ASTRONOMICAL PHENOMENA FOR THE WEEK, 1885, *MAY* 24–30

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on May 24

Sun rises, 3h. 58m.; souths, 11h. 56m. 36·3s.; sets, 19h. 55m.; decl. on meridian, 20° 51′ N.: Sidereal Time at Sunset, 12h. 5m.

Moon (Full May 28, 21h.) rises, 15h. 16m.; souths, 20h. 59m.; sets, 2h. 33m.*; decl. on meridian, 5° 55′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury	3 21	10 21	17 21	11 3 N.
Venus	4 14	12 19	20 24	21 47 N.
Mars	3 6	10 29	17 52	14 56 N.
Jupiter	10 36	17 50	1 4*	13 25 N.
Saturn	5 19	13 27	21 35	22 21 N.

* Indicates that the setting is that of the following day.

Occultation of Star by the Moon

May	Star	Mag.	Disap. h. m.	Reap. h. m.	Corresponding angles from vertex to right for inverted image ° °
28	θ Libræ	4½	2 10	3 5	148 253

Phenomena of Jupiter's Satellites

May	h. m.		May	h. m.	
26	20 10	II. tr. ing.	29	20 46	I. occ. disap.
	23 6	II. tr. egr.	30	0 18	I. ecl. reap.
27	21 57	III. occ. disap.		20 25	I. tr. egr.
28	20 39	II. ecl. reap.		20 56	IV. occ. reap.
	23 37	I. tr. ing.			

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

May	h.	
25	13	Mercury at greatest elongation from the Sun 25° west.
30	21	Mercury in conjunction with and 3° 15′ south of Mars.

THE VALUE OF A MARINE LABORATORY TO THE DEVELOPMENT AND REGULATION OF OUR SEA FISHERIES[1]

It is a striking fact, to which attention has before now been drawn, that whilst the agriculturist, on whom we depend for a large part of our food supplies, has very largely availed himself of scientific knowledge in the treatment of crops and herds, the fisheries of our coasts, which provide an almost equally large amount of food to the people, have never been carried on with any regard to an accurate knowledge of the fishes on which they depend.

Agriculture is, in this country, a refined branch of chemistry; but there has been no demand for a knowledge of marine life which might enable the fisherman to pursue his calling to the greatest advantage. In fact, our fishery industries are still barbaric; we recklessly seize the produce of the sea, regardless of the consequences of the method, the time, or the extent of our depredations. In the same ignorant fashion as the nomadic herdsmen of Asia descend upon a fertile valley, and after exhausting it, leave it to time and natural causes for its recuperation, so do we treat the fishing-banks of our coast.

So long as fishing was relatively small in amount this method was not altogether objectionable. But with the increase of population, and the introduction of steam fishing boats and more effective instruments of capture, there is reason to believe that some at least of our coast fisheries are being destroyed, and that others may follow in the same direction.

Other civilised nations have perceived the necessity of attempting to regulate the various kinds of sea-fisheries on rational principles—that is to say, on principles based on an exact knowledge of the life and habits of the fi hes which it is desired to capture. The French, the Norwegians, and above others, the Americans, have given attention to this matter.

There is reason to believe that the Romans had gained a special skill—now lost—in cultivating sea fish. Whatever that may have amounted to, it is certain that modern Europe has entirely neglected the cultivation, and even the care of sea fisheries. It has been the merit of the Fish Commission of the United States to make the first attempt in modern times to deal with sea fisheries in the spirit of civilisation, that is of men who are determined to understand and control, for the advantage of their race, the operations of nature, rather than to leave things to chance, the unknown development of physical causes.

The direct efforts of the American Commission, and the knowledge which scientific men have accumulated with regard to fishes, without designing aid in the regulation and development of fisheries, do not enable us at present to answer many of the questions with regard to different sea fishes which we urgently require to know if we are to deal like reasonable, practical men with our fisheries, so as to improve them, or even so as to prevent their extermination.

At the late Fisheries Exhibition Congresses, the universal cry, the one unanimous demand, was "more knowledge!" We cannot tell whether beam-trawling with steamboats is injurious or not to some of our most valuable sea fishes, until we have more knowledge. We have not sufficient knowledge to enable us to say that it would restore some herring grounds to their former richness, if the fishermen were kept off those grounds for a few years.

We do not know why soles are getting scarcer every year; we know nothing about soles, and so we can do nothing to remedy their constantly increasing diminution.

