

service rendered to the vessel, and not the freight-earning power as the basis of assessment. Mr. White differs, however, from Mr. Rothery in the mode in which the space occupied by the vessel should be measured. He considers that for all practical purposes this space is equal to the parallelepipedon formed by the extreme length, extreme breadth, and the mean draught, and consequently thinks that "parallelepipedon tonnage," as it is called, has much to recommend it. The possibility of berthing other vessels at the same dock or wharf is not sensibly altered by the under-water shape, consequently the above seems a fair measure of service rendered.

Mr. White does not consider that the above proposal would lead to the adoption of a box-shaped type of vessel. He thinks that the cost of propulsion of a steamer would effectually check any such tendency.

Mr. White concludes his most able paper by the following piece of advice, which we trust may be taken to heart by whatever government finally undertakes to revise the tonnage laws.

"In conclusion, I would venture one remark respecting the course of procedure which promises to give the best results, if a revision of the tonnage law is decided upon. Valuable as the labours of committees and commissions may be in testing the feeling of those interested in shipping, and putting on record the opinions of competent authorities who view the subject from different standpoints, it does not appear that a satisfactory revision can be looked for in this direction. The precedent to be found in the preparation of the law of 1854 seems to be a good one. Following after the work of the commissions came the careful, extensive, and laborious inquiry of Moorsom, a scientific expert, having a thorough acquaintance with the subject, and placed in direct communication with the shipping community. If the long-talked-of Central Council or Advisory Board should be constituted to deal with matters relating to the mercantile marine, and if it should be assisted by a competent scientific staff of naval architects, we may hope that, among other much-needed action, will be included the revision of the tonnage laws in a sense that will give more general satisfaction than could otherwise be obtained."

#### THE NAVAL AND MARINE ENGINEERING EXHIBITION

THE Exhibition which Mr. Samson Barnett, jun., has opened at the Agricultural Hall, and which closes to-day, contains a very large number of objects connected directly and indirectly, and sometimes even totally disconnected with naval purposes. The collection is by no means totally devoid of novelties and of objects of considerable scientific interest. The Exhibition contains numerous models of recently-built war and merchant ships, a few small marine engines and boilers, and portions of large-size marine boilers, together with fittings of engines and boilers in great variety. There are also several specimens of steam steering gear, ships' telegraphs, steam capstans, cranes, and machinery generally for loading and unloading vessels, boat-lowering apparatus, life-saving appliances, dredging gear, and refrigerating appliances. Naval artillery was not well represented, but Messrs. Hotchkins and Co. exhibited some fine specimens of their beautiful revolving cannon, which have been adopted in the navies of several foreign governments, notably in those of France, Germany, Russia, and Italy.

The ships' models are as a rule very deficient in interest, in spite of the fact that they represent many of the most famous of modern vessels, such as the *Devastation* and *Polyphemus*, among men-of-war, and the *Servia*, the *City of Rome*, and the *Ravenna* amongst passenger steamers; for they were mostly half models of the outsides of the vessels, which, though they give a very

good idea of the exterior form, afford no information as to the construction, the interior arrangements, or the engines and boilers. This is somewhat disappointing when we remember what strides have been made in recent years in the construction of iron ships.

In the Department of Marine Engines and Boilers there was a remarkable absence of models, or even of drawings of the very fine engines with which our first-class war and merchant steamers are now fitted. By far the most important objects exhibited in this section were the magnificent flanged front plates of boilers, one of these being fifteen feet in diameter, and made in a single piece, with three flanged openings for furnaces, from a single 3-ton ingot of Siemens' steel. The same firm also exhibited several specimens of Fox's corrugated furnaces, an invention which has conferred the greatest benefits on the cause of steam navigation, by rendering possible the use of the very high boiler-pressures which are so essential to economy of fuel. Mr. David Joy also showed a model of his own celebrated valve-gear, which has given such excellent results with locomotives at Crewe, and which will doubtless soon become favourably known to marine engineers. This valve-gear is probably the most serious competitor to the old link-motion driven by eccentrics, first adopted by Stephenson for locomotives, and which has remained in pretty general use up to the present time. Mr. Joy's motion, besides being simpler, effects a better distribution of the steam, in many respects, than the link-motion.

Amongst the most interesting features of the Exhibition were the refrigerating machines. Of these there were four, exhibited by Messrs. Bell-Coleman, Messrs. T. Pigott and Co., the Haslam Foundry and Engineering Company, and Messrs. J. and E. Hall. As we have so recently described the principle of action of these machines, it will not now be necessary to go into details. It may, however, be mentioned that they are at the present moment being used by the Peninsular and Oriental, the Cunard and the Orient Steam-ship Companies, and also by the London and St. Katharine Dock Company, and the Orange Slaughtering Company. The successful application of mechanical refrigeration to the preservation of fresh meat and other provisions, is a subject of such immense importance, that we are not surprised at the great interest excited by these machines.

