November 30, 1867.

ANNIVERSARY MEETING.

Lieut.-General SABINE, President, in the Chair.

Mr. Savory, on the part of the Auditors of the Treasurer's Accounts appointed by the Society, reported that the total receipts during the past year, including a balance of £666 1*s.* 6*d.* carried from the preceding year, amount to £4932 3*s.*; and that the total expenditure in the same period amounts to £4436 12*s.* 9*d.*, leaving a balance of £483 16*s.* at the Bankers, and of £11 14*s.* 3*d.* in the hands of the Treasurer.

The President announced that the Council had elected Sir Philip Egerton as a Trustee of Sir John Soane's Museum for the next five years.

The Secretary read the following Lists :—

Fellows deceased since the last Anniversary.

On the Home List.

Major-General John George Bonner.
William Brinton, M.D.
Edward Burton, Esq.
William Cotton, Esq., D.C.L.
Walter Crum, Esq.
Colonel Sir George Everest, C.B.
Michael Faraday, Esq., D.C.L., LL.D.
Professor John Goodsir.
William John Hamilton, Esq.
Sir John Jacob Hansler, Knt.
Sir William Snow Harris, Knt.
Sir William Lawrence, Bart.
Ashhurst Majendie, Esq.
Commander James Mangles, R.N.
John Mercer, Esq.
Thomas Richardson, Esq., M.A., Ph.D.
Charles Milner Ricketts, Esq.
William Parsons, Earl of Rosse, K.P., M.A., LL.D.
James Smith, Esq.
Sir James South, Knt.
Alexander John Sutherland, M.D.
Lord Justice Sir George James Turner, Knt., D.C.L.
Robert Warington, Esq.
John, Lord Wrottesley, M.A., D.C.L.

On the Foreign List.

Alexander Dallas Bache.

Fellows elected since the last Anniversary.

Lord Chief Justice The Right Hon. Sir William Bovill.
William Baird, M.D.
W. Boyd Dawkins, Esq.
Baldwin Francis Duppa, Esq.
Albert C. L. G. Günther, M.D.
Julius Haast, Esq., Ph.D.
Capt. Robert Wolseley Haig, R.A.
Daniel Hanbury, Esq.
John Whitaker Hulke, Esq.
Edward Hull, Esq.
Edward Joseph Lowe, Esq.
James Robert Napier, Esq.
Benjamin Ward Richardson, M.D.
J. S. Burdon Sanderson, M.D.
Henry T. Stainton, Esq.
Charles Tomlinson, Esq.

The President then addressed the Society as follows:—

GENTLEMEN,

THE year which has passed since I last addressed you has been to us a mournfully eventful one. Death has taken from us three of our most eminent and respected Members. Two were my predecessors in this Chair, for whom, only a few months ago, we might well have hoped that many years of useful life were yet in store. In regard to the third, the declining health of Faraday (one of the greatest names in our annals) for a considerable time forbade such hope in his case.

Whilst you deplore with me the losses we have sustained, you will be prepared to read with strong interest the biographical notices of these distinguished men, which are very shortly to appear in our obituary. It is well that I am able to announce that these will be so soon in your hands, for even the feeble attempt on my part to do justice to such a theme on this occasion, which might otherwise have been expected of me (altogether inadequate as it must have been), would have occupied the greater part, if not the whole, of the time claimed by our more ordinary topics.

I pass therefore at once to the relation of the action taken by the Royal Society in the promotion of science in the past year.

At the last Anniversary I gave an account of the progress made up to that time in printing the Catalogue of Scientific Papers. I am happy now to be able to announce that the first volume lies before us ready for publication. It comprehends a portion of the first part of the Catalogue, in which the titles are arranged alphabetically, according to authors' names, and extends from A to Clu. An explanatory Preface and Introduction are prefixed, as is also a list of the periodical works from which the titles have been extracted, with the abbreviations under which they are referred to. I need scarcely remind you how often the appearance of the first volume of a series is necessarily subject to delays not incident to the succeeding volumes. This has happened in the present case; and we may now confidently anticipate that the work will progress rapidly and uninterruptedly. You are aware that the work is being printed at Her Majesty's Stationery Office, and that arrangements will be made, with the approval of the Government, for distributing a certain number of copies as presents to scientific institutions and other parties, while the remainder will be offered for sale at such a price as may defray the cost of printing.

The attention of the President and Council has continued to be much occupied during the past year in aiding, at the request of Her Majesty's Government, in the reorganization of the meteorological department of the Board of Trade, and in preparing the preliminary arrangements of a system of British Land-Meteorology to be carried out under the authorization of that Board.