We do not know why oysters are scarce, or how to make them more abundant. A few hap-hazard attempts to cultivate oysters are now and then made, but have resulted in an immense loss of money rather than in gain, because we do not know all about oysters in the same precise and detailed way in which we know all about wheat, or all about pigs or chickens.

We do not know why some fishes swim in great shoals year after year at certain seasons near certain spots, and then to the dismay of the fishermen suddenly give up ever passing that way. We do not know whether we could hatch the young of soles, turbot, cod, and other valuable fishes, and stock the sea with them as we do our rivers with trout and salmon.

We do not know whether we could favour the increase of such fishes by cultivating in the sea their favourite food. In many cases we do not know what their food is.

We do not know whether we might increase these fishes by destroying their enemies.

In fact, we know exceedingly little about the minute details of the life of marine animals, and if we wish to deal with sea fisheries like rational men, we must find out these minute details, and gradually apply the knowledge so gained.

A laboratory on the sea-shore, provided with boats and fishermen, and having within its walls tanks for hatching eggs and watching sea fish, and conveniences for the work of naturalists trained in making such observations, is the way to meet the deficiency in our knowledge above noted.

This was perceived many years ago in France, and more recently various laboratories have sprung into existence on the Mediterranean and on the American coast.

There is not, as yet, any such place of investigation on the English coast, and it is this deficiency which the Marine Biological Association, of which my honoured friend, Prof. Huxley, is President, and H.R.H. the Prince of Wales is patron, proposes to meet by building and maintaining a really efficient and thoroughly organised laboratory and experimental aquarium on the shore of Plymouth Sound.

The Association does not propose merely to build this place, but to arrange for the carrying out there of most importan investigations on such questions as those I have a few minutes ago named. They have the hearty and earnest co-operation of all the naturalists in the United Kingdom, Scotch and Irish naturalists having united with their English brethren to form this institution.

Naturalists are glad to take part in the study of these practical questions, because the arrangements and the studies which are necessary to answer the questions of the practical fisherman, are also just those which are necessary to advance the knowledge of the order of nature which forms the single object of truly scientific investigation. They will systematically and eagerly join with one another in the operations of the Plymouth laboratory, to obtain thorough knowledge with regard to the habits, food, breeding, and life-conditions of all kinds of marine fishes, such

[1] Abstract of paper read at the Society of Arts, Wednesday, May 13, 1885. By E. Ray Lankester, M.A., LL.D., F.R.S., Professor of Zoology in University College, London, and Fellow of Exeter College, Oxford.

as will be not only valuable but actually indispensable to the practical fisherman; and in the reports of the work done in the new marine laboratory which will be published by the Association, I do not doubt that the basis for future legislation and for future methods of sea-fishery will be found.

I may here venture to mention some of the results obtained by the efforts of the naturalists who form the United States Fish Commission—at the head of which is Prof. Spencer Baird. I would, however, especially remark that the Commission has only been at work for ten years, and that very great practical results cannot be expected at once. A vast amount of knowledge has to be obtained before we can deal practically with all the various kinds of sea-fishes; and it is to me a proof of the wonderful sagacity and activity of the American naturalists that they have already been able to do what they have done in the practical direction.

Prof. Baird has especially attempted to artificially cultivate sea-fishes. It seems to him that it is better, if it be possible, to replenish the seas by stocking them with young fish, to take the place of those removed by fishermen, rather than to impose legislative restrictions and penalties upon the fishermen. The attempt to artificially cultivate sea fish is an admirable example of the relation of scientific knowledge—that is, thorough and cause-reaching knowledge—to practical commercial operations.

There are two distinct stages in this attempt at artificial cultivation. The first is the scientific. You must ascertain how, when, and where the fish naturally breeds; you must find out, experimentally, how to procure its eggs, fertilise them, and rear the young to a given size—on a small scale. That is the business of the scientific naturalist. When he has ascertained all the details of this operation—which differ entirely in the case of different fishes, and may take years to ascertain—then the second stage is entered on. The commercial man then comes forward, and in the light of the knowledge obtained for him by the scientific man, attempts the hatching of the fish on a large scale—not by the hundred, but by the million.

The American Fish Commission has undertaken both stages of the work, and the second is necessarily a very costly one. A very promising result has been obtained in the artificial breeding of codfish, and again in the case of the shad. [Details of these operations were here given by the author.]

