been made.

The two other pamphlets seem to be an application to American clays of some ideas suggested by the present writer in several papers a few years ago: "On the Speed of Vitrification of Clays," etc. Clays are made up of a heterogeneous mixture of particles of different sizes and composition; when clay products—bricks, etc.—are being fired, the more refractory particles start dissolving in the matrix formed by those which melt first. In the extreme case, the whole would form a homogeneous vitreous mass. The firing is stopped before this condition is reached. The stage at which the process of vitrification is arrested is determined by the nature of the required products—porcelain, firebricks, etc.—and on the character of the particular clay "body" being used. Each clay has its own specific character, and this explains how a fireman with no sound principles to guide him—but a triumph of empiricism with one, or maybe two, types of clay—often fails ignominiously when he is transferred from one district to another, using a different type of clay.

J. W. MELLOR.