utility. The chief feature is probably the careful provision made for the distribution of voltage and current about the building, the utmost flexibility in this respect being essential for the varied purposes of test and research.

The building—mainly on one floor—comprises one large bay (Fig. 1) for machines and alternating current test work, two parallel rooms of half the area for heavier test work and resistance and direct-current work respectively, with offices and workshops beyond. The photometry section, on two floors, runs at right angles to these on the east. Above are the rooms for the photometric measurements, with a 90-feet track for arc-lamp work; the ground floor provides accommodation for life tests,

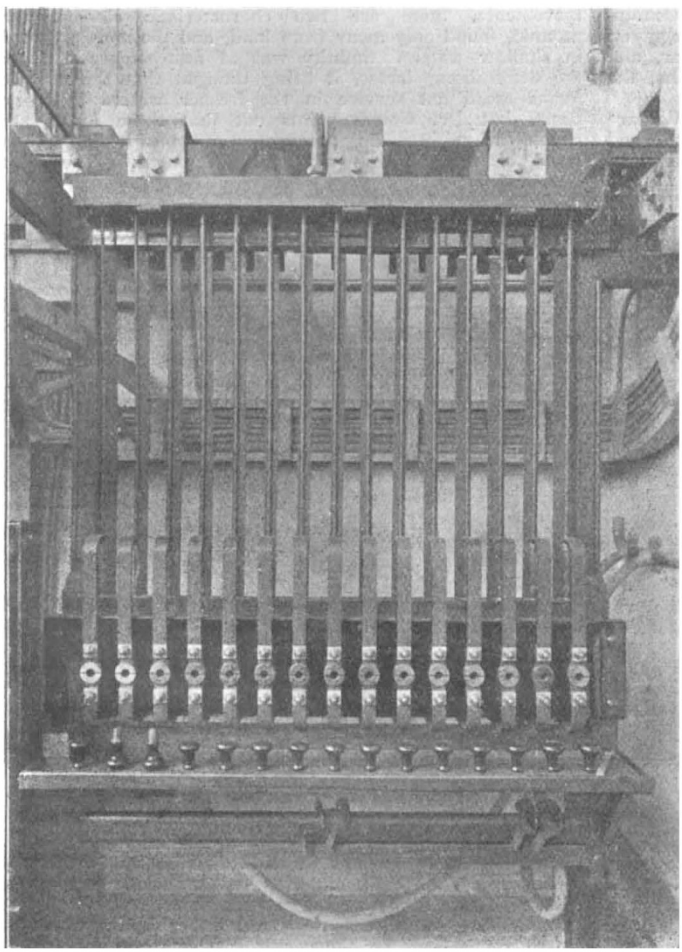


FIG. 3.—Water cooled regulating resistances—capacity 6000 amperes.

and is already largely occupied with the specially designed life-test racks necessary to cope with the probable demand to which reference has been already made. The results of the work on light standards at the laboratory since 1903 were laid before the Institution of Electrical Engineers by Mr. Paterson in December, 1906, in a paper which gained an institution premium, and much time has been devoted during 1907 to work on the pentane standard, while the photometry of differently coloured lights is also receiving attention.

The instruments for alternating current standard work occupy the centre of the main bay (Fig. 1); on the right, under a platform to screen off light, are the two standard electrostatic voltmeters, reading up to 400 volts, on two approximately circular scales 26 feet in length, with an accuracy of 1 part in 10,000. Outside the building, on the opposite side of the main bay, is a small, entirely detached, fire-proof high-tension transformer house, to be occupied by the 100,000-volt transformer, with the aid of which it is proposed that Mr. Rayner should continue the valuable researches on insulating materials already published. Twelve-inch ducts carry the high-tension current into the large bay.

Fig. 2 gives a general view of an instrument testing station—or testing bench—at the east end of the large bay (see Fig. 1). The bench part of the stand in front is arranged as a cupboard with glass top, in which instruments of horizontal type can be tested at any temperature; for other purposes the glass can be covered with teak lids. The back compartment contains heating lamps and a fan for carrying the heated air to any part of the station, the upper part being arranged so that it can be covered with a thin celluloid cover. Above the station may be seen the main heavy current leads. In Fig. 3 are shown the water-cooled regulating resistances employed for heavy current work of 6000 amperes capacity.

The resistance room, in charge of Mr. Melsom, contains arrangements for all high and low resistance work, except that on ultimate standards; for tests on cables, insulation testing sets, &c., and for dry-cell testing. For accommodating accumulators under test a small building has been erected outside the north wall.

Mr. Paterson and his collaborators have given the utmost attention to all detail throughout the building, the benefit of which will doubtless be felt as the work increases.

Although the development of the laboratory since 1901 has been rapid, it is clear that even now it has but barely reached its most active period of growth. The need and the value of the services it can render become progressively more apparent, and Dr. Glazebrook's able administration and untiring energy may be expected to produce even greater, if perhaps not so obvious, advances in the next seven years.

THE NORTH SEA FISHERIES INVESTIGATIONS.

WHEN the British Government in 1902 undertook to cooperate with other countries bordering on the North Sea in an investigation into the fisheries of that region, it delegated its share of the work in the north to the Scottish Fishery Board and in the south to the Marine Biological Association of the United Kingdom. The latter has now issued its second report upon the work done by its naturalists and hydrographer covering the period 1904–5.

Four papers are included, and the first is by Dr. Wallace on the age and growth-rate of plaice in the southern North Sea, and is the result of the application of a method of determining the age of the fish by the otolith or "ear-stone." Various attempts have been made to determine the age of fishes. The scales furnish some evidence, but in most cases, at any rate, they are hard to read. The otolith method, on the other hand, is easy, and much more rapid than the scale method.

The otolith shows on its surface a series of concentric rings alternately light and dark, and Reibisch in 1899 found that each light ring represented the growth of the otolith during the summer, while the dark rings represented winter growth. There seems to be no difference in structure in the alternate rings, the different appearance being produced entirely by a difference in the density of the substance. In the light opaque rings the particles are more closely packed, while in the dark more or less transparent rings the particles are farther apart. Since

Reibisch's discovery of the importance of these rings as an indication of the age of the individual fish, Redecke, Johansen, and Wallace have all independently proved the correctness of his discovery.

In the present paper Dr. Wallace applies the method to determine the rate of growth of the plaice, its distribution in relation to age, and other points of interest with regard to the habits and life of the species.

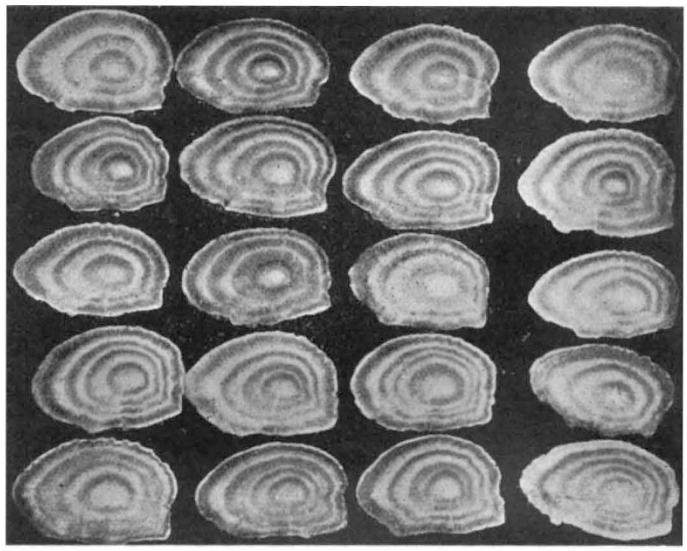
Previous to the application of this method the only means of getting approximately at the age of the fish was by measuring the length of large numbers of individuals and obtaining a frequency curve, but, as Dr. Wallace points out, this method had many disadvantages which are avoided by the otolith method.

By examination of the otoliths, not only is the average length for any age determined, but also the maximum and minimum lengths are obtained. The only assumption made is that all plaice emerge from the egg on April 1! Since the plaice only spawns once a year, and the spawning season at the most lasts three months, the error, owing to this assumption, is negligible.