Again, in dealing with the American oyster, the Commission has obtained what promises to be a very great success. [Details of this case were given.]

But there is an almost unlimited field of work before the American Commission.

Experiments and observations similar to those carried out by the American Commission, will be undertaken by the Biological Association at Plymouth. For example, the artificial cultivation of that most valuable of British fishes, the sole, will be at once taken in hand. At present absolutely nothing is known as to the spawning of the sole—the male fish is not even recognised. In the first instance the naturalists at Plymouth will study the eggs and the mode of spawning of the sole, and the way in which the eggs are fertilised naturally. Then the necessary conditions for the rearing of the young fish will be ascertained. After that it will be possible to hatch a vast number of young soles and turn them out into Plymouth Sound, and to determine in this particular area, which is admirably adapted by its natural delimitations for the experiment, whether the take of soles in the Sound has been increased by the operation.

Similar experiments will be tried with other fish; and also knowledge will be gained as to the food of various fishes, and the causes which determine their movements, their increase, and their diminution in the neighbourhood of Plymouth.

This knowledge will help us to form sound and reliable conclusions as to the supposed injurious effects of steam trawlers and other modes of fishing, and so lead on to sensible and valuable legislation in regard to the seasons and modes of fishing best suited to obtain the maximum benefit from the harvest of the sea.

The English oyster, though differing from its American congener, can no doubt be brought under control by a thorough-going knowledge of all the conditions affecting it at all periods of life; and this it will be a first duty of the Marine Biological Association to attain. [Suggested inquiries as to the oyster were here mentioned.]

Lastly, the subject of "bait" is one of great importance, which we shall be able to deal with effectively. Not only shall we find new and effective baits, at present neglected by our line fishermen, but we shall be able to direct the cultivation of such valuable baits as the mussel and the limpet.

There is no fact which gives one so vivid an idea of the immense commercial value of sea fisheries as the amount which is annually expended on mussels for use as bait in those fisheries. There are few statistics on this subject, or indeed on any matters relating to our sea fisheries, and it will be one object of the Marine Biological Association to collect such statistics. But there is a certain amount of information as to the use of mussels for bait. Thus between October, 1882, and May, 1883, twenty-eight boats engaged in the haddock fishery at Eyemouth, in the North of Scotland, used 620 tons of mussels (about 47,000,000 individuals), costing nearly 1800*l.* to the fishermen, that is to say, over a million and a half of mussels for the whole time, or about 7000 a day to each boat—at the rate of one penny for twelve mussels. The total value of mussels used for bait in the deep sea line fisheries of the British coasts must amount to many hundred thousand pounds in a year—and we can only roughly guess at the value of the fish caught by this large expenditure on bait. In spite of the great economic importance of the mussel, its complete history of reproduction and growth is not known, and though in France and Germany it is carefully and profitably cultivated, very few attempts have been made on the British coast to protect or to artificially favour mussel scalps so as to make them remunerative properties.

This is a subject with which a marine laboratory would enable us to deal in a very short time. The same general remarks, *mutatis mutandis*, apply to the second most important bait, viz, the limpet.

Before concluding this sketch of the work which lies before the managers of a marine biological laboratory, I may say a few words as to the nature of the buildings and equipment required for such an institution.

The most efficient scientific laboratory of the kind is that erected at Naples by Dr. Dohrn, a drawing of which is exhibited. The Naples laboratory, with its tanks, row boats, and steam launches, has cost about 20,000*l.*, and involves an annual expenditure of about 4000*l.* A staff of observers is paid out of this sum, and the efforts of the institution have hitherto been entirely directed to the obtaining of accurate scientific knowledge with regard to the fauna and flora of the Bay of Naples. It is justly regarded as one of the most important scientific institutions in Europe.

The United States Fish Commission have erected, from time to time, various small laboratories, and are now about to expend 10,000*l.* on a laboratory at Wood's Hole, and 20,000*l.* on building fish-ponds protected by piers of masonry. Since its commencement, the United States Commission has received from the Imperial revenue about 300,000*l.* In 1884 alone it received 70,000*l.* It must be remembered that these large sums cover the expense of very extensive operations in fish-breeding on a commercial scale, and are not solely for the purpose of preliminary investigation.