In my Anniversary Address of last year, I brought before you, as fully as

the time at our command would permit, the reasons which had influenced both the Government and the Royal Society in desiring the establishment in this country of meteorological observatories conducted on a systematic plan, and directed towards the attainment of a more perfect knowledge of the meteorology of our country than we at present possess.

The scheme, which, at the instance of the Board of Trade, had been suggested by the President and Council, consisted in the establishment of six or seven observatories, well distributed over the area of the British Islands, furnished with self-recording instruments on the pattern of those devised and in use at the Kew Observatory, and transmitting their records of the temperature, pressure, electric and hygrometric state of the atmosphere, and of the direction and force of the wind to a central office, where (under the general superintendence of a committee of scientific men) they should undergo the processes of reduction and combination, and be applied to the general study of the phenomena.

The Government, acting with due caution, determined on submitting this suggestion, as well as, generally, the functions of the meteorological department of the Board of Trade as it had previously existed, to a committee of scientific and practical men to be nominated by the Government itself, the Royal Society being invited to name one of the members.

The suggestion to which I have adverted, of the establishment of a small number of meteorological observatories supplied with self-recording instruments for the purpose of making a full, accurate, and *continuous* record of meteorological phenomena at certain selected stations, appears to have received the unqualified and emphatic approval of the committee, and to have been viewed by them as the most effectual means of supplying a secure and adequate basis for the discussion of the variations of the weather in the British Islands. Self-recording instruments are spoken of in the report as likely to prove of eminent local and international utility; it is anticipated that the establishment of observatories furnished with them in England may be expected to confer a wide benefit, that they would give precision and fulness to the charts of our own weather, and would set an example that foreign governments would probably soon follow, and that they would afford material in a very acceptable form to meteorologists at home and abroad for the discussion of weather phenomena.

The Board of Trade, after reference to the Admiralty and to the Treasury, adopted the Report of their Committee in a "Circular" dated November 29th, 1866; and at the same time asked the Royal Society whether they would be willing to name a committee of their own members to give their gratuitous services in the organization of the observatories recommended, and in the general superintendence of the Meteorological Department.

The public service thus requested was unhesitatingly undertaken; and on the 13th of December, 1866, a committee was named of eight of the Fellows of the Royal Society who were willing to devote themselves to the onerous and responsible duties of such an undertaking. Estimates

were required, and were furnished by them, of the probable cost of the organization, and of the annual expense of the Observatories. In August of the present year (1867) the estimates were passed in the House of Commons; and I have now the satisfaction of announcing, on the part of the Committee, that they have reason to believe that in January 1868, being not more than six months after the passing of the estimates, Observatories supplied with self-recording instruments which have been prepared and verified at Kew, working under competent superintendence, and with a trained staff at each Observatory, will have commenced their observations at Falmouth, Kew, Stonyhurst, Armagh, and Glasgow, and that there is ground of expectation that, in a month or two later, Valentia and Aberdeen will be added to the list.

The estimates passed in August 1867 will have defrayed the expenses of organization and maintenance of these seven Observatories until the 31st of March 1868 (the close of the present financial year). The *continuance* of the Observatories must necessarily depend upon the disposition of Government to recommend, and of the House of Commons to supply, the necessary funds. The Superintending Committee of the Royal Society are prepared for either alternative, viz. either to continue their general superintendence, or to regard their honourable and laborious undertaking as terminated. In the former case, it will become their office to trace the variations of the weather, as presented in the continuous and well-distributed records over the area of the British Islands, viewed in conjunction with the telegrams from the Ports and with the information received from other countries, and thus so to contribute to a knowledge of the laws which govern those variations as to enable meteorologists gradually, and as far as may be possible, to place the practice of forecasting the weather on a sound and dependable basis.

The Report of the Committee of the Board of Trade contains many valuable suggestions regarding the treatment which the information accumulated in the office of the meteorological department of that Board should undergo, with the view of extracting from it the information it is capable of affording on the meteorological statistics of the *Ocean*, and specially of the parts most frequented by British ships. This great branch of meteorological research, so eminently befitting a great maritime and commercial nation, was most prominently urged on the consideration of Her Majesty's Government by the President and Council of the Royal Society in a letter dated February 22, 1855; and in the subsequent establishment of the Meteorological Department of the Board of Trade it was recognized as being one of the chief functions of the office so constituted. The collection of a very considerable mass of information, embodