## The Microscope in Science and Industry.

A CONFERENCE of the Royal Microscopical Society was held at Sheffield, April 20-22, which was attended by many fellows of the Society and some eighty delegates from other societies. Members of the Conference were received on Monday afternoon at the Town Hall by the Right Hon. the Lord Mayor and Lady Mayoress and in the evening at the University by the Vice-Chancellor.

On Tuesday morning, April 21, the scientific proceedings were opened by an address from the president, Mr. A. Chaston Chapman, who said that he had very great pleasure in presiding over the first Conference held out of London under the auspices of the Royal Microscopical Society. It was his firm belief that the Conference could not fail to exercise a powerfully stimulating effect upon the development of that branch of pure and applied science which it was the special function of the Society to represent. The Society was established in 1839 for the promotion of microscopical and biological science in general. In process of time and with increasing emphasis during comparatively recent years, the microscope has become an essential instrument of research and control in a large number of industries. It is difficult to think of a single industry in which the microscope is not an instrument of almost daily use, and there are many in which it has led to discoveries of fundamental importance. The Society's attentions are not, however, confined to industrial applications of the microscope. The other and older activities have been in no way neglected; the ordinary meetings, as well as those of the Biological Section, are characterised by a vitality which augurs well for the Society's future and for the successful carrying out of the great task it has undertaken. With the introduction of new instruments of research and the continuous development and refinement of the older ones—amongst which the microscope occupies a foremost position—the scientific investigator will find new fields of inquiry ever opening out before him. Many instruments with which the scientific investigator is concerned yield indications which may be described as indirect; it is the main interest of the microscope that it reveals the actual object to the eye, and with certain qualifications necessitated by technical imperfections, and apart from metaphysical subtleties, it can be assumed that what is seen is the thing itself. The microscope would appear to be the only scientific instrument which can claim a Society for its own, and when it is remembered what it has done in the past for human knowledge and its possibilities are considered, it seems worthy of that honour. When it is realised that rulings of more than 100,000 to the inch can be resolved and that the largest molecules such as those of starch or proteins may not be beyond the power of modern ultramicroscopic perception, results may be within reach which even the rashest and most imaginative would scarcely dare to predict.

Some of the papers presented during the morning were read in title only. A joint paper on "The Development of the Use of the Microscope in Steel Works," by Sir Robert Hadfield, Mr. T. G. Elliot, and Mr. G. B. Willey was read by Sir Robert Hadfield. Modern metallography is based upon the observation under the microscope of the internal structure of metals. The paper traced the outline of the development of this application of the microscope and gave examples of its help in works-problems connected with ferrous metals. A comparison of the microstructure of metals with their chemical, physical, and mechanical properties often shows that microscopic examination affords an economical method of interpreting irregularities. A paper by Mr. F. F. Lucas (New York) on "New Facts developed by High-power Metallography" also brought forward some interesting points. The micro-structure of austenite, martensite, and troosite was described; the process of decomposition of austenite and martensite to pearlite, and cold work and regranulation was discussed. Another paper that attracted much attention was one by Mr. J. Ramsbottom on "Some Points in the Life Histories of Yeasts." There is apparently an alternation of generations in yeasts. Endospores either germinate directly and give rise to dwarf forms or copulate in pairs to produce normal colonies. It is possible that some of the numerous "species" of Torula, so troublesome particularly to medical men and brewers, are really dwarf forms of Saccharomyces. The importance of this to the brewing industry is indicated by the fact that the "Hofbrau" yeast, which is of the typical "Frohberg" type in the normal form, is of the "Saaz" type in the dwarf form. It is interesting to note in connexion with the modern tendency to use light of short wave-length in microscopy that the paper was illustrated by a number of ultra-violet (cadmium) light photomicrographs taken by the late Prof. K. Kruis.

The morning's proceedings ended with the inevitable photograph of members of the Conference. In the afternoon, visits to the works of Messrs. Thomas Firth, Vickers, and Walker and Hall gave a new meaning to the blessed word "steel" to southern biologists. The proceedings on Tuesday were completed by a reception by the Master Cutler at the Cutlers' Hall.

On Wednesday morning the majority of the papers had a "technical" bias. Mr. Conrad Beck advised caution in the interpretation of microscopic images. Examination of a microscopic image with another microscope shows that, due to diffraction, it is a disc surrounded by a few rings of light. Two points are pictured as two discs, a row of points forming a line is a row of overlapping discs or a band of perceptible thickness. A structure of lines is portrayed as a series of bands more or less overlapping and confused. The size of the disc-image of a point is the factor governing resolution. If the band-images of two lines in the object do not overlap, they can be recognised as two elements and are said to be resolved. When the bands are of a thickness equal to their distance apart, they can just be resolved; thus if a microscope has a resolution of 1/100 lines to the inch, every detail that it shows will appear to be 1/100 of an inch larger than it really is. Resolution is the correct method of describing the sharpness with which a microscope will show an object. The rings round the disc image may generally be disregarded, though under certain conditions they are visible, and many of the sheaths supposed to surround bacteria are really diffraction contour lines. The size of the diffraction disc depends on two factors: the angle of the cone of light collected by the microscope from each point of the object and the wave-length of the light that passes from the object into the object-glass. These factors determine the amount of detail that actually exists in the image—but sufficient magnifying power must be employed to render such detail visible to the eye. The limiting factor of microscopic vision is not magnifying power but aperture and wave-length. Large magnifying power without sufficient aperture is empty magnification. From 1000 to 1500 diameters is as large a magnification as can be advantageously used with anything but ultra-violet light. The use of an immersion lens has the

effect of reducing the wave-length of the light and thus increases resolution. The illumination of opaque objects or dark-ground illumination utilises the whole aperture of a microscope because the object acts as a self-luminous body. With transparent objects the resolution is profoundly influenced by the illumination. The correct method of providing this with a substage condenser was discussed in its various aspects, and its relation to glare and the difficulties of delineating almost transparent structures considered.