The Marine Biological Association proposes to proceed in a modest manner, arranging in the first instance for the carrying out of the necessary experimental inquiries. A site has been obtained on the Citadel Hill, at Plymouth, by permission of the authorities of the War Office, and here will be erected a laboratory, comprising on the ground floor large and small tanks, and above, a series of working rooms fitted with small tanks. Through all a stream of sea-water will be driven by pumping apparatus, from large tanks in the basement, containing several thousand gallons. These reservoirs will only be replenished two or three times in the year. Boats, including a steam-launch, will be required, and two or three fishermen, who will act as attendants. A resident superintendent, who will be a thoroughly qualified naturalist, will be appointed at a salary of 200*l.* a year, and will be lodged on the premises. Naturalists will frequent the laboratory at their own expense for the purpose of study, and from time to time competent investigators will be appointed to carry out particular inquiries. The latter will be paid for their work from special sources, not from the general income of the Association until that reaches a large amount. Great assistance will be afforded to the work of the Association by the local fleet of fishing boats, which is very numerous, and comprises some vessels of large size. It is estimated that a capital sum of 10,000*l.*, and the prospect of an income from annual subscribers, members of the Association and others, of about 500*l.* a year, will enable the important work which has been taken in hand to be commenced. The Council of the Association feel very great confidence that they will be able to obtain annually sufficient funds to keep the laboratory in efficient working order when once the capital sum of 10,000*l.* has been subscribed. Towards the latter amount they have already raised a sum exceeding 5000*l.* From Plymouth as a centre, in the course of future years, the operations of the Association will extend, and additional laboratories will no doubt be constructed hereafter by the Association on other parts of the coast of the United Kingdom, should the first one prove a success, and the work carried out through its agency meet with public approval and support.

Whilst the Marine Biological Association aims at obtaining, by the operations of its laboratory and experimental aquarium, that knowledge which is clearly necessary for the improvement and regulation of our sea fisheries, it must be remembered that its work will necessarily enlarge and advance the great science of biology, and that to many of us this is its surest promise of utility, for we cannot always directly govern the march of scientific progress. The whole field of knowledge must be cultivated, in the simple faith that the increase of knowledge is the greatest good which human effort can achieve. By adopting a thorough and comprehensive scheme of study of the problems connected with the life of fishes, we shall, as invariably happens in the history of science, obtain results which at present we cannot foresee, but which, we may feel assured, will yield in unexpected ways rewards and blessings to humanity.

METEOROLOGICAL INSTRUMENTS

THE Royal Meteorological Society recently held its sixth Annual Exhibition of Instruments at the Institution of Civil Engineers, 25, Great George Street, S.W. This Exhibition was devoted to sunshine recorders, and solar and terrestrial radiation instruments.

The first attempt at obtaining an instrumental record of the amount of sunshine was made by Mr. J. F. Campbell, of Islay, in the year 1853, when he mounted a hollow glass sphere filled with acidulated water, in the centre of a cup of mahogany, so arranged that the sun's rays were focussed on the interior of the cup and burned it. The lines of burning, therefore, indicated the existence of sunshine. Solid glass spheres have been substituted for the hollow ones, and cards in metal frames have replaced the wood; but in its principle the sunshine recorder of 1885 differs little from that erected on Richmond Terrace, Whitehall, thirty years ago. Other modes of recording sunshine are based on the action of the rays of the other end of the spectrum on the actinic instead of the heat rays. Among workers in this direction may be mentioned Marchand of Fécamp, Sir Henry Roscoe, and others. The most recent improvements in this direction are those by Prof. McLeod and by Mr. Jordan.

With regard to solar radiation thermometers, the successive stages in the assumed perfecting of these instruments have been as follows:—An ordinary mercurial thermometer acts as a spherical mirror, and reflects the rays which fall upon it. To lessen this the bulbs were first made with black glass; moreover, originally the degree marks were put upon the supporting slab, then they were put upon the tubes of the thermometers. It was then found that in a position where two thermometers with similarly coated bulbs were exposed to the sun, but one was exposed to more wind than the other, the indicated temperatures varied greatly. To avoid this it was proposed that the thermometer should be inserted in a glass shield exhausted of air. Various forms of mounting have been adopted, but the chief efforts have been expended in determining the influence of the amount of air left in the so-called vacuum. The next stage was that, inasmuch as black glass had a bright surface, there was still much light reflected, and therefore the surface was dulled with a coat of lamp-black—so that all heat falling upon the bulb might be absorbed. Subsequently, owing to the influence of the lower temperature of the unblackened thermometer tube, about one inch of it was coated like the bulb. As evidence of the degree of exhaustion, a small mercurial pressure gauge was attached to the thermometer, and by other makers platinum wires were soldered through the shield so that the stratification of the electric arc might indicate the amount of air still left.

With regard to terrestrial radiation thermometers, the pattern of instrument used has varied very little. The Rutherford minimum has almost always been used, but its sensitiveness has gradually been increased: the spherical bulb was replaced by a cylinder, the cylinder was elongated and bifurcated, and eventually, in order to strengthen the forks, they were united into what is known as a "link." Another plan was to flatten the cylindrical bulb into as thin a plate as possible, this giving a maximum of surface in proportion to the contents. The bulb was also made double, and thus we have the so-called "bottle" pattern, and then the tube was let into the side of the bottle, and both ends of the bottle were left open, and so we have the "open cylinder"—a remarkable specimen of glass-blowing. Then there have been two patterns of mercurial thermometers—Casella's and Negretti's. Difficulties have arisen from the degree marks being obliterated by the weather. To guard against this the tube has been inclosed in what are known as Leach's shields, and many attempts have been made to render the joint at the entrance of the tube watertight. This is not easy, because the thermometer is exposed to a great range of temperature, and the air inside the shield varies so much in volume that it forces its way through almost every joint. The object is, however, effected when the external jacket is sealed on the stem near the bulb.

In addition to specimens illustrating the various patterns of the above instruments, the Exhibition also included a number of new instruments, and many interesting photographs, sketches and diagrams. The photographs of clouds and lightning were very good.

At the meeting of the Society the President, Mr. R. H. Scott, F.R.S., read a paper giving a brief account of the various instruments and arrangements to be found in the Exhibition for the purposes of recording solar and terrestrial radiation and the duration of sunshine both in regard of its light and its heat, the last-named being obtained by means of the sunshine recorders, which are now pretty generally used. He exhibited twelve monthly maps showing the percentage proportion of hours of recorded sunshine to the hours the sun was above the horizon in the various districts of the United Kingdom. He stated that the features which strike any one on examining the maps of sunshine, which are for the most part for the five last summers and for the four last winters, excluding January to March, 1885, which has not yet expired, are:—First, the broad fact that the extreme south-western and southern stations are the sunniest, as has already frequently been pointed out. Jersey is undoubtedly the most favoured of our stations in this particular. Second, that in the late autumn and winter Ireland is much sunnier than Great Britain, Dublin having absolutely the highest percentage of possible duration of sunshine in November and December, and being only equalled by Jersey in January. The Dublin instrument is not situated in the city, but at the Mountjoy Barracks in the Phœnix Park, beyond the Vice-regal Lodge. The north-east of Scotland is also exceptionally bright, as the station, Aberdeen, lies to leeward of the Grampians. In April the line of 40 per cent. of possible duration takes in Jersey, Cornwall, Pembrokeshire, the Isle of Man, and the whole of Ireland except Armagh. The absolute maximum of the year occurs in May, and the amount rises to 50 per cent. (nearly to 60 in Jersey) over the district just mentioned as enjoying 40 per cent. in April. In June there is a falling off, which is continued into July and even into August in the Western Highlands. In the South of England, however, a second maximum occurs in August, the figure for Jersey rising to 50 per cent. This is mainly due to the exceptionally bright weather of August, 1884, in the southern counties of England. In September, Ireland shows a falling off, and the greatest degree of cloudiness is in Lincolnshire. In October, the Midland Counties of England are the worst off. In November the line of 40 per cent. encloses two districts, one Dublin, already mentioned; the other the Eastern Counties (Cambridge and Beccles). The absolutely highest monthly percentages in the period under consideration are in the month of May, 1882, in which St. Anne's Head, Milford Haven, had 62 per cent., while Geldeston (Beccles), Douglas (Isle of Man), and Southbourne (Bournemouth) show 61 per cent.

SCIENTIFIC SERIALS

THE *American Journal of Science*, April.—On the use of carbon bisulphide in prisms, being an account of experiments made by the late Dr. Henry Draper of New York. The results so far obtained by Dr. Draper in his investigations on the cause of the difficulties encountered in the use of carbon bisulphide in prisms seemed so valuable and so likely to prove useful to others engaged in photographing the prismatic spectrum that it was decided to publish them in the *American Journal of Science*.