occurred to me. The facts can be accounted for in a perfectly simple manner if we suppose, as postulated by the theory of Hering, that there is an independent white sensation, and, further, that the latent period for a colour sensation is very much greater than that for white. For green, under the conditions of my experiments, the latent period would be at least 1/40 second, while for white it can hardly exceed 1/500 second, though the luminosity of the two may be as nearly as possible equal. The latent period for red is probably not very different from that for green under similar circumstances, while that for blue is considerably greater.

If in a darkened room a ray of green light is admitted to the eye for 1/40 second, one sees a flash of green; but, assuming that the suppositions which have been put forward are correct, the visible flash is not contemporaneous with the physical illumination. One does not begin to experience the green sensation until after the green ray which excited it has been shut off. What is actually perceived is, in fact, a positive after-image, the duration of which may be considerably longer than that of the stimulus. But if a sufficiently luminous white surface is presented to the eye immediately upon the expiration of the brief period of stimulation by green light, the after-image formed will not be positive, but negative, and the only colour perceived will be purple. The fatigue to which the negative image is due must have been set up during the latent period, when no image at all was actually perceived.

The formation of vivid pulsative images depends not only upon the latent period, but also upon persistence, luminosity, the duration of the primary impression and of the periods of light and darkness, and upon other circumstances. And the conditions which are best for some colours are not so for others. This fact obviously suggests that the pulsative image might afford a means of analysing compound colour-sensations, though so far it has been found available only to a limited extent. If the complete spectrum is projected upon the screen, it is seen at once that the blue-green pulsative image of the red, and the purple pulsative image of the green, are far more intense than the pulsative images of the yellow, the blue and the violet portions of the spectrum. Accordingly, if we make an orange colour-patch by combining red and yellow rays, it is not surprising to find that its pulsative image is blue-green, hardly differing at all from that of red, instead of sky-blue, which is the colour of the ordinary after-image of orange. Now the pulsative image of a patch illuminated by the simple orange rays of the spectrum is also found to be blue-green; hence the inference is clearly suggested that the spectral orange rays excite a red sensation. This particular fact will probably be regarded as one which needs no demonstration, but it is mentioned as an illustration of the proposed method of analysis. Several others in which the conclusions can be verified by trial might be given. Now it is noticed that under most ordinary conditions the purple pulsative image of green is more easily produced than that of any other colour. Under the same conditions we find that the pulsative images of yellow, of blue and of white are purple, and, assuming that the test referred to is a sound one, we conclude that yellow, blue and white all excite a green sensation. The proposed method of analysis may probably be carried much further than has yet been done.

This paper also contains an account of some new observations upon a class of phenomena to which I have drawn attention in a former communication (*Proc. Roy. Soc.*, vol. lx. p. 368; NATURE, vol. lv., p. 367). If the image of a white object is suddenly formed upon the retina after a period of darkness, the object generally appears to be surrounded for about one-tenth of a second by a narrow red border. It was noticed that when the bright object producing the image was looked at through variously coloured glasses the red border did not appear unless the glass used was capable of transmitting red light, and it was suggested that the phenomenon was due to sympathetic excitation of the "red nerve-fibres" lying immediately outside the portion of the retina directly affected by the radiation. The orange and yellow glasses employed for the observations referred to of course transmitted red light. Using the pulsative image apparatus with the eyepiece method, I now find that the simple red, orange and yellow rays of the spectrum, whether alone or in conjunction with any others, are competent to produce the red borders. The effect stops short at the beginning of the greenish-yellow. When blue and green rays are employed to illuminate the patch, either separately or in combination with each other, a blue-green border is produced. This is less intense than the red one before referred to, but if viewed in the manner described in the paper, the appearance of the green border due to pure spectral blue light of about λ4700 is very striking. Violet produces no coloured border of the kind, and its admixture with other rays has no sensible effect upon the phenomenon. It can hardly be doubted that effects which occur, sympathetically as is suggested, just outside the boundary of the physical image, must also occur within the boundary; and if that is so, it follows that red, orange and yellow rays, nearly up to the beginning of the greenish-yellow, excite a red sensation, while green and blue excite a green sensation. There is at present no evidence of the same kind as to the existence of any other fundamental colour-sensation, though there must, of course, be at least one more.

