

## SCIENCE.

## ROYAL SOCIETY ANNIVERSARY.

THE Anniversary Meeting of the Royal Society was held on Wednesday last, a large number of Fellows being present to witness the presentation of the medals and to hear the President's annual Address. It was a source of universal regret that the medallist—that is, the Copley medallist of the year—Mr. Charles Darwin, was prevented by sickness from attending.

Major-General Sabine's Address, which is too long to reproduce *in extenso*, referred first to the progress recently made in the Catalogue of the Titles of Scientific Memoirs contained in the scientific periodicals in all languages from 1800 to 1863, which is now being compiled by the Royal Society. The various Foreign Academies are rendering all assistance, and the MSS., when completed, will be handed over to Her Majesty's Government, to be printed at the public charge, a certain number of copies being presented to scientific institutions at home and abroad, in the name of the British Government and of the Royal Society, and the remainder of the impression being offered for sale at the cost of paper and printing only, and the proceeds applied towards the discharge of the expense incurred in the printing. No pecuniary return is looked for on the part of the Society. The expense hitherto incurred by the Society amounts to about £1400; and possibly £300 or £400 more will be required.

After passing in review the many important papers which have recently appeared in the Philosophical Transactions, he referred to the pendulum observations to be made in India, the importance of which was foreshadowed in the Address last year. Colonel Walker has directed that the Indian Survey should be provided with instruments for determining the absolute values of the three magnetic elements at the Indian stations. We may thus hope to obtain a further investigation of the (apparent) systematic anomaly in the direction of the lines of magnetic force in the central parts of India, which is so remarkable a feature in the admirable magnetic survey of that portion of the British dominions executed by the Messrs. de Schlagentweit.

"The authorities in the colonies of Mauritius and Victoria have decided on the establishment of magnetical observatories supported by Colonial funds, to be equipped with similar instruments to those at Kew, and to be conducted on the system which is there exemplified.

"We have learnt with satisfaction from Stockholm that the Swedish Expedition to Spitzbergen has returned from the second year of a survey preliminary to the measurement of an arc of the meridian, and that the result has been that no doubt is entertained of the practicability of the measurement of an arc of, at least 3°, with a possibility of further extension. The report of the completion of the preliminary survey is to be published in the early part of the winter; and the summer of 1865 is looked forward to for the commencement of the arc itself.

"The Copley Medal has been awarded to Charles Darwin, Esq., F.R.S., for his important researches in Geology, Zoology, and Botanical Physiology.

"In 1832 Captain FitzRoy, commissioned by the Admiralty to proceed in command of the *Beagle* on a voyage of survey to the Southern Hemisphere, liberally offered, in the interest of science, to give up half his cabin to any qualified naturalist who would volunteer to serve on the Expedition, no remuneration being attached to the duty. Mr. Charles Darwin, then a ripe student at Cambridge, ardently devoted to the study of natural history, having heard of the offer—like Sir Joseph Banks, in the earlier of Cook's voyages—eagerly came forward as a volunteer. The voyage of the *Beagle* extended over the consecutive years from 1832 to 1836, and embraced regions presenting such fertile fields for research in the volcanic, coral, and other islands of the Atlantic and Pacific oceans that the results of his observations actively occupied, after his return, ten years of Mr. Darwin's time in publication, and have since mainly suggested and determined the most prominent of his latest labours. His scientific works and memoirs have included a very wide range of subjects, which may be classified under the heads of Geology, Zoology, Physiological Botany, Physical Geography, and Genitive Biology, each of which he has enriched with important original contributions. The award of the Copley Medal has been founded on Mr. Darwin's researches in the three first-named branches of science.

"Geology.—Mr. Darwin has been pre-eminently successful in the solution of a great problem in

physical geography, and in applying it to the explanation of geological phenomena, by his important work on the Structure and Distribution of Coral Reefs, which appeared in 1842. The successive voyages of many eminent navigators had shown that vast tracts in the deepest parts of the Pacific and Indian oceans were studded with circular groups of coral islets enclosing lagoons, and that long detached reefs of the same formation flanked lines of coast in a nearly unbroken stretch of about 1000 miles. The reefs and islands had been carefully mapped and surveyed; and the different forms exhibited by them had been accurately classified under the names of "Atoll Islands," "Encircling Reefs," "Barrier Reefs," and "Fringing or Shore Reefs." Eminent naturalists had observed the habits and mode of growth of the zoophytes in the most favourable localities; and the comparatively shallow depths at which the reef-building species live had been determined. But no satisfactory explanation of the phenomena was arrived at—why atolls assumed their peculiar form, and why barrier reefs included broad lagoon channels between them and the contiguous coasts. Some explanations were indeed propounded, but were manifestly inadequate to meet all the conditions.