Amongst the miscellaneous exhibits we can specially mention the numerous collapsible and other life-boats, and the boat-lowering apparatus, some of which are really admirable. Also the wire-rope rigging, and the stout wire torpedo nets, exhibited by Messrs. Bullivant and others.

It seems a pity, considering the great amount of interest which has been excited by this Exhibition, that it should only remain open for ten days.

#### TOTAL ECLIPSE OF MAY 17

WE have given from time to time, in the Astronomical Column, particulars of the approaching total eclipse, pointing out that it is visible at a point on the Nile, in lat. 26° 32' N. We are glad to be able to state, that an expedition left this country yesterday with the view of obtaining photographic and spectroscopic observations. The expedition has been organised by the Science and Art Department and the Royal Society combined, on the recommendation of the Solar Physics Committee.

The expedition sails to Suez in the Peninsular and Oriental steamship *Kaisar-i-Hind*, and a good idea of the local arrangements made will be gathered from the accompanying article, which we reprint from the *Daily News* of yesterday:—

May 17, 7 a.m., sun eclipsed, visible at Greenwich. Thus runs the records in our pocket-books. So short,

sharp, and decisive, that to talk about an eclipse expedition in connection with it seems at first sight an absurdity, unless indeed we dignify by that name a jaunt in a penny steamer to Flamsteed's famous hill. Thanks, however, to School Boards, boys' clubs, and the like, the explanation will be apparent to everybody, and it is this. For, although on the 17th of next month the moon will come between us and the sun in such a way that part of the sun will be covered at Greenwich, which may be taken as a short title for the British Islands, the covering-up will not be total, and we shall have, therefore, only what is called a partial eclipse, hardly worth looking at, from the physical astronomers' point of view. But a thin line can be drawn on the globe from the West Coast of Africa, through Egypt, Persia, Central Asia, and China, along which the moon will entirely cover the sun; and here, instead of a partial eclipse, we shall have a total one.

This is one of the most important phenomena we can observe in the whole domain of physical astronomy, for a reason with which the readers of the *Daily News* are already familiar, namely, that when the light of the bright interior nucleus of the sun which we usually see is prevented from illuminating our upper air, by the interposition of the dark moon, the sun's atmosphere, which we never see except at such times, is revealed in all its majesty, and invites study on the part of those who care for the mechanism of the universe in which their lot is cast. Now England is going to be represented at a point on this thin line, and therefore we must talk about an eclipse expedition in connection with this event; for while we write, the directors of the Peninsular and Oriental Company, who have ever shown the keenest anxiety to further the interests of science, are allowing the sacred bullion-room of the *Kaisar-i-Hind*, now getting up steam in the Royal Albert Docks, to be desecrated—as some will think, and they are welcome—by packing-cases of ungainly shape containing such instruments and combinations of brass and iron as have never been built before. The expedition in question, which has been equipped and manned by the Science and Art Department and the Royal Society combined, at the suggestion of the Solar Physics Committee appointed by the Government, of course is intended to occupy a position along that thin line to which reference has already been made, and the most easily accessible point is one on the Nile, about 100 miles north of Thebes, in lat. 26 deg. 32 N.; the most easily accessible, but not perhaps quite the best, for the reason that on the Nile the totality—that is, the period during which the moon entirely covers the sun—will only last some 72 seconds, whereas at Teheran there will be 104 seconds of darkness, which it is to be hoped the Russian astronomers will utilise. Seventy-two seconds! The time is not long, and when it is stated that the preparation of the new instrumental combinations and the investigation of the new methods to be employed have required three months' solid work and thought, many will ask whether the game is worth the candle. The following considerations will show that it was distinctly the duty of the men of science interested in these problems to endeavour to secure observations:—In the first place, it is a little discouraging to travel thousands of miles, and to go through all the preliminary work and anxiety connected with such an expedition, even if the eclipse is two or three minutes long, should the weather chances be 2 or 3 to 1 against success. On the Nile the weather chances—that is, the ordinary weather chances—are perfect, and there will be neither rain nor cloud. Secondly, the eclipse happens at the most critical time of the solar activity, thereby offering a most marked contrast to the last one observed in 1878. Then the sun was quite quiet. It was in a condition of almost unparalleled repose. Now, judging by what has happened, the sun should be in a condition of intense action, and from the

recent rapid increase both of spots and prominences we know the prediction is being fulfilled. Thirdly, the remaining ten eclipses observable during the present century—for, thanks to the diligence of Mr. Hind and others, we know almost to a minute when and where total eclipses will be visible until the year 1900—are not conveniently situated for observation, as the following list will show:—Next year one occurs with a maximum totality of 6 min., but the course is almost entirely over the Pacific Ocean. In the Marquesas, however, a duration of totality of 2 min. 53 sec. may possibly be available. The next (1885) is accessible only in New Zealand, where the greatest totality will be almost 2 min. The longest eclipse, as before, falls on the Pacific. The eclipse of 1886 has the longest totality in the century, but this falls over the Atlantic. In Grenada the totality will last 3¼ min. On the African coast, south of Angola, the duration will be more than 4½ min. The eclipse of 1887 will be best observed in Russia, and 50 miles north of Moscow the totality will have a duration 2½ min. On Lake Baikal the totality will last 3 min. 38 sec. The eclipse of 1889 will have at Angola a duration of about 3½ min., and at Barbadoes of about 1¾ min., its greatest duration being upon the East Atlantic. The next eclipse (1892) falls entirely on the South Pacific, and Antarctic Oceans, and must be lost, although the duration of totality extends to more than 4 min. On the whole, the most favourable eclipse for observation in the present century will be that of 1893, which enters the American continent near Coquimbo, where totality lasts nearly 3 min.; then, crossing Brazil, it leaves the land near Ciara, where the duration will last 3¾ min. Crossing the Atlantic, it will again reach land near Bathurst, with a totality lasting about 4 min., and, crossing Central Africa, will leave the land finally near Khartoum. The eclipse of 1894 will occur almost, if not entirely, over the sea or the inaccessible regions of Central Africa, but it may be total in the Seychelles. High latitudes are singled out for the path of the next eclipse (that of 1896), which, entering the Old World in Norway, passes across through Siberia to Japan. At Tana, in Finland, a totality of about 1¾ min. may be observed. Hindostan will be the most favourable locality for observations of the eclipse of 1898, which will have a totality of a little more than 2 mins.

It will be seen from the above list that although doubtless attempts will be made to secure observations of some of these eclipses, yet that in no case are we likely to get such a grand harvest of facts as have been secured during the last twenty years, notably during the eclipses of 1868 in India, 1869 United States, 1870 Mediterranean, 1871 India, 1875 Siam, and 1878 United States again. This condition of things of course makes one hope that the coming seventy-two seconds will be utilised to their utmost, and in consequence of the warm co-operation of the Egyptian Government, which has been appealed to by our Foreign Office, a serious attack is contemplated; that is to say, in consequence of the local transport facilities afforded, large instruments, combining great solidity and fineness of adjustment, will replace the mountain artillery, so to speak, which alone can sometimes be employed. The something like thirty cases into which each separate part of the two equatorial stands and telescopes to be used, with their spectroscopes and cameras, have been separately packed for convenience of carriage, will, on disembarkation at Suez, be placed in a special van which, on arrival at Cairo, will be ferried over the Nile, and so on to Siut, the most southerly railway station in Egypt. Another instance may be given of the keen interest which the Egyptian Government is taking in the matter. The shorter the totality, of course the nearer the exact central line of the eclipse must the observing party be in order to secure the maximum of the calculated period of obscuration. Stone Pacha, chief of the staff, who is personally sparing no pains to make all

preliminary arrangements, and to secure the success of the observations, has detailed one of his officers, at present stationed in Upper Egypt, to check the latitudes of the French map where the eclipse track crosses the Nile. Indeed, he has done more than this, and here comes the dark side of the picture so far as the observers are concerned. The eclipse happens in the very midst of the Khamseen season—that is the period of fifty days during which Lower Egypt is apt to be swept by a hot, exhausting south-east wind, so dust-laden at times, that the sun is totally obscured. To escape the chances of this double eclipse, or at all events to minimise them, it will be necessary for the party to occupy high ground. Stone Pacha is, therefore, after consultation with our Consul-General in Egypt, prospecting for a camp and providing the necessary camp equipage, and although he himself will not, we believe, accompany the expedition, it is hoped that an officer of the Khedive's household, himself an adept in astronomy, which he has studied at both Paris and Washington, will accompany the expedition as guide, counsellor, and friend, to assist in making the necessary arrangements with the various local authorities. So much, then, by way of preliminary. Now, a word on the instruments to be employed on this occasion. The resources of modern science place many means of attack in the hands of the astronomer. To get an idea of the physics of the solar atmosphere—what it looks like—to study, so to speak, its circulatory system, to which such special attention has been recently directed by the bold hypothesis of Dr. Siemens—to investigate its extent, and to determine the luminosity of its various regions, we have the astronomical telescope, and, better even than this for some purposes, the photoheliograph, that is an instrument which enables us to obtain a photograph of all the sun's surroundings visible during the eclipse. To determine the chemical nature of the various regions, a question to which the keenest interest attaches at the present time, we have the spectroscope and the spectroscopic camera. By means of these instruments we can see what we cannot photograph, and photograph what we cannot see. In former eclipses, when the duration of totality has been longer, it has been possible to have different instruments mounted on different stands—there has been time to go from one to the other. But on this occasion such a course would be impossible. On one stand, therefore, we have four telescopes and two spectroscopes for eye observation. On another stand we have a photoheliograph and spectroscopic camera for photographic registration. In the observing telescope two spectroscopes are so arranged that a movement of the eye through two inches is all that is required to pass from the greatest spectroscopic dispersion (7 prisms of  $60^\circ$ ) to the lowest (1 prism of  $60^\circ$ ) which can be conveniently employed during an eclipse. In this way it is hoped that the spectrum of the brightest and the spectrum of almost the dimmest part of the sun's atmosphere can be observed, and for the first time in the history of eclipse observation, comparisons will be made with the solar spectrum itself, as a solar photograph taken before totality will be used as a scale. Much is hoped in the way of the photographic record, for since the last eclipse, the science of photography, following step by step the new views of molecular grouping suggested by the spectroscope, has provided us with silver salts, identical in chemical composition, but so different physically that the red part of the solar spectrum can now be recorded as satisfactorily as the blue part of the spectrum has ever been. Nor is this all. The rapidity with which an image can be impressed upon a sensitised plate has been enormously increased, so that if all goes well, seconds now take the place of minutes, and more can be recorded in five seconds now than was possible in five minutes twenty years ago.

We have no space in the present article to refer more precisely to the exact work which it is proposed to under-

take, but this much may be said, that in eclipse, as in all other kinds of scientific observation, each attempt made to secure facts, instead of exhausting, increases the number of points of interest to be investigated, and now-a-days we not only get this principle at work from eclipse to eclipse, but daily work in our laboratories and physical observatories suggests questions which can only be solved at such times. Hence eclipse observations are getting more and more connected with terrestrial chemistry and terrestrial physics by this intermingling of laboratory and eclipse work, and hence also the area of general interest will be increased as time goes on.

In conclusion, we may state that the Government expedition will consist of Mr. Norman Lockyer, F.R.S., and Dr. Schuster, F.R.S., with their assistants, Messrs. Lawrance and Woods. Capt. Abney, who was at first detailed for the duty, is prevented by ill-health from joining the expedition, but the photographic preparations have been made under his supervision. It may be added that Mr. William Black and Mr. J. Y. Buchanan, late of H.M.S. *Challenger*, will accompany the expedition, and it is hoped that Prof. Tacchini may join it at Cairo. The *Kaisar-i-Hind* leaves Gravesend at 12.30 this day.

#### THE EDINBURGH FISHERIES EXHIBITION

THE International Fisheries Exhibition, which opened at Edinburgh on the 12th ult., and to which reference has been already made in the columns of NATURE, is likely to prove a complete success—not only commercially, but also as an exhibition of much that is interesting in the natural history of our most valuable marine animals.

The apparatus of capture takes up a large space in the Waverley Market Hall, but no particular novelty in the way of fish-traps is shown; no artificial bait that would supersede the whelk or the mussel in the taking of cod has apparently been yet invented, although much required. Several models of improved rigs for fishing-boats are shown, but no improvement has apparently been effected on the ponderous beam trawl, which is much complained of as a cumbrous instrument of fish capture. The exhibition is rich in specimens of stuffed fish contributed by various bodies of London anglers—but why not label them? It is not given to every visitor to a fishery exposition to know a jack from a perch. Some of the late Mr. Buckland's finely modelled and correctly coloured fishes have been sent from Kensington—notably a model of a salmon captured in the Tay, which weighed, when taken, 72 lbs. Considering the importance of the salmon to Scotland as a rent-yielding fish, we had expected to find in the exhibition a methodical display of the progress of that mysterious disease which has of late overtaken that fish; but, beyond a drawing of an afflicted salmon, we saw no other indication of the calamity. The display of oysters in progress of growth from the *spat* to the stage of reproduction, although not large, is exceedingly interesting. We pass over, in the meantime, the merely commercial exhibits, of which of course there are many, and shall only say of the piscicultural exhibition, that it merits at our hands a much fuller notice than we have room to bestow on it at present. A large number of maps, charts, books, and engravings, bearing on the natural history of our food-fishes and the economy of the fisheries, may be seen and consulted in the exhibition hall, whilst the illustrations of river pollution and purification attract a large degree of attention. Despite the deficiencies at which we have hinted, the exhibition is a valuable one, and, although not all at once, may lead to some new departures in the art of fishing, which may tend to augment in a striking way the national commissariat.

Among the exhibits which have attracted special attention are those sent by Mr. Oscar Dickson, of Gothen-