The bearing of these border experiments upon theories of colour-vision is indicated in the paper. The following is among the most important points referred to. It is found that a comparatively small proportion of red mixed with other spectral rays results in the formation of a red border. According to the Young-Helmholtz theory, green spectral rays excite the fundamental red sensation to about the same extent as orange-red rays; yet no red border is formed by the green, though that formed by the orange-red is very strong. The natural deduction is that no red sensation is excited by green light.

As regards a different point which has been much debated, certain observations seem to be absolutely conclusive. According to Helmholtz the phenomena of simultaneous contrast are due entirely to mental judgment; according to Hering their origin is a physiological one. Experiments with one of the eyepiece methods, in which the apparent diameter of the pulsative image is about one-fourth of that of the white-light disc or field of view, seem to place the matter beyond dispute. If a purple pulsative image is produced from a strongly illuminated green colour patch, the whole of the physically white field surrounding the patch appears to be purple. It cannot possibly be that the colour of the ground is a psychological effect resulting simply from contrast with green, for no green whatever is consciously perceived; the cause must necessarily be of a physiological nature. A similar effect is produced in an even more striking degree by blue and by violet colour-patches, the whole field appearing to be of the same hue as the pulsative images, namely orange and yellow. Phenomena of simultaneous contrast, as they are called, are therefore certainly not in all cases to be explained solely on psychological grounds.

The experiments which have been discussed establish nothing decisively in favour of either of the two principal theories of colour-vision. Some of the observations seem to support the Young-Helmholtz theory, others that of Hering; others, again, appear to indicate that neither theory in its present form is tenable. I venture to think that our knowledge of the subject might be materially increased by further experiments on the lines of those described.

SHELFORD BIDWELL.

THE SECOND INTERNATIONAL CONFERENCE FOR THE EXPLORATION OF THE SEA.

AFTER the International Conference which met at Stockholm in June 1899 for the consideration of a scheme for the systematic scientific study of fishery questions, it was proposed to meet again to complete the programmes at Christiania in the autumn of 1900. Various circumstances made it necessary to postpone the meeting, which eventually took place in the second week of May, when representatives of Germany, Belgium, Denmark, Finland, Great Britain, Norway, Holland, Russia and Sweden (the order is that adopted in the official *compte-rendu*—alphabetically in the French language), to the number of twenty-five, assembled in Christiania. The delegates included Dr. Herwig, president of the German Society for Promoting Sea-fisheries; Profs. Krümmel and Brandt of Kiel, and Profs. Heincke and Henking from Germany; Prof. Gilson of Louvain from Belgium; Captain Drechsel, Dr. Martin Knudsen and Dr. C. G. J. Petersen from Denmark; Dr. Nordqvist from Finland; Sir Colin Scott Moncrieff, Prof. D'Arcy Thompson, Dr. H. R. Mill and Mr. W. Garstang from Great Britain; Prof. Nansen and Dr. Hjort from Norway; Dr. P. P. C. Hoek from Holland; Dr. Knipovich from Russia; and Profs. Pettersson and Cleve, Dr. Trybom, Captain Maechel and Messrs. Wijkander and

Ekman from Sweden. Dr. H. H. Gran and Mr. K. V. Hammer acted as secretaries, and Profs. G. O. Sars and Mohn were invited to take part in the deliberations of the Conference.

The Norwegian Government received the Conference, the Prime Minister, Mr. Steen, acting as host, and very cordial messages were received from the King. The Municipality of Christiania also showed a lavish hospitality, and everything that could be done to promote the comfort of the delegates had been thought of and provided for. The meeting lasted from Monday, May 6, to Saturday, May 11, and the work—either in the full meetings, in committees, or, by no means least important, in personal conversation—was practically continuous from early morning till past midnight. The result was, on the whole, highly satisfactory; concessions had doubtless to be made all round, and some conclusions which might not be the best conceivable had to be accepted as the best obtainable; but the harmony of the international fellow-workers was unbroken, and during the whole meeting no question had ever to be put to the vote, agreement in every case being unanimous. The president of the Congress was Prof. Nansen, but the chief delegate of each of the chief countries represented presided each on one day.

The first work was the revision and completion of the Stockholm programme in its two divisions, which were known as the hydrographical and the biological. The former division, having been well elaborated at Stockholm, was easily disposed of, but the biological programme was entirely recast, several independent schemes of work which had been brought forward by the delegates having to be combined with the provisional programme. Next came the question of the organisation of the scheme of international research, which was only partially achieved. As it was necessary to refer several points to the various Governments concerned, it was decided that a committee of the vice-presidents should draft a series of recommendations to be sent in the same form to all the participating Governments, but not to be made public until a decision had been arrived at. Finally, a number of resolutions in the form of "pious opinions" were proposed and adopted.