Having determined the "age-groups," Dr. Wallace discusses their distribution in the area investigated, and in connection with this is brought out the existence of a "selective migration," that is, the distribution or sorting out of individuals according to size. The larger fish of the year tend to move into deeper water than the smaller. It is not a new observation that large fish are found in deeper water, but age is a factor which has not previously been taken into consideration. At any depth are to be found fish representing the larger ones of a recent year, the average sized ones of an earlier year, and the smaller ones of a still earlier year, and so on, but the bulk of the fish of any one size will belong to one particular year, so that at any given depth we shall find the fish of one particular year dominant.

Although this is the rule up to three or perhaps four years old, these older fish seem to be affected by other factors not yet sufficiently understood, as on apparently similar grounds the average size of the fish may differ considerably.

In discussing the average growth-rate of the plaice in the southern North Sea, Dr. Wallace points out that there is a different average growth-rate in the two sexes, and also that the longevity of the female is greater than that of the male. Up to five years of age the average number of males and females is apparently the same, but after that the males rapidly fall off in numbers, and in plaice of eight years old and upwards 91 per cent, are females. The males arrive at maturity one or even two years earlier than the females, and after seven years practically cease to grow.



Views of the concave (outer) surfaces of right otoliths of twenty-five plaice, mostly with four rings. Magnified about three times.

We reproduce one of the excellent series of photographs of otoliths taken by Mr. R. A. Todd, representing the right otoliths of twenty plaice. The fish were 27 cm. long, and the majority were four years old, as can be seen from the otoliths, which nearly all show four white rings.

Dr. Wallace's paper is somewhat difficult reading owing to the short paragraphs and frequent interpolation of tables, diagrams, and references. A short summary covering all the ground would, we think, in the circumstances have been specially useful.

Mr. R. A. Todd has continued his researches on the food of fishes, and some most valuable results are brought out by his laborious work. First he notes the fact that the younger fish of every species examined (thirty-four in all) chiefly depend upon crustacea for their sustenance, amphipods, cumacea, and decapod larvæ forming the chief food supplies.

Secondly, he shows that although in the young fish competition between all species may be great, in the adults competition is not nearly so keen, except in certain cases which he mentions. The chief food of all fishes appears to be fish, molluscs, and crustaceans, but a few species seem to favour echinoderms and cœlenterates as supplementary supplies. Competition is avoided by each species preferring some few particular species, which often seem to form its staple diet.

Mr. Todd's researches have led to some interesting observations as to a fasting period peculiar to one or two Pleuronectidæ. It seems that this is connected with the spawning period, as in the salmon, but in the case of the plaice it is chiefly the male which abstains from food, since on the spawning grounds "the greater the excess of ♂ over ♀ the greater the proportion of empty stomachs."

The report upon the plankton of the English Channel, by Dr. L. H. Gough, contains some interesting observations as to the causes of distribution. In spite of the fact that the minute organisms constituting the plankton are primarily dependent for their distribution on the water movements, there are two characteristic classes, the oceanic, found only away from land, and the neritic, found in shallow waters. Salinity was at first supposed to be the determining factor, it being thought that the oceanic forms could not survive in the fresher waters near the coast, but Dr. Gough points out that these forms are capable of withstanding a greater range of salinity than is to be met with in the region explored. The most recent theory to account for this distribution is that the decomposing organic matters in the shallower waters where bottom fauna and flora flourish are poisons to the oceanic species, whereas they are either innocuous to or possibly necessary for the neritic species.

The fourth paper in the report deals with the surface waters of the North Atlantic Ocean south of 60° N. lat. from September, 1904, to December, 1905. Mr. D. J. Matthews explains that the paper is almost entirely descriptive, giving an account of the distribution of surface salinity and temperature over a period of sixteen months. Samples of water have been obtained over a large area through the assistance of the captains of a number of steamers.

Even during the short period covered certain striking facts have been observed as to the movements of the waters. For instance, a distinct waxing and waning of the Labrador current has been detected.

Monthly charts showing temperature and salinity for the whole sixteen months add greatly to the interest of the paper.

The volume forms a valuable contribution to science.

FRANK BALFOUR BROWNE.