arc and by placing it in a strong magnetic field, the frequency can be enormously increased, and as many as a million vibrations a second may be obtained. Mr. Poulsen also finds that it is advantageous to have the anode of copper and the kathode of carbon, but when high currents are used the anode must be cooled by water running through tubes arranged for this purpose.

Mr. Poulsen showed several interesting experiments, illustrating the delicacy of the receiving circuit, in that on the slightest variation of frequency the activity of the receiving circuit ceases. Another experiment with a generator the oscillation circuit of which was connected directly to a resonator the frequency of which was in agreement with that of the generator circuit (about one hundred and seventy thousand oscillations per second), showed stationary oscillations with maximum tension at the top of the coil, and gave a peculiar soundless flame. As indicating the enormous amount of energy produced, Mr. Poulsen showed several experiments—lighting six incandescent lamps which were simply connected to a coil of wire which was brought near the oscillation circuit; destruction of a copper ring of wire when brought near, &c.

Turning to the transmitter used by Mr. Poulsen, there are two things of special interest, viz. the coupling and the signalling. As regards the coupling, the usual method employed is a very loose or close coupling, and the tuning is very sharp in either case. As regards the methods of signalling, various arrangements may be employed, but perhaps the most simple is by causing the key to short circuit a resistance periodically, which resistance must be large enough to reduce the amplitude and be included in the antenna-circuit. This method reduces sparking and permits of quick telegraphing. One may also telegraph by varying the tension of the magnetic field or of the feeding current, or altering the amount of hydrogen round the arc.

The receiving circuit for continuous waves includes an oscillation circuit with the least possible damping and in loose connection with the antenna-circuit. Owing to the continuity of the waves the detector may be arranged in such a way that it only intermittently forms part of the circuit of oscillation. Hence damping is avoided which the permanent inclusion of the detector would introduce. The apparatus which causes the intermittent contact is known as the "Ticker," and the usual material used for the contacts is either gold wire or German silver. Mr. Poulsen claims to be able to tune in practice to one per cent., and has received three messages simultaneously without mutual interference, the difference of wave-length in this instance amounting to three per cent.

Under the new method of undamped continuous waves Mr. Poulsen has sent a message from Lyngby, near Copenhagen, to North Shields, a distance of 530 miles, with a pole only 100 feet in height, for the expenditure of one kilowatt, and he hopes from this shortly to be able to get perfect communication across the Atlantic.

The chief advantages of Mr. Poulsen's system appear, therefore, to be:—(*a*) Extreme accuracy of tuning—thus ensuring selective signalling with no interference. (*b*) Freedom from interferences due to atmospheric electricity. (*c*) Greater efficiency due to accuracy of tuning and to the low potential of the electric surges impressed upon the aërial radiator.

Mr. Poulsen hopes that undamped and continuous wave-trains may yet be adapted to wireless telephony. The demonstration certainly proved that a great advance has been made in wireless telegraphy, and should the methods employed be brought into regular commercial use, there can be little doubt that Sir W. H. Preece's remark that probably the "death knell" of spark telegraphy has been sounded will prove to be an accomplished fact. In the first place syntony will become a really practical affair, and interference troubles between neighbouring stations, which have to a certain degree been responsible for the necessity of international legislation, will disappear. Secondly, the cost of transmission will be diminished, as with undamped oscillations the energy used in transmission can be enormously diminished. For the same reason the effective distance over which messages can be transmitted will be correspondingly increased, and we may hope to see the real establishment of that Transatlantic communication so often announced and so often abandoned. J. L. M.

THE MARINE BIOLOGICAL ASSOCIATION AND INTERNATIONAL FISHERY INVESTIGATIONS.

LORD CARRINGTON, President of the Board of Agriculture and Fisheries, paid a visit to the Lowestoft Laboratory of the Marine Biological Association on Friday, November 23, in order to see the work which is being carried on at the laboratory in connection with the international fishery investigations in the North Sea. The principal features of the work were illustrated by means of a number of specimens and charts, which were explained by Dr. Garstang, the naturalist in charge of the laboratory, and by his assistants.