The introductory clause of the official report, referring to the complete programme, runs: "Considering that a rational exploitation of the sea should rest as far as possible on scientific inquiry, and considering that international cooperation is the best way of arriving at satisfactory results in this direction, especially if in the execution of the investigations it be kept constantly in view that their primary object is to promote and improve the fisheries through international agreements, this International Conference resolves to recommend to the States concerned the following scheme of investigations which should be carried out for a period of at least five years."

A. *Hydrographical Work.*—The object of this work is defined as the distinction of the different layers of water according to their geographical distribution, depth, temperature, salinity, dissolved gases, plankton (as an index of movement of water) and currents. To effect this object it is recommended that simultaneous observations should be made in the North Sea, English Channel, Baltic and North Atlantic along certain definite lines four times in the year, the middle point of the series of observations being in the first half of February, May, August and November. Instruments and methods are prescribed, and it is provided that meteorological as well as oceanographical observations shall be made, and that facilities shall be offered to the various national meteorological offices to cooperate in the study of the upper atmosphere at sea by the use of kites. The observations made on each of the international trips are to be plotted on synoptic charts at the earliest possible date after the return of the vessels. Stress is laid on the provisional nature of any determinations of salinity or density made at sea, and on the importance of carrying out such observations with the highest precision in laboratories on shore. The unit of depth is to be the metre, although it is allowable to add the depths in fathoms. The sea-mile is to be the unit of horizontal distance. For temperature, thermometers graduated in either centigrade or Fahrenheit degrees may be used, but all readings are to be reduced to centigrade for publication. While the new tables of the physical constants of sea-water prepared by Dr. Martin Knudsen, of Copenhagen, are to be employed, and are sufficient for their purpose, it is pointed out that it is desirable to have the existing tables of the absorption of atmospheric gases in sea-water revised. The mapping of the deposits on the sea-bed of the area to be studied is another desideratum to which attention is called. It is also pointed out that it is desirable to encourage regular observations of surface temperature and the collection of samples of surface water on board the steamers of regular lines which cross the area under investigation, a branch of work which has yielded excellent results in the hands of the Danish Meteorological Institute and in those of Mr. H. N. Dickson.

B. *The Biological Programme.*—Here two classes of recommendations are to be distinguished, those referring to obligatory work which each of the nations concerned is held bound to carry out, and to optional work, which, while desirable in order to complete the scheme of investigation, is not of such urgent importance. The areas in which the various nations are to work are suggested both for the hydrographical and the biological researches. Briefly put, they provide that the North Sea south of 58° N. should be divided by the meridian of 2° E., to the west of which British vessels should do the work, to the east of which Belgium, Holland, Germany and Denmark should undertake the sections lying off their own coasts. From 58° to 62° N., Great Britain, Norway and Denmark would share the work in the North Sea and North Atlantic. From 62° northward would be the sphere of interest of Norway in the Atlantic and of Russia off the Murman coast. The Baltic and its approaches would be dealt with by the three Scandinavian nations, together with Germany, Russia and Finland. No objection would be made to any of the research vessels extending their operations beyond the area allotted to them provided that the work in that area is not neglected.

The biology of food fishes is to be investigated in a comprehensive manner. The preparation of charts is recommended, showing the distribution in all their stages of growth of plaice, sole, turbot, cod, haddock and herring in the North and Arctic Seas, and of flounder, cod, sprat and herring in the Baltic. The observations to yield data for these charts are to be carried out as often as possible and with uniform trawls and other appliances, while the measurement and all particulars of the fish caught are to be recorded in a systematic and uniform manner.

In this respect optional researches are suggested on the life-history of food fishes with regard to their development, migrations and feeding places, all in connection with hydrographical conditions. To help towards this end the liberation of marked fish over wide areas and in large numbers is recommended. It is also considered useful to inquire as to whether fish of different species after being caught by various methods are likely to live if immediately liberated.