"The subject was in this state when Mr. Darwin took it up. Combining careful observations upon coral reefs and atolls with reflections upon the range and distribution of volcanic islands, he divided the area of the Pacific and Indian oceans into tracts of elevation and depression. All the coral phenomena of atolls, encircling reefs, and barrier reefs were accounted for upon the supposition of a long protracted but gradual subsidence under the ocean of large areas of land, admitting the coral formation to grow up whilst its foundation sunk down; while fringing reefs were explained as appertaining to areas of elevation where the land had risen up or was progressively rising. On this view the apparently discordant facts ranged themselves in perfect harmony. Fringing reefs were thus converted into barrier reefs, and encircling reefs into atolls, the instant the last particle of land sinks beneath the ocean. Representing on a map the two classes of facts by different colours, it was shown that active volcanoes are absent in the region of atolls and barrier reefs, while they abound in areas of coral fringes and of elevation.

"Mr. Darwin's researches were received by naturalists with lively satisfaction, as fixing an era in the history of the investigation, and as contributing one of the most important illustrations which geology had received since it had been shaped into a science. A flood of light was thus thrown upon the ancient calcareous formations which enter so largely into the composition of the superficial crust of the earth, and something like a definite idea was arrived at respecting areas of depression and elevation.

"In addition to his researches upon coral reefs Mr. Darwin has made numerous contributions to geology, both in the descriptive and theoretical divisions of the science. As belonging to the former class may be cited his admirable 'Journal of Researches,' containing observations on the geology of the various countries visited during the voyage of the *Beagle*; notes during a survey of the east and west coasts of South America, with a transverse section of the Cordilleras between Valparaiso and Mendoza; geological observations on South America, published as a separate work in 1846; geological observations on the Volcanic Islands, visited during the voyage of the *Beagle*, with brief notices of the geology of Australia, New Zealand, and the Cape of Good Hope, also published as a separate work; on a remarkable bar of sandstone off Pernambuco; on the deposits containing extinct mammalia in the neighbourhood of the Plata; on the geology of the Falkland Isles; on the distribution of erratic blocks in South America.

"In theoretical or speculative geology may be cited his memoir on the connexion of certain volcanic phenomena in South America, and on the formation of mountain-chains and volcanoes as the effect of continental elevations; his memoirs on the Parallel Roads in Glenroy; on the effects produced by the ancient glaciers of Carmarthenshire; on the transport of erratic boulders from a lower to a higher level; and on the origin of saliferous deposits. From the ossiferous superficial deposits in the neighbourhood of the Plata Mr. Darwin brought home an important collection of fossil mammalian remains, which formed the subject of a separate volume by Professor Owen. In his memoir 'On the Formation of Moulds,' as the result of the digestive process of the common earthworm, he furnished a fresh

and instructive illustration of the large effects which are produced in the organic kingdom by the continued agency of apparently insignificant instruments.

"The present occasion admits of little more than a bare enumeration of these labours, which are stamped throughout with the impress of the closest attention to minute details and accuracy of observation, combined with large powers of generalization. The Geological Society of London signified its estimate of their importance by the award of a Wollaston Medal.

"Zoology.—In zoological science Mr. Darwin's eminent merits were to some extent acknowledged ten years ago by the award of a Royal Medal. On that occasion the zoological work that was most particularly distinguished was his monograph on the Cirripeds, a class of animals whose life, history, structure, and classification had previously been involved in the greatest obscurity and confusion. Notwithstanding the difficulties attending the study of these animals, and the extraordinary anomalies presented in their structure, habits, and affinities, Mr. Darwin was successful, as the result of unwearied labour and patience, and of the exercise of the most acute and accurate observation, in clearing up all that was obscure, and in disclosing for the first time numerous facts of the utmost interest and importance. But, since the principal points contained in this monograph have been already detailed in the Proceedings of the Royal Society on the occasion referred to, it is needless here to recapitulate them. It will be sufficient to remark that the justness of the estimation then placed upon Mr. Darwin's labours has since been completely confirmed by the concurrent voice of all zoologists, and that the monograph on the Cirripeds is universally acknowledged to be a model of what such a work should be, and as fully entitling its author to a place in the foremost rank of zoological observers and authors. His labours in the same department were completed by the publication, about the same time, of two monographs on the Fossil Cirripeds of Great Britain, published by the Palaeontological Society. . . .

