of a peculiar shape entirely unknown in Finland. Such hooks have been found in salmon taken in all Swedish and Finnish rivers falling into the Gulf of Bothnia. At one of the salmon fisheries in the Uleå River, for instance, where the fish is sold cleaned, twenty-five such hooks, all of brass, were collected last summer and handed to me. With a few exceptions the hooks are of one kind, viz. made of brass wire 2 to 2·5 mm. thick, a little compressed in the hook itself, while the length varies from 9·5 to 11·5 cm. Most of the hooks are 10·5 cm. in length, and the width of the bend 2·5 to 3·5 cm. Generally a bit of line 1 to 2 mm. thick, made of flax, hangs to the hook, while, when the line is long enough, a lead, conical in shape and 10 to 20 grm. in weight, is found on the same. Sometimes Latin characters are engraved on the lead, as, for instance, in one taken in the above-mentioned river last summer, which had on it "C" and "K" on each side. I am of opinion that all the hooks which have passed through my hands are of the same type and manufacture.

As it is of great practical value to discover whence these peculiar brass hooks have come, I have given considerable attention to the question, the result of which is that I have come to the conclusion that they were brought from the north coast of Germany, where they are used for salmon-fishing in the winter. Great fisheries are carried on along this coast in a depth of 30 to 60 m. and 10 to 30 km. from the shore, as far as, and probably beyond, the Russian frontier. The lines used are very like those used on the south coast of Sweden, but the hooks and leads are quite different. Prof. Benecke, of Königsberg, to whom I sent a hook taken from a salmon in the Uleå River, asserts too that these have come from the shores of Prussia and Pomerania. As hooks of this kind are not used in any other part of the Baltic or outside of it, it is evident that the salmon must have brought these from the above-mentioned places to the shores of the Gulf of Bothnia.

It is, on the other hand, but seldom that hooks of iron and tin are found in salmon in our rivers, which is caused, I believe, by the circumstance that the Scandinavians use far stronger lines for salmon-fishing than the Germans. I have, however, two in my possession which are of the exact kind used by fishermen in the sea about Bornholm and the south-east coast of Sweden.

Besides the above-mentioned kinds of hooks I have obtained a very peculiar one taken from a salmon off the town of Kristinestad. It is 4 cm. long, of hammered thick brass wire, and of a very uncommon shape, and through two holes fastened to two double-twined brass wires 40 cm. long, and 1 mm. thick. I do not know from what part of the Baltic this strange hook hails, but I believe from the Russian shore of the same.

The discovery of hooks of a foreign shape in salmon in the northern rivers of Sweden and Finland was made about 200 years ago, as may be seen in the journals of the Swedish Academy of Sciences of the seventeenth century, and even at that date their remarkable shape and manufacture attracted attention.

The relatively great number of brass hooks found in salmon taken in the rivers around the Gulf of Bothnia demonstrates beyond doubt that the fish, after visiting the coast of Northern Germany, return to the northernmost shores of Sweden and Finland, while some have visited the southern part of Sweden on their way north, as the iron hooks clearly indicate. If it is true, as is generally believed, that the salmon returns for spawning to the rivers of its birth, we may with equal force assume that the great takes of young salmon on the southern coast of Sweden and the shores of Baltic Germany during recent years is due to the rigid closing in of the rivers of Northern Sweden and Finland, whence they migrate south. During the last fifteen years, since when closing began in the Finnish rivers, the takes of young salmon—from 1 lb. to 2 lb. in weight—in nets about Bornholm and on the shores of Germany, have fabulously increased, and my opinion is that these fisheries are of such a destructive nature to this noble fish in Sweden and Finland that some arrangement ought to be made between the Baltic Powers to put a stop to the same.

