from scurvy, which can now be avoided, extreme cold is not unfavourable to health, but the magnitude of the results and the absence of serious accidents in the face of such difficulties are beyond all praise.

W. H. DINES.

(4) BIOLOGICAL RESULTS.

As regards the biological results of Lieut. Shackleton's achievement, little can be inferred from the tantalisingly brief statements made in the telegrams. That there will be news of great interest is certain, for Mr. James Murray, whose skill and perseverance as an investigator were proved in the course of the Scottish Lake Survey, is not one to have failed in making the most of his unique opportunity. There is biological as well as geological interest in the report—rich deposits of foraminiferal mud (with abundant Biloculina) 40 feet above sea-level, of radiolarian remains in the erratic chert boulders at Cape Royds, and of Coal measures in latitude 85°, with seams of coal 1 foot to 7 feet thick. The frozen fresh-water lakes near Cape Royds contained large sheets of a "fungus-like plant" and abundant diatoms. Many lichens were found and a few mosses. Mr. Murray found abundant infusorians, rotifers, and water-bears (Tardigrada) in the fresh-water lakes, and demonstrated afresh the strong resistance which rotifers have to extremes of temperature. It is well known that many rotifers may survive very thorough desiccation, and that some are able to resist deprivation of air in an ordinary air-pump vacuum. Zelinka showed that Callidina can revive after exposure to −20° C. and immersion in hot water at 70° C.; it will be interesting to hear what fresh instances of plasticity are afforded by Mr. Murray's researches on the microscopic fauna of these polar lakes. One of the despatches says that numbers of rotifers which had been frozen into ice for three years revived after a few minutes' thawing, and began eagerly devouring the fungus that abounds in the lakes. What is probably an unauthorised addendum to the original telegraph credits Mr. Murray with discovering that the southern rotifers are peculiar in being viviparous, but viviparous species of rotifers have been known for a long time. Another crumb of biological information is the report of the ringed penguin at Cape Royds, which extends the record of the southerly range of this bird. The only other crumb requires a grain of salt, for it tells us that the marine fauna near Cape Royds resembles the Carboniferous fauna of Australia.

THE SOLAR RESEARCH UNION.

THE first volume of Transactions, at the first and second conferences, of this International Union has already been noticed in NATURE (vol. lxxv., p. 458).

The present publication concerns itself with the proceedings of the third conference, held at Meudon on May 20–23, 1907, together with reports of various committees of the union, and some original papers which have not appeared previously in an accessible form. As in the case of the first volume, the general editorship has been in the capable hands of Prof. Schuster, chairman of the executive committee.

Of the six parts into which the book is divided the first two consist simply of lists of the scientific bodies constituting the union, delegates present, and men of science invited to take part. The third section, thanks to the excellent record kept by the three secretaries, gives full minutes of the six meetings held during the conference.

The first action of the delegates was to elect as president, by acclamation, M. Janssen, the venerable and illustrious director of the Observatory of Meudon, whose subsequent death has been universally mourned. His short speech, accepting office and returning thanks, was concluded by the following words:—"C'est à vous, Messieurs, que je confie l'avenir de cette science du soleil que j'ai cultivée avec passion pendant plus de quarante années, de cette science des mondes dont j'entrevois l'avenir fructueux. Laissez-moi vous remercier, au moment où je termine ma carrière, de la joie que vous me donnez aujourd'hui."

Mutual helpfulness and coordination, with due regard to the disparity among the equipments involved, might be regarded as the watchwords of the conference. The necessity for these in the spectroscopic determination of the solar rotation periods and in the observation and classification of solar prominences was urged by various members.

M. Perot presented a new measure of the red cadmium line for use as a primary standard, made by MM. Benoît, Fabry, and himself, while the committee on standards of wave-length was given, by resolution, the further duty of preparing a list of secondary standards, to be submitted to the constituent societies, and, if approved by them, adopted by the Union. Both the paper on the red line of cadmium and a further paper by MM. Fabry and Buisson, on the measurement of wave-lengths for the establishment of a system of standard lines, are printed in full.

A complete account of the scheme of sun-spot spectrum observations, suggested by the committee on sun-spot spectra and drawn up by Prof. Fowler, was adopted by the Union, and is incorporated in the Transactions. This scheme allots to each observer a section of the spectrum of about 250 tenth-metres, together with certain other observations outside the special region, but is far from discouraging the initiative of the individual in undertaking further work when opportunity presents itself. The whole of the visible spectrum, in overlapping sections, is already portioned out among the observers available. Though almost without doubt the future of this subject lies with the photographic method, it is a wise policy to make use of the equipments already existing and of the observers already trained in visual observations of spot spectra for a more complete and co-ordinated study than has yet been undertaken. The further knowledge gained will be a welcome endowment for the large sun-spot spectrographs when they are more plentiful than at present.

With regard to the solar constant, resolutions were adopted stating the need for central stations where instruments for this work might be tested and standardised, and indicating the laboratory of M. Ångström at the University of Upsala as the principal central station. A report of the work carried out in the Smithsonian Astrophysical Observatory, relative to the solar constant, is also printed.

The report of the committee on work with the spectroheliograph gives the general programme of observations suggested to the individuals and institutions cooperating in this important work. The need for mutual help, in the interest of progress, is particularly great in work of this character. For intimate study of the rapidly changing solar activities a series of photographs taken as closely together in time as possible is desirable. With a ring of stations round the globe the records at the more westerly would be in sequence after the more easterly, and thus in any one day a series of photographs would

[1] "Transactions of the International Union for Cooperation in Solar Research." Vol. ii. (Third Conference.) Pp. viii+244. (Manchester: University Press, 1908.) Price 7s. 6d. net.

be available on which to trace changes. The present distribution of contributing stations, India, western Europe, and America, fulfils in some sort this need, though a distinct lacuna exists in the longitude of Australia.