"In other departments of zoology Mr. Darwin's labours, though not given in the same complete form as in the monographs, have been numerous and important. They are distinguished by the same extent and variety of knowledge, the same scrupulous fidelity, accuracy, and minuteness of observation, and by the sagacity with which the most important generalizations have been drawn. Amongst these contributions should more especially be noticed the observations on the distribution and habits of the animals described in the 'Zoology of the Voyage of the *Beagle*,' and in the 'Journal of Researches' in the course of that voyage, in which most interesting and justly popular work we find first distinctly enunciated the important 'law of the succession of Types,' or the law that existing animals have a close relation with the extinct species found in the same regions. Nor amongst the many other weighty and interesting remarks contained in this volume should notice be omitted of those which have reference to the common assumption that the presence of the remains of large animals necessarily implies that the country inhabited by them must have possessed a luxuriant vegetation. The fallacy of this assumption is plainly shown by Mr. Darwin, and the importance of his correction of a prevalent error of this kind can hardly be overrated.

"In his most recent work 'On the Origin of Species,' although opinions may be divided or undecided with respect to its merits in some respects, all will allow that it contains a mass of observations bearing upon the habits, structure, affinities, and distribution of animals, perhaps unrivalled for interest, minuteness, and patience of observation. Some amongst us may perhaps incline to accept the theory indicated by the title of this work, while others may perhaps incline to refuse, or at least to remit it to a future time, when increased knowledge shall afford stronger grounds for its ultimate acceptance or rejection. . . .

"Botanical Physiology.—Mr. Darwin's first botanical work, 'On the various Contrivances by which British or Foreign Orchids are fertilized by Insects, and on the Effects of Inter-crossing,' marks an epoch in the history of physiological botany, and, taken in all its bearings, is, perhaps, the most masterly treatise on any branch of vegetable physiology that has ever appeared. The objects which the author had in view in entering on a comprehensive study of the sexual system of Orchideae were to show that the contrivances by which they are fertilized are as varied and almost as perfect as any of the most beautiful adaptations of the animal kingdom, and that these

contrivances have for their main object the fertilization of one flower by the pollen of another. In pursuance of this object Mr. Darwin set himself to investigate, first, the structure and development of the flower of living specimens of nearly every British species; secondly, to observe how impregnation was naturally effected in each; thirdly, to make a similar structural investigation of the principal exotic forms; and, fourthly, to ascertain by experiment the method by which these also are in all probability fertilized. To these investigations Mr. Darwin brought all the resources of a most skilful microscopic dissector, of an unwearied and exact observer, of a sagacious experimentalist fertile in resources, of an entomologist versed in the structure and habits of insects, and of an excellent judgment in interpreting obscure phenomena, and drawing from them correct conclusions.

"The result is a work no less remarkable for the novelty of its facts, and for the importance of their bearing, than for its being the first which correlates the structure with the functions of the floral organs of one of the largest and most conspicuous of the families of plants. It would not be difficult to justify this strong encomium by examples of great interest taken from the work itself, but it would be incompatible with the limits of this Address; suffice it therefore to say that the general conclusion to which Mr. Darwin arrives is, that all the forms, even the most grotesque, which the floral organs of Orchids possess are directly and obviously of use, and that every structural and physiological modification, however minute, tends, with scarcely an exception, to ensure the fertilization of the ovules of one plant by the pollen of another.

"Mr. Darwin's next contribution to physiological botany is entitled 'On the Two Forms, or Dimorphic Conditions, in the Species of *Primula*, and in their remarkable Sexual Relations.' The phenomena of there being two distinct forms of flower in the genus *Primula* has long been familiar to naturalists, but the real nature of the difference between them, and of their respective functions, had not occurred to anyone. Mr. Darwin first suspected that the relations between the forms might be sexual, and he has since, with consummate skill, incontrovertibly proved this to be the case. By a most searching examination of a vast number of specimens of each form, in cultivated varieties as well as in species, he found that in all the two forms presented, in their stigmatic surfaces, ovules, and pollen, constant differences, unbroken by a single instance of transition between the distinct forms. By experiments continued for several years he proved that in this genus complete fertility is only obtained by impregnating one form by the pollen of the other, each species of *Primula* being divided into two sets or bodies, which cannot be called distinct sexes, for both are hermaphrodite; yet they are so in a certain sense, for they require reciprocal union to effect perfect fertility. This remarkable fact has as yet no known parallel. The cross-impregnation is effected by insects, the structure of insect and flower being such that one form cannot by this means be impregnated either by its own pollen or by that of a flower of its own form.