By marking the salmon in England and Scotland, pisciculturists have come to the conclusion that varieties of salmon during their stay in salt water visit preferably certain parts of the coast for their food; thus, according to the late Frank Buckland, the shores around Yarmouth are the favourite haunts of the "bull-trout" of certain English and Scottish rivers. The great student of the salmon fisheries of Scotland, particularly those of the River Tweed, David Milne Holme, relates as an example of how quickly fish of the salmon kind can travel to a favourite feeding-ground, that a "bull-trout" marked with a silver thread with an inscription in the River Tweed, on March 29, 1852, was taken, on April 2, near Yarmouth, having thus accomplished a distance of nearly 300 miles in four days. Another fish was marked in the same river on March 10, 1880, and was caught at Yarmouth on May 5, having taken fifty-five days for the journey.

As the salmon, *Salmo salar*, according to the experience gained in Scotland, prefers sandy feeding-grounds during its stay in salt water, and as the bottom of the Baltic on the coast between Memel and Rügen, at Bornholm and South-East Sweden, is sand at a certain depth, where its favourite food is found, the cause of the migrations of the salmon in the Baltic southwards may be accounted for, while their return to the northern rivers of Sweden and Finland in the spring is unquestionably due to their breeding instincts.

Helsingfors AND. JOH. MALMGREN

THE BRITISH ASSOCIATION

REPORTS

Report of the Committee, consisting of Major-Gen. Sir A. Clarke, R.E., C.B., Sir J. N. Douglass, Capt. Sir F. J. O. Evans, R.N., K.C.B., F.R.S., Capt. J. Parsons, R.N., Prof J. Prestwich, F.R.S., Capt. W. J. L. Wharton, R.N., Messrs. E. Easton, R. B. Grantham, J. B. Redman, J. S. Valentine, L. F. Vernon-Harcourt, W. Whitaker, and J. W. Woodall, with C. E. De Rance and W. Topley as Secretaries, appointed for the Purpose of Inquiring into the Rate of Erosion of the Sea-coasts of England and Wales, and the Influence of the Artificial Abstraction of Shingle or other Material on that Action. Drawn up by C. E. De Rance and W. Topley.—The importance of the subject referred to this Committee for investigation is universally admitted, and the urgent need for inquiry is apparent to all who have any acquaintance with the changes which are in progress around our coasts. The subject is a large one, and can only be successfully attacked by many observers, working with a common purpose and upon some uniform plan. The Committee has been enlarged by the addition of some members who, by official position or special studies, are well able to assist in the work. In order fully to appreciate the influence, direct or indirect, of human agency in modifying the coast-line, it is necessary to be well acquainted with the natural conditions which prevail in the places referred to. The main features as regards most of the east and south-east coasts of England are well known; but even here there are probably local peculiarities not recorded in published works. Of the west coasts much less is known. It has therefore been thought desirable to ask for information upon many elementary points which, at first sight, do not appear necessary for the inquiry with which this Committee is intrusted. A shingle-beach is the natural protection of a coast; the erosion of a sea-cliff which has a bank of shingle in front of it is a very slow process. But if the shingle be removed the erosion goes on rapidly. This removal may take place in various ways. Changes in the natural distribution of the shingle may take place, the reasons for which are not always at present understood; upon this point we hope to obtain much information. More often, however, the movement is directly due to artificial causes. As a rule, the shingle travels along the shore in definite directions. If by any means the shingle is arrested at any one spot, the coast-line beyond that is left more or less bare of shingle. In the majority of cases such arresting of shingle is caused by building out "groynes," or by the construction of piers and harbour-mouths which act as large groynes. Ordinary groynes are built for the purpose of stopping the travelling of the shingle at certain places, with the object of preventing the loss of land by coast-erosion at those places. They are often built with a reckless disregard of the consequences which must necessarily follow to the coast thus robbed of its natural supply of shingle. Sometimes, however, the groynes fail in the purpose for which they are intended—by collecting an insufficient amount of shingle, by collecting it in the wrong places, or from other causes. These, again, are points upon which much valuable information may be obtained. Sometimes the decrease of shingle is due to a quantity being taken away from the beach for ballast, building, road-making, or other purposes. Solid rocks, or numerous large boulders, occurring between tide-marks, are also important protectors of the coast-line. In some cases these have been removed, and the waves have thus obtained a greater power over the land. To investigate these various points is the main object of the Committee. A large amount of information is already in hand, much of which has been supplied by Mr. J. B. Redman, who for many years has devoted special attention to this subject. Mr. R. B. Grantham has also made important contributions respecting parts of the south-eastern coasts. But this information necessarily consists largely of local details, and it has been thought better to defer the publication of this for another year. Meanwhile the information referring to special districts will be made more complete, and general deductions may be more safely made. As far as possible the information obtained will be recorded upon the six-inch maps of the Ordnance Survey. These give with great accuracy the condition of the coast, and the position of every groyne, at the time when the survey was made.