The study of the quantitative distribution of pelagic eggs, larvæ and young fishes is to be carried out as part of the routine work at all stations where physical observations are made, the method recommended being by vertical hauls of Hensen's large egg-net. As an optional extension of this part of the work the study of the eggs and young of food fishes may be continued in the intervals between the quarterly cruises, and experiments should be made on the artificial fertilisation and hatching of ova.

The researches of individual specialists are to be promoted by the collection of material as to the local varieties of plaice, herring and mackerel in the entire area subject to international investigation, and such researches may also be extended to include other useful species. The areas where undersized or immature fish specially abound are to be very carefully inquired into, and the quantity of such fish landed at the various ports as the result of various methods of fishing are to be ascertained. The statistical methods may be extended by the occasional sending out of experts on board fishing vessels to examine the catch as it is brought on board.

The study of plankton and bottom fauna is to be carried out by qualitative samples being collected as one of the routine operations at the various stations for hydrographic observations on the quarterly cruises, not merely from the surface, but by vertical hauls. Where possible, similar collections at other times and at regular shore stations is recommended as an optional extension. Quantitative hauls with Hensen's plankton-net are also recommended, the material collected being offered for examination to specialists who may be willing to undertake the work of quantitative determination. Endeavours should be made with suitable apparatus to investigate the organisms which inhabit the lowest water layers immediately above the bottom. The macroscopic animal and plant life of the bottom should also be studied, with special reference to the nutrition of food fishes. Among the optional researches which are suggested with reference to the bottom fauna are observations on the bacteria of the bottom and of the water immediately above.

The last section of the biological programme deals with the importance of elaborating fishery statistics so as to yield data for constructing maps of the fishing grounds, and for determining the influence of physical conditions on fish.

With regard to the apparatus to be used in these observations, Prof. Nansen, Dr. Hjort and Mr. Garstang gave a demonstration on board the *Isbjorn* in Christiania fjord of the insulating water-bottle as used for exact measurements of temperature, and of various forms of closing tow-nets.

C. *Organisation of the International Council, Central Bureau and International Laboratory.*—The organisation which is to put the elaborate system of observations recommended by the Conference into operation and to record and work out the result is obviously the most important part of the whole scheme, as upon its successful working depends the whole of the success of the attempt at concerted action. The International Council is thus described :—

"The permanent International Council shall consist of commissioners elected by the Governments interested. Each Government should appoint two commissioners who may be represented at meetings by substitutes, and may be accompanied by experts who, however, shall not be competent to vote.

"The council elects its president and vice-president and appoints all officials of the Central Bureau. Should the general secretary represent hydrographic science, one of his principal assistants should be a biologist, and *vice versa*. The other assistant shall preferably be experienced in statistical work. . . .

"It will be for the Governments concerned to decide among themselves the amount of the contributions to the Central Organisation. The expenses of the Central Organisation are approximately estimated at 4800*l.* yearly. . . .

"The purpose of the Central Bureau will be :

"To give uniform directions for the hydrographic and biological researches in accordance with the resolutions drawn up in the programme of the present Conference, or in accordance with such modifications as may be introduced later with the consent of the States represented.

"To undertake such particular work as may be entrusted to it by the participating Governments.

"To publish periodical bulletins which shall contain the actual data obtained in the cruises of all the participating States at the earliest possible date, and also such other papers as may prove useful in coordinating the international work. . . .

"The site of the Central Bureau, to be decided by the Governments concerned, shall at the same time be the residence of the general secretary.

"The purpose of the International Laboratory shall be :—

"To control apparatus and to ensure uniformity of methods. The various apparatus and instruments now used for oceanic research should be examined in order to settle which are the most trustworthy. Experiments may also be made to improve the apparatus and instruments or to construct new and better ones.

"The water-samples sent by the workers of the participating States are to be analysed and examined at the Central Laboratory, from which also samples of standard water should be provided. . . .

"The International Laboratory is subordinate to the Central Council, to which its accounts shall be rendered. Its operations shall be reported to the Central Bureau.

"The site of the Central Laboratory shall be decided by the Governments concerned, and should be conveniently situated for oceanic researches."

The relations of the Central Bureau and the International Laboratory will probably be somewhat difficult to define, and the success of the two practically independent institutions will depend on the strength and tact of the International Council, the selection of the members of which will devolve upon the Governments associating themselves with the work.