A paper, by Prof. Hale, on the measurement of spectroheliograms gave rise to an interesting discussion concerning the methods of reducing the photographs already obtained. In his case, after some experiments, a photometric method of determining the areas of selected flocculi had given satisfactory accord, while Sir Norman Lockyer was able to report that, in the direct measurement of the series of spectroheliograms being formed at South Kensington, and in spite of the difficulties, good agreement was obtained by the two observers engaged in the work. In the study of the relation between solar activities and terrestrial changes, measurements of the numbers and areas of flocculi are likely to be of great importance. At all times the areas affected are greatly in excess of the spotted areas, while during the almost spotless periods of sun-spot minima, flocculi persist (in lessened degree), and bridge what would be otherwise practically a gap in the records.

The computing bureau of the union, established at Oxford under Prof. Turner, will make special studies of such spectroheliograph negatives as are entrusted to it by members: this, however, without prejudice to the right of reducing and studying photographs by those responsible for their taking. A start has already been made at Oxford on some plates lent by Prof. Hale.

The difficulties in the selection of the flocculi, recorded on the plates, for measurement, together with differences in size and quality of the photographs, make satisfactory and comparable measures far from easy. Great credit is due to the institutions and workers on this subject for the progress already made.

A proposition by Sir Norman Lockyer supporting the project for the establishment of a solar physics observatory in Australia was carried unanimously. This project, if carried into effect, would add another link to the chain of spectroheliographs girdling the earth.

An account, by M. Deslandres, of the spectroheliograph equipment and work accomplished with it at Meudon, together with an excellent picture of the sun in K_2 light, and a series of spectra in the neighbourhood of K used for the determination of the radial velocities involved in the solar activities, concludes the volume.

The delegates were invited by Prof. Hale to come to California for the next meeting, so that the date 1910 and the place Mount Wilson were provisionally decided upon, Prof. Hale being thanked for his kind invitation.

The publishers are to be congratulated on the get-up of the book, the paper and printing being good and the binding neat and effective.

T. F. C.

THE MANUFACTURE OF BASIC STEEL.

OF the many varieties of cast- or pig-iron, the three following percentage compositions may be taken as representing three most important types:—

	(*a*)	(*b*)	(*c*)
Carbon	3·5	3·5	3·5
Silicon	2·5	1·0	2·5
Manganese ...	0·5	2·0	0·6
Sulphur	0·05	0·06	0·04
Phosphorus ...	0·05	2·0	1·6

An average chemical specification with regard to sulphur and phosphorus in steel is "not to exceed 0·06 per cent. of each." For certain Government work the standard is 0·04, and easier specifications allow of 0·08, but 0·06 is a fair average.

The first pig (*a*) is suitable for conversion into steel by the acid process, in which the oxidising agent, whether oxygen of the air or oxygen from oxide of iron, acts upon the metal while it is contained in a vessel or a hearth composed mainly of the acid material silica. In this process the slag is necessarily of an acid nature, and sulphur and phosphorus therefore are not eliminated. Enormous quantities of iron ore are available, which contain very much higher proportions of phosphate than the hæmatite from which the cast iron of the (*a*) variety is produced, and as in the blast furnace practically all the phosphorus in the charge of ore, fuel, and flux enters into the metal, pig-irons are made that are much too high in phosphorus for conversion into steel by the acid process. By using a vessel or a hearth lined with basic material, such as burnt dolomite or magnesia, the steel can be finished in contact with a slag sufficiently basic to effect the removal of the phosphorus. The basic process as commonly worked some years ago, and sometimes even to-day, consisted in charging a mixture of about equal parts of pig-iron and scrap on a basic hearth, and then, by additions of iron ore and lime, eliminating the silicon and manganese, as well as the carbon and the phosphorus, to the extent necessary in the manufacture of mild steel. By this ordinary method of working, as the phosphorus is only sufficiently eliminated when the carbon is low, the process was generally used for the manufacture of mild steels, as unless the highly phosphoric slag is removed from the surface of the metal at the end, during re-carburisation phosphorus is reduced from the slag, resulting in an increased percentage of phosphorus in the bath. Sulphur is not to any great extent removed during the process as ordinarily conducted, and although the amount of sulphur in the bath can be reduced by additions of fluor-spar during the conduct of the process, these additions, if in excess, not only prove destructive to the banks of the basin-shaped receptacle, but render the phosphate in the slag insoluble, and thus decrease its value for agricultural purposes.

The pig-iron for the basic process must therefore be comparatively low in sulphur for successful regular working, and if by any means it should be high in sulphur must be subjected to a desulphurising process, such as the Massenez manganese process or the Saniter oxychloride or fluoride process.

The ordinary conditions for the manufacture in the blast furnace of pig-iron high in silicon content are those favourable to the production of a pig-iron low in sulphur, but a high-silicon pig-iron used in the ordinary basic process is again destructive to the banks of the furnace. The manufacture of a low-silicon low-sulphur pig, such as (*b*), can be effected by the use of manganiferous ores added to the blast-furnace charge. These ores are expensive, and the manganese in the pig-iron is lost during the conversion of the pig into steel. These statements give shortly the conditions connected with the manufacture of basic steel.

Many attempts have been made to improve the ordinary method of working, either from the point of view of being able to accept pig-iron high in sulphur, or, on the other hand, of being able to use a pig-iron high in silicon, because of the difficulty and expense connected with making the pig low in silicon and sulphur.

In 1894 a patent was granted to Messrs. Bertrand and Thiel for removing the silicon, the bulk of the phosphorus, and part of the carbon and manganese in