when the other telluric lines had almost entirely disappeared, he saw B perfectly distinct. At a like zenith distance from the sun this group seemed to him even blacker and more intense than usual. Hence his inference that it could not proceed from the vapour of water. This eminent physicist, a thoroughly convinced partisan of spectral unity for the simple gases, had ascertained that in the spectrum of atmospheric emission there was no trace of any ray or band corresponding to B. It followed for him that the air could not absorb radiations it was incapable of emitting. If therefore this group, variable like the other telluric rays, could be attributed neither to aqueous vapour, to nitrogen, nor to the oxygen of the air, from what element did it derive its origin? Ångström spoke of carbonic acid, but perhaps without believing in it. He seemed deeply interested in Tyndall's experiments on the absorbing power of gases by heat. We know that this skilful investigator had found that the coefficients of absorption of oxygen and nitrogen by no means corresponded with the coefficient of absorption of the air. The difference he attributed to some unknown element sufficiently rarefied to escape our analyses, and endowed with immense absorbing power. Ångström had probably this unknown element in his mind, but he remained uncertain to the last.

The great authority of the Swedish physicist could not fail to have its influence on the judgment of those approaching the question after him. Captain Abney, who has so greatly distinguished himself by his remarkable scientific labours, asserts in NATURE (October 12, 1882, p. 585) that the groups A and B cannot be regarded as telluric, but as proceeding from a medium lying between the sun and the earth. Piazzi Smyth, who had at first looked on B as telluric, seems to have finally adopted Captain Abney's views, and is disposed to think that B as well as A may after all be the product of some interplanetary medium. In his opinion the recent theories of Siemens seem to confirm his view of the case.

The attention that I have for several years paid to the portion of the solar spectrum stretching from A to *b* has naturally led me to deal with this subject. Here is the method by which I succeeded in separating and classifying the spectral lines. After certain preliminary measures taken with the greatest care to determine their exact position, each region of the spectrum is drawn on two maps. The first is intended to reproduce the appearance of this region when the sun is at 60° from the zenith, the second when at 80°. These distances have been chosen in such a way that in the latitude of Nice the observations may be continued throughout the year. When the weather seems favourable at the hour when the sun is in the desired position, the intensity of each line is marked on the map itself with all possible exactness, the hygrometric state of the air being indicated each time. The process is slow, delicate, and laborious, but the result is certain. After I have thus made eight or ten series of observations on each drawing, they are carefully examined, and the indications relative to any given line enable me confidently to decide:—(1) whether it is not metallic; (2) whether a telluric line belongs to a constant or to a variable atmospheric element. By this method I have been able to satisfy myself that A, B, and α are telluric groups due to the constant elements of the air. *At the same distance from the zenith they have always the same intensity.* I refer of course only to the main groups in each of them, and to the couples following them on the least refrangible side.

It remained to determine exactly to what atmospheric element the groups in question were to be attributed. M. Egoroff, Professor of Physics at the University of Warsaw, has recently succeeded in solving the problem. He had for several years ardently devoted himself to this inquiry, and in 1882 we jointly made a series of experiments on the subject in the Paris Observatory. A pencil of electric light directed from Mount Valérien on the Observatory, distant 10 km., gave us the spectrum of the telluric rays all but complete. There was no difficulty in distinguishing A, B, and α, which are so easily recognised. Capt. Abney has questioned the results obtained by us. Yet they are incontestable, and in any case the experiment can be easily repeated.

At last, after these preliminary studies, M. Egoroff, operating directly on oxygen closely compressed in a metallic tube, and traversed lengthwise by a pencil of strong light, has obtained the groups A and B. The thickness of the oxygen thus traversed was doubtless insufficient for the production of α. But however this be, it may now be confidently asserted that these three, which are of such remarkable appearance, and which so closely resemble each other, have their origin in the absorption due specially to atmospheric oxygen.

I need not dwell upon the importance of this result; but how is it to be reconciled with the observations of Messrs. Janssen, Ångström and Piazzi Smyth? To judge from the sketch contained in the *Annales*, and above referred to, M. Janssen must have seen in the spectrum of aqueous vapour bands corresponding to those of the solar spectrum in the region of B. One of them even coincides exactly with the chief member of the group. According to my own observations, to produce this effect the vapour of water would have to yield at this point a non-resolvable band, which would simply obscure the intervals between the lines, as is seen in the spectrum 1 of my drawing. This observation should then vary according to the hygrometric state of the air, and not, as it has always seemed to me, according to the height of the sun. Or else this band is not represented in the exact position it ought to occupy, and should be shifted more to the left, where in fact are found many lines of the vapour of water constituting an important group (see plate).

If, on the other hand, Ångström saw B more intense at a temperature of 27° C., it was doubtless owing to a simple effect of contrast. The other telluric lines being greatly weakened, those that retain their intensity must naturally appear blacker. Such an effect is frequently produced in the course of my observations, and against it I have to be constantly on my guard. And now how can we explain why the spectrum of absorption of the oxygen differs so much from its spectrum of emission? The lack of sufficient data renders all explanation impossible; but the certainty of the fact obliges us to conclude that *cold* has not the same properties as *incandescent* oxygen, and allows us to suspect that it may be the same with all gases.

In asserting that A and even B do not really vary in intensity when the sun approaches the horizon, such an eminent observer as Piazzi Smyth would have greatly surprised professional spectroscopists, were they not aware how difficult and delicate a matter is the management of an apparatus of highly dispersive power. Let but the luminous pencil be badly adjusted, the prisms less than faultlessly regulated, the slightest cloudiness settle on the surfaces, the images, especially in the extreme red, will at once appear as if drowned in the diffused light, which obscures the most evident effects and even disfigures their essential characters. Strange phenomena are often produced, the causes of which it seems impossible to discover, and which easily give rise to illusions. But when we work under favourable conditions with a well-designed and well-constructed apparatus, it becomes superabundantly evident that A and B vary considerably in intensity according to the height of the sun, and are certainly telluric.

During the total eclipse of 1882, both M. Trépied and myself fancied we observed on the edge of the lunar disk a notable strengthening of the rays of the B group. If Captain Abney's theory could have been confirmed, it would have certainly added great weight to our observations, and for my own part I should have felt highly satisfied at the result. Unfortunately, the atmosphere of oxygen which should now be attributed to the moon in order to produce the observed effects, seems scarcely reconcilable with the absence of refraction in the luminous rays striking the edge of our satellite. I greatly fear the results obtained in Egypt are one of those illusions, of which nearly all spectroscopists have been more or less the victims.

It would now be important to ascertain whether the nitrogen and carbonic acid of the air may not be represented by any line or any group in the solar spectrum. The study I am at present engaged in, according to the above described method, will not fail, I trust, to yield precise results on this important point. Hitherto, apart from the oxygen groups, I have discovered no line that may be confidently attributed to the constant elements of the atmosphere. Hence it is desirable to await the result of my researches before giving effect to the project adopted by M. Bischoffsheim to establish on Mont Gross metallic tubes of considerable length, in which the spectra of absorption of gases may be studied on a grand scale.

THE MIGRATIONS OF "SALMO SALAR" (L.) IN THE BALTIC

THE following statement gives further details supplementary to our recent article on this subject:—

Since the earliest times salmon have been caught in the Finnish rivers which had in their mouths or entrails hooks

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