"In a subsequent paper Mr. Darwin has shown that in a species of the genus *Linum*, which is also dimorphic, whilst the pollen in the two forms is absolutely undistinguishable microscopically, and the stigmas differ but slightly and not in any apparently important respect, the pollen of one form is ineffectual when placed on the stigma of its own flower, but acts immediately upon that of the other form. The generally received idea, that the impregnation of plants may be effected indifferently by wind or by insects, is shown to be fallacious, plants being structurally adapted for the one or the other, and not indifferently for either.

"He has similarly investigated a still more complicated case in the common *Lythrum salicaria* of our ditches, which, as regards its flowers, is trimorphic, there being three instead of two sexual forms, differing in the relative lengths of their two series of stamens and of their styles. In estimating the novelty and value of Mr. Darwin's botanical discoveries we should not overlook that they have all been obtained by the study of some of the most familiar and conspicuous of our native plants, and some of the best known and easily procured cultivated exotics.

"The Council have awarded a Royal Medal to Warren De La Rue, Esq., for his Observations on the Total Eclipse of the Sun in 1860, and for his improvements in Astronomical Photography."

The President remarked, "Among those who have successfully cultivated this comparatively new department of astronomy, it may, perhaps, be fairly said that Mr. De La Rue stands pre-eminent. It is not that he claims any priority in making this application of the photographic art. Several astronomers have made experiments in celestial photography, and some of these earlier than Mr. De La Rue; but no one, I believe, has devoted himself so systematically and assiduously to overcome the many difficulties which are met with in the process; and no one has been so successful in the results which he has obtained, particularly in regard to the sun and moon, his photographic pictures of which bodies are sufficiently delicate in their details to admit of the most precise measurement. No one who has not seen Mr. De La Rue's pictures of the moon can form an idea of their exquisite sharpness and beauty of definition. No doubt part of the superiority of these pictures is due to his employment of a reflecting telescope of exquisite defining power, the large mirror of which was figured by his own hands, and by peculiar machinery of his own contrivance. Thus he entirely avoided those imperfections of the actinic image which arise from outstanding chromatic dispersion in the very best refractors, especially when, as usual, they are achromatized for the luminous and not for the chemia rays of the spectrum.

"The photographs obtained in the solar eclipse of 1860 have been discussed by Mr. De La Rue in a most elaborate paper in the Philosophical Transactions for 1862, forming the Bakerian Lecture. In this memoir, and in his reports on the progress of Celestial Photography in the volumes of the British Association for 1859 and 1861, Mr. De La Rue has fully described his processes and instruments, and has thus deepened the feelings of obligation to him, by giving others the benefit of his long experience in the art, though even with this guidance no one can hope to attain to great proficiency in its practice without time, patience, and perseverance.

"The Council have awarded a Royal Medal to Mr. Jacob Lockhart Clarke for his researches on the intimate structure of the Spinal Cord and Brain, and on the development of the Spinal Cord, published in five memoirs in the Philosophical Transactions, and in other writings. . . . One of those who, in former times, most signally advanced this department of anatomical knowledge was an early Fellow of this Society—Dr. Thomas Willis, whose celebrated treatise on the Anatomy of the Brain was illustrated by drawings from the pencil of no less eminent an Associate than Sir Christopher Wren, also a Fellow, and afterwards President of the Society.

"One of the principal subjects of Mr. Clarke's investigation was the grey substance which forms the interior part of the spinal cord. The figure which this part assumes in different regions of the cord has been more exactly described and delineated and the nature and arrangements of its constituent elements more fully examined and more clearly exposed than heretofore. Two columns or tracts, composed of nerve-cells, and previously undescribed, have been shown to exist in the grey substance through nearly the whole length of the cord, and two others in a shorter extent. Moreover, Mr. Clarke was, as we believe, the first to point out that the central canal of the spinal cord is lined with epithelium, and he certainly first explained the true nature of the tissue immediately surrounding the canal, which had previously been mistaken for nervous substance.