After being entertained at luncheon at the Royal Hotel by the council of the Marine Biological Association, Lord Carrington, who was accompanied by Mr. W. E. Archer, assistant secretary to the Board, visited the steam trawler *Huxley*, which carries out the investigations at sea.

Among those present to meet Lord Carrington were Mr. E. Beauchamp (M.P. for Lowestoft), the Mayor of Lowestoft, Mr. C. Hellyer (chairman of the committee of the National Sea Fisheries Protection Association), Mr. Deputy Sayer, of London, Mr. A. B. Capps and Mr. J. Jackman, of Lowestoft, and the following members of the council of the Marine Biological Association:—Dr. A. E. Shipley, F.R.S. (chairman), Prof. Bourne, Sir Charles Eliot, K.C.M.G., Dr. Harmer, F.R.S., Dr. Lister, F.R.S., Prof. D'Arcy Thompson, C.B., Dr. Chalmers Mitchell, F.R.S., Mr. G. L. Alward, Mr. J. A. Travers (treasurer of the association), and Dr. E. J. Allen (secretary and director), together with the members of the Lowestoft staff (Dr. W. Garstang, Mr. J. O. Borley, Dr. W. Wallace, Mr. R. A. Todd, and Mr. A. E. Hefford).

Under the present arrangement the scheme of international investigations terminates in July, 1907, but the council of the Marine Biological Association, in view of the importance of the work already accomplished, is urging His Majesty's Government to continue similar researches upon a more permanent basis. In this connection the following statement of the views of the council has been forwarded to His Majesty's Government:—

The council of the Marine Biological Association consider that the experience of the past few years justifies the opinion (1) that scientific investigations carried out on the deep-sea fishing grounds by means of a special seagoing steamer have produced results of great value concerning the biology of our food-fishes; (2) that a continuance of such experimental investigations is urgently required, in addition to the regular maintenance of market statistics and observations, in order to provide the exact knowledge necessary for the formulation of effective measures for the improvement of the supply of fish; and (3) that the advantages of international cooperation in

investigations extending over large areas are so great that it would be a decidedly retrograde policy that such cooperation should be abandoned. In support of the opinions expressed above, the council adduce the following statements and arguments with reference to sections (1) and (2) respectively, and believe that the statements will be fully substantiated in the detailed reports on the international investigations already published or in course of preparation.

(1) In conformity with the main object of British participation in the international scheme of investigations, as explained in the House of Commons by Mr. Gerald Balfour on June 12, 1902, and in accordance with resolutions of the International Council at Copenhagen in July of the same year, the investigations carried out in the North Sea by the association, at the request of H.M. Government, have been largely concentrated upon the biological aspects of the undersized-fish question, especially as concerns the supply of plaice.

By means of nearly 1000 hauls of the trawl the sizes of the plaice in different parts of the southern North Sea have been determined in detail and mapped out for different seasons of the year. The measurements of plaice recorded at sea on the S.S. *Huxley* exceed a total of 100,000. These investigations have clearly revealed the distribution of the various sizes of plaice in the English area during the period of investigation, and have contributed extensive material towards the collective report on this subject which is in preparation by the International Committee.

The causes which influence this distribution have been carefully investigated with respect to (1) depth; (2) nature of sea-bottom; (3) character of the food-supply; (4) growth, age, sex, and maturity; (5) locality of the nursery and spawning grounds; (6) seasonal migrations; (7) density of fish-population; and (8) intensity of fishing; and on most of these points definite results have been obtained.

By means of experiments with more than 7000 marked plaice the migrations of this species have been plainly traced in important areas, and much progress has been made towards the explanation of the observed movements.

The same experiments have furnished important results concerning the rate of growth in the chief parts of the English area.

An examination of the otoliths of more than 12,000 plaice caught and measured during the trawling investigations has yielded much new information concerning the age of plaice at different sizes on the chief fishing grounds, and has indicated a valuable method of controlling the results obtained from the marking experiments.