Mr. H. Wrighton spoke on "Some Details in Metallurgical Microscopy" and went rather fully into the matter of illumination. Dr. Rogers discussed test objects for metallurgical microscopy. Microscopists have had for a long time a number of test objects by which the comparative merit of a lens can be readily ascertained. To metallurgists, pearlite is most commonly available. For powers of 1000 and upwards, stainless steel was suggested. The final paper was by Mr. W. J. Rees on the micro-examination of refractory materials. There are three methods available. The examination of thin transparent sections by transmitted light by the application of normal petrographic technique. The examination of flat polished surfaces by reflected light, which is difficult to apply on account of the friability of most refractories; the comparative effects obtained by the use of etching reagents such as hydrofluoric acid, are not sufficient to distinguish many common constituents. The examination of powdered materials is especially useful in the examination of silica bricks and of fused alumina-silica refractories.

Sir Robert Hadfield proposed that representations should be made to the Royal Society that the Sorby Research Fellowships should be used for the furtherance of metallurgical microscopy by research on the question of higher magnification and better resolution. The official proceedings closed with votes of thanks to the Lord Mayor, the Vice-Chancellor of the University, Sir Robert Hadfield, and the Local Committee. Parties of members spent the afternoon in visits to the works of Messrs. Hadfields, Cammel Laird, and Joseph Rodgers.

Throughout the Conference an excellent trade exhibition of microscopical and cognate apparatus was open in the Chemistry and Physics Laboratories of the University. Of many excellent and dazzling instruments it would seem invidious to mention any particular exhibit. At the same time a number of novelties attracted a great deal of attention, and in the circumstances it was natural that these should be of particular service in metallurgical work. Messrs. Beck's exhibit included a "Radial" photomicrographic apparatus of great convenience and rigidity. Messrs. Chapman and Alldridge showed some of their vertical illuminators at work, Messrs. J. W. Ogilvy showed amongst other items a 16 mm. oil-immersion objective, and Messrs. Swift a micro-goniometer.

## The "Honey-Sense" of Bees.

A RECENT paper by Frisch[1] records some interesting observations on the manner in which bees notify to members of the same hive the existence of a rich source of honey. By the use of a glass-fronted observation hive and by marking the bees with various combinations of coloured spots, Frisch states that he found that a bee which had just returned from an exceptional source of supply, performed a rapid dance lasting from thirty to sixty seconds. This might be repeated in one or more places in the hive, during which the performing bee necessarily came in contact with the surrounding insects, and it was observed that these latter stroked the abdomen of the dancing bee with their antennæ. Afterwards these same bees emerge from the hive and search in ever-widening circles, up to a kilometre away from the hive, for the source of honey the existence of which has been communicated to them in the manner described.

Experiments showed that in this search the bees are in part guided by the flower scent associated with their informant. After collecting their honey-loads they in their turn regain the hive and exhibit the same dancing movements, thereby enlisting additional recruits for the exploitation of their find. But the number of bees thus brought is more or less proportional to the honey supply as, if access to an artificial source of honey is rendered difficult, the returning bees do not dance and no addition is made to the numbers collecting from this source.

From the greater ease which Frisch experienced in training bees to scent as compared with colour, and from the fact that recruits came to scented but not to scentless flowers, he concludes that scent is more important than colour. This view, whilst in agreement with that of Plateau, is at variance with the conclusions of Wery, who found that flowers which were completely enclosed in glass globes attracted bees as readily as those exposed. Frisch's views on the importance of scent and the seat of this sense in the antennæ is difficult to reconcile with Forel's experience that bees from which the antennæ had been removed visited flowers with even greater precision than unmutilated individuals. In addition to the flower-scent perceived by recruits as attaching to the returning bees, Frisch adduces evidence to show that the bee possesses a scent-gland by means of which it secretes a volatile substance at the honey source, and this, together with the scent of the flower, guides the recruits to their destination.

Pollen-collecting bees likewise perform a dance when returning from a rich source of pollen, but this is stated to differ in character from that performed by the honey-collectors. Here too the recruits are guided both by the pollen scent and the scent secreted by the recruiting bee. E. J. S.

[1] K.v. Frisch, "Sinnesphysiologie und Sprache der Bienen." (Berlin: Julius Springer, 1924.) 1·20 gold marks.

## University and Educational Intelligence.

CAMBRIDGE.—The trustees of the Captain Scott Memorial Fund have offered to hand over to the University a sum of about 13,000*l.* for the erection, endowment, and maintenance of the "Captain Scott Polar Research Institute." They suggest that 6000*l.* be set aside for the building and its upkeep, indicating that there are clear advantages in the Institute being a wing of a departmental building; presumably the Trustees have the Department of Geography in mind, and it may be hoped that this gift may stimulate into success the endeavours that have been made to secure adequate accommodation for the Department. The Council is to propose a Grace gratefully accepting the proposed gift.

Lord Ullswater, chairman of the Cambridge University Commissioners, has informed the Vice-chancellor that in order to enable the Commissioners to organise a Faculty system for the University, as proposed by the recent Royal Commission, and also in order to meet some of the most pressing needs of the Library, the Government has increased the annual state grant from 60,000*l.* to 85,000*l.*

Dr. J. H. Jeans, Trinity College, will deliver the lecture on the Rouse Ball foundation on May 11, his subject being "Atomicity and the Quantum Theory."