"The course and connexions of the fibres of the nerve-roots after they enter the substance of the spinal cord have, as yet, been by no means fully made out; but Mr. Clarke's investigations have shed considerable light on that obscure point of anatomy, and, amongst other observations of moment, he has shown that a part of the posterior or sentient roots take, in the first instance, a downward direction—an unlooked-for anatomical fact, which was afterwards strikingly shown by Brown-Sequard to be in harmony with the result of physiological experiments."

"The structure of the medulla oblongata, and the relation of its several tracts or divisions to the columns of the spinal cord, as well as the intimate nature of the grey masses which are there superadded, and their connexion with special sets of fibres and nerve-roots, have received fresh elucidation from the keen scrutiny and sagacious interpretation of Mr. Clarke. Mr. Clarke has also investigated the mode of the development of the spinal cord in the fetus.

"The Council have awarded the Rumford Medal to Professor John Tyndall, F.R.S., for his researches on the Absorption and Radiation of Heat by Gases and Vapours.

"Previously to the researches of Professor Tyndall hardly anything had been done in the way of an experimental determination of the absorption of radiant heat by gases and vapours. Melloni had inferred from his experiments that atmospheric air is sensibly diathermanous in a length such as that of an ordinary room, while Dr. Franz came to the conclusion that a column of air only three feet long absorbed more than three-and-a-half per cent. of the heat-rays from an argand lamp. The discrepancy of these results gives some view of the difficulty of the experiments; but it is only by the perusal of the earlier part of Professor Tyndall's first memoir on the subject that the skill and patience can be appreciated with which the various sources of error were one by one detected and eliminated by him." After referring to Professor Tyndall's memoirs, General Sabine remarked:—

"It may serve to show the difficulties which beset the inquiry, arising from the interference of disturbing causes, to state that two such experienced physicists as Professor Tyndall and Professor Magnus of Berlin should have arrived at, and long maintained, opposite conclusions respecting the absorption of radiant heat by air, and the influence of aqueous vapour. This led Professor Tyndall, in a third memoir, to consider more especially the case of aqueous vapour, which he had already treated in his two former papers. The result is that his conclusions have been so confirmed by a system of checks and counter-checks, and by the complete harmony which they present with what we know to be true in other cases, that it seems impossible to doubt their correctness.

"The conclusion that the chief absorbing action of the atmosphere on non-luminous heat is due to the aqueous vapour which it contains has numerous and important bearings on meteorology, and has been applied by Professor Tyndall to the explanation of some phenomena which appear hitherto to have been imperfectly understood.

"In a fifth memoir, which may be expected to be published in a few days, he examines, among other things, the penetrative power of the heat radiated from various flames, and shows that such heat is absorbed with especial facility by the gases which result from the combustion.

"Professor Tyndall concludes from his researches that, as a general rule, the opacity of a substance with respect to radiant heat from a source of comparatively low temperature increases with the chemical complexity of its molecule; and he has given some remarkable instances in which the law is found to be true. Whatever may be thought of our ability to explain the law in the present state of our knowledge respecting the molecular constitution of bodies, the law itself is in any case highly remarkable."

## CARINTHIAN LAKE-DWELLINGS.

At the meeting of the Imperial Academy of Vienna on the 6th August last Professor Hochstetter gave a brief sketch of the results of his investigations of the lakes of Carinthia and Carniola in search of traces of pile-dwellings. In spite of the unfavourable circumstances presented by the great excess of water in the lakes during the past summer, Professor Hochstetter found evidences of pile-dwellings in four Carinthian lakes—namely, in those of Wörd, Keutschach, Rauschelen, and Ossiach—in which, at certain points, pile-works, pots, sherds, hazel-nuts, bones, and other objects were obtained. In the Keutschacher lake, which was the only one particularly investigated, traces of piles were visible nearly in the middle of the lake, where the water is usually from four to six feet, but was this summer at least ten or twelve feet in depth. From the midst of these piles the dredge brought up various objects, such as half-carbonized fragments of nutshells, pieces of burnt clay and incrustated charcoal, and numerous fragments of shells of *Anodonta*. Subsequently M. T. Ulleppich of Klagenfurt obtained from the same spot a great quantity of black potsherds, with peculiar zigzag markings and half-burnt pieces of clay, which appear to have been pressed in between round sticks; he also procured a round plate of mica-schist, a whetstone, and a fragment of stag's-horn. Professor Hochstetter has no doubt that we have here remains of very ancient date, and that, by carrying on operations at the proper season, these pile-dwellings, with their peculiar utensils and other objects of the stone and bronze periods, will be discovered both in the Keutschacher lake and in the other localities indicated by him just as in the Swiss lakes.