Appended is a copy of the questions circulated. The Committee will be glad of assistance, from those whose local knowledge enables them to answer the questions, respecting any part of the coast-line of England and Wales. Copies of the forms for answering the questions can be had on application to the Secretaries.

Appendix—Copy of Questions.—1. What part of the English or Welsh coast do you know well? 2. What is the nature of that coast? (*a*) if cliffy, of what are the cliffs composed? (*b*) what are the heights of the cliff above H.W.M.? Greatest, average, least. 3. What is the direction of the coast-line? 4. What is the prevailing wind? 5. What wind is the most important—(*a*) in raising high waves? (*b*) in piling up shingle? (*c*) in the travelling of shingle? 6. What is the set of the tidal currents? 7. What is the range of tide? Vertical in feet, width in yards between high and low water, at spring tide, and at neap tide. 8. Does the area covered by the tide consist of bare rock, shingle, sand, or mud? (*a*) its mean and greatest breadth; (*b*) its distribution with respect to tide-mark; (*c*) the direction in which it travels; (*d*) the greatest size of the pebbles; (*e*) whether the shingle forms one continuous slope, or whether there is a "spring full" and "neap full," if the latter, state their heights above the respective tide-marks. 10. Is the shingle accumulating or diminishing, and at what rate? 11. If diminishing, is this due partly or entirely to artificial abstraction (*see* No. 13)? 12. If groynes are employed to arrest the travel of the shingle, state—(*a*) their direction with respect to the shore-line at that point; (*b*) their length; (*c*) their distance apart; (*d*) their height—(1) when built, (2) to leeward above the shingle, (3) to windward above the shingle; (*e*) the material of which they are built; (*f*) the influence which they exert. 13. If shingle, sand, or rock is being artificially removed, state—(*a*) from what part of the foreshore (with respect to the tidal range) the material is mainly taken; (*b*) for what purpose; (*c*) by whom—private individuals, local authorities, public companies; (*d*) whether half-tide reefs had, before such removal, acted as natural breakwaters. 14. Is the coast being worn back by the sea? If so, state—(*a*) at what special points or districts; (*b*) the nature and height of the cliffs at those places; (*c*) at what rate the erosion now takes place; (*d*) what data there may be for determining the rate from early maps or other documents; (*e*) is such loss confined to areas bare of shingle? 15. Is the bareness of shingle at any of these places due to artificial causes? (*a*) by abstraction of shingle; (*b*) by the erection of groynes, and the arresting of shingle elsewhere. 16. Apart from the increase of land by increase of shingle, is any land being gained from the sea? If so, state—(*a*) from what cause, as embanking salt-marsh or tidal foreshore; (*b*) the area so regained, and from what date. 17. Are there "dunes" of blown sand in your district? If so, state—(*a*) the name by which they are locally known; (*b*) their mean and greatest height; (*c*) their relation to river mouths and to areas of shingle; (*d*) if they are now increasing; (*e*) if they blow over the land, or are prevented from doing so by "bent grass" or other vegetation, or by water channels. 18. Mention any reports, papers, maps, or newspaper articles that have appeared upon this question bearing upon your district (copies will be thankfully received by the Secretaries). 19. Remarks bearing on the subject that may not seem covered by the foregoing questions. [N.B.—Answers to the foregoing questions will in most cases be rendered more precise and valuable by sketches illustrating the points referred to.]