The marking experiments have afforded a new factor for estimating the intensity of fishing under modern conditions, and for measuring differences in this respect in different regions. In the case of medium-sized plaice (10–15 inches in length), we have found that out of 1100 fish of this size liberated at various seasons of the year in the southern area, where sailing trawlers predominate, approximately 30 per cent. have been recaptured within one year from the date of liberation, and that out of 400 fish similarly set free on the Dogger Bank and adjacent grounds, where steam trawlers predominate, about 40 per cent. have been recaptured in the same period.

The council regard these results as of great significance from a practical, as well as a scientific, standpoint, especially as there is reason to believe that the figures understate the full severity of the fishing.

Other results derived from the marking experiments and otolith investigations throw new light on the relative mortality of the two sexes, their habits of seasonal segregation, and their relative susceptibility to capture by the trawl, points which bear directly upon the problem of the effects of trawling upon the economy, and therefore the supply, of this species.

By the transplantation of large numbers of small marked plaice from the coastal waters to the Dogger Bank and other grounds, it has been found, during two years in succession, that the rate of growth is much greater on the Dogger Bank than on the nursery grounds, and the consideration of other factors renders it highly probable that the supply of fish can be profitably influenced by the transplantation of small plaice on a commercial scale.

A number of special experiments have been carried out on the *Huxley* to determine the vitality of trawl-caught plaice of different sizes. Owing to the variety of the conditions which influence the experiments, it is not possible at present to express these results in a single set of figures representative of average conditions, but the experiments support the opinions (1) that under commercial conditions of trawling on the nursery grounds a large proportion of the small plaice taken are mortally injured, and would not live if returned to the sea, and (2) that the beam trawl is less injurious than the otter trawl under similar conditions.

With respect to other food-fishes, such as cod, haddock, sole, turbot, &c., a complete register has been kept of the catch of the large commercial trawls on every occasion (between 900 and 1000 hauls), and about 250,000 measurements, exclusive of those of plaice, have been recorded. The information thus acquired has laid a broad basis of exact and trustworthy knowledge concerning the general features of the fish-populations of different fishing grounds, and concerning the size, weight, and to some extent the rate of growth of the various species represented.

This information has been supplemented by more than 700 experiments with fine-meshed nets and dredges for determining the character of the sea-bottom itself, the dominant features of the bottom fauna, and the distribution of the fish eggs and fry which escape the commercial nets. In particular cases experiments have been carried out on the migrations and rate of growth of marked fishes, especially of cod, sole, lemon sole, and latchet, and the relation of size to age in the case of cod and sole has been studied to a certain extent by means of otoliths. Extensive observations have been made upon the food of many species in different localities, and concerning their relations to one another either as prey, competitors, or enemies.

With regard to the hydrographic and plankton investigations specified in the international programme, the association has fully carried out its obligations in this respect by the most thorough and painstaking investigation of the waters of the English Channel. The results have been regularly forwarded for incorporation in the quarterly charts and records issued by the Bureau of the International Council, and have been reported on from year to year.

(2) In view of the fact that special research has been mainly concentrated hitherto upon the plaice, and that other valuable species present points of practical importance which still await solution, especially the sole, turbot, cod, and haddock, it is very desirable that the investigations which have been begun on these species should be continued and developed.

In this connection the council would point out that the necessity of scientific investigations has been generally recognised, whether such investigations be or be not carried out under a scheme of international cooperation.

While the council have indicated above the substantial progress which has been made with the experimental work at sea under their control during the past few years, they strongly urge that if this work should be brought to a sudden conclusion the prospective value of much preliminary labour and expense would be lost. Continuity of work is a factor of more than usual importance in experimental investigation of this character, not only because the conditions of the phenomena are constantly changing, but also because the extent and value of the results likely to be obtained are largely dependent on the experience of the staff employed.

NOTES.

M. MASCART is retiring from the position of director of the Central Bureau of Meteorology in Paris. He will be succeeded on January 1, 1907, by M. Angot.

MR. L. A. PERINGUEY has been appointed to the directorship of the South African Museum, Cape Town, to fill the vacancy caused by the resignation of Mr. W. L. Sclater. Mr. Peringuey, who has been assistant director for some years, is a well-known entomologist, and author of many papers on South African Coleoptera and other insects.