Resolutions.—The general resolutions adopted by the Conference included an expression of the desirability of the provision of at least one steamer specially adapted for marine research by each of the participating States. This is so self-evident as hardly to require statement. Norway already possesses such a vessel in the *Michael Sars*, which has already done excellent work under Dr. Hjort; Russia has also equipped a vessel for fishery observations, and Germany has sanctioned a very carefully-planned ship, involving some very important innovations, which is now, we believe, almost ready to be launched. To carry out the British share of the work properly two vessels will be required, and for so promising a field of practical application of science it seems reasonable to hope that they will be provided.

The opinion is formally expressed that the Central Bureau should commence operations as soon as possible, and not later than the beginning of next year, while the first set of international cruises should take place not later than May 1902. To make this possible it is recommended that the International Council should meet in Copenhagen as soon as the participating Governments decide to accept the programme of the Conference.

A resolution expresses sympathy with the efforts of Governments which are endeavouring in the face of difficulties from foreign trawlers to preserve an area, such, *e.g.*, as the Moray firth, from fishing operations, for experimental purposes. Another thanks Dr. Knudsen for his recently published hydrographical tables, in which he gives a new determination of the physical constants of sea-water. The remaining resolutions suggest methods for graphically representing the dynamics of oceanic movements, approve of the inclusion of observations on freshwater lakes simultaneous with, and similar to, those on the sea, and point out the importance for deep-sea fisheries and for weather forecasts of bringing the Faeroes and Iceland into the telegraphic system of Europe.

It remains now for the Governments of the northern marine nations of Europe to give effect to this carefully planned scheme.

H. R. M.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following is the text of the speech delivered by Prof. Love in presenting Dr. P. L. Sclater for the degree of D.Sc. *honoris causa*, on June 20 :—

Adest Philippus Lutley Sclater, Sodalis Societatis Regalis, Magister Artium in Academia nostra, Philosophiæ Doctor in Bonnensi, Collegii Corporis Christi Socius honoris causa creatus. Qui vir, ut primos eius annos et incunabula laudis breviter præstringam, si quis alius, vere Wiccamicus vocandus est, cum non solum ipse et postea duo eius filii sed olim pater atque avus in illustrissima Schola Beatæ Mariæ de Winton instituti sint. Ita per quattuor hominum ætates huius domus nomen in annalibus Wiccamicis notissimum. Nostræ mox Academiæ particeps et Collegii Corporis Christi alumnus duos fere et quinquaginta abhinc annos graduatus est.

In *ὀρνιθολογίᾳ* quam vocant hic profecto familiam ducit : hoc gubernante Societas Zoologica Britannica laude maxima floret; horti autem Zoologici Londinenses nullis usquam cedunt. Quod ad doctrinam exquisitiorem et rei Zoologicæ peritiam attinet, illud potissimum dixerim, hunc regionum Zoologicarum naturam et limites primum perspexisse cum regionibus sex constitutis, Palæarctica, Nearctica, Neotropicali, Æthiopica, Orientali, Australi, orbem terræ non hominum civitatibus sed ferarum generibus partiretur. Quam rationem quinquaginta fere abhinc annos excogitatam plurimi ita emendare et corrigere conati sunt, quo in numero erat ipse Huxley, vir in hoc genere doctrinæ præstantissimus, ut etiam hodie probatissima et naturæ convenientissima esse videatur. Multa docuit hic vir ingeniosissimus quæ adhuc omnium iudicio comprobantur, velut Africæ septentrionalia harenosæ Nomadum solitudini superiacentia re vera Palæarctica esse atque Europæ affinia; Arabiæ autem meridiana in regionem Africanam sive Æthiopicam cadere : de duabus etiam Americæ continentibus felicissime monuit, hanc ab illa divici, non isthmo illo Panamensi, sed septentrionali Mexicæ latere, cum ultra citraque hanc quasi lineam accuratissime descriptam diversissima ferarum genera inveniantur.

SIR HENRY ROSCOE, F.R.S., has been elected Vice-Chancellor of the University of London for the ensuing year.

PROF. J. G. MACGREGOR, F.R.S., professor of physics in Dalhousie College, Halifax, Nova Scotia, has been elected to succeed Prof. Tait as professor of physics in the University of Edinburgh.

DR. F. H. NEWMAN, of the Royal College of Science, London, has been appointed director of technical education and principal of Tullie House, Carlisle. Tullie House consists of a public library, museum and school of art. It is the intention of the committee to build a technical school at an early date, the land having been already purchased. Dr. Newman commences his duties on July 1.