SECTION A—MATHEMATICAL AND PHYSICAL SCIENCE

On Loss of Heat by Radiation and Convection as affected by the Dimensions of the Cooling Body; and on Cooling in Vacuum, by J. T. Bottomley.—In the course of a series of experiments on the heating of conductors by the electric current, which were carried on during the past winter, I obtained a considerable number of results which both gave me the means of calculating the *emissivity* for heat in absolute measure of various surfaces under different circumstances, and also caused me to undertake a number of special experiments on the subject. These experiments are still in progress, and I am making preparation for a more extended and complete series; but a brief notice of some of the results already arrived at may not be without interest to the British Association.

The experiments were made on wires of various sizes, some of them covered and some of them bare, cooling in air at ordinary temperatures, and at normal and also at very much reduced pressures.

The mode of experimenting was as follows;—

A current passing through a wire generates heat, the amount of which is given by Joule's well-known law—

$$H = C^2 R/J \quad . \quad . \quad . \quad . \quad . \quad . \quad . \qquad (1)$$

where C is the current, R the electrical resistance, J Joule's equivalent, and H the quantity of heat generated per unit of time; each being reckoned in C.G.S. units. Let l be the length of the wire, d its diameter, and σ_t the specific resistance of the material at temperature $t°$ (at which temperature let us suppose that the wire in the given external conditions is maintained by the current). Then

$$R = \frac{\sigma_t l}{\frac{1}{4}\pi d^2} = \frac{4\sigma_t l}{\pi d^2}$$

Hence from (1)—

$$H = \frac{C^2}{J} \cdot \frac{4\sigma_t l}{\pi d^2} \quad . \quad . \quad . \quad . \quad . \quad . \qquad (2)$$

Consider, now, that the wire suspended in the air is losing heat by its surface, and let us suppose that it neither loses nor gains heat by its ends. Let H' be the quantity lost by emission from the surface per unit of time. Let e be the emissivity, or quantity of heat lost per unit time per unit area of the cooling surface per unit difference of temperatures between the cooling surface and the surroundings; and $t°$ being, as has been said above, the temperature of the wire, let θ be the temperature of the surroundings. Then

$$H' = \pi d l . e . (t - \theta) \quad . \quad . \quad . \quad . \quad . \qquad (3)$$

But when the wire has acquired a permanent temperature, with the current flowing through it, there is as much heat being lost at the sides as is being generated by the current. In this case $H = H'$; and we obtain the expression for e—

$$e = \frac{4 C^2 \sigma_t}{J \pi^2 d^3 (t - \theta)} \quad . \quad . \quad . \quad . \quad . \qquad (4)$$

My experiments consist in measuring the strength of the current and the temperature of the wire, the latter being effected by measuring the electric resistance of a known length of the wire while the current is flowing through it, and hence inferring the temperature. These being known, and likewise the temperature of the surroundings, we have all the data for finding e, the emissivity of the surface in absolute measure. The experiments of Mr. D. Macfarlane giving emissivities in absolute measure are well known, and are of undoubted accuracy. They were communicated to the Royal Society (*Proc.* Roy. Soc., 1872, p. 93); and the results are quoted in Prof. Everett's "Units and Physical Constants" (chap. ix. § 137). These experiments were made with a copper globe about 4 cm. in diameter, suspended in a cylindrical chamber, with top and bottom, about 60 cm. in diameter, and 60 cm. high. The results may be briefly summed up as follows:—

Macfarlane finds an emissivity of about 1/4000th of the thermal unit C.G.S. per square centimetre per second per degree of difference of temperatures between cooling body and surroundings for a polished surface, with an excess of temperature of a little more than 60° C.; and, for a blackened surface, the same emissivity with an excess of 5° C. or under.

Using round wires of small diameter (0·85 mm. and under), and with the surfaces either brightly polished or in common dull condition of a wire fresh from the maker, I have found a much larger emissivity than 1/4000. I have obtained different values of e for wires of different sizes, varying from 1/2000 down to 1/400, which was obtained with a wire of 0·40 mm. diameter, and with an excess of temperature of 24° C. It seems to be shown by all the experiments I have made that, other things being the same, the smaller the wire the greater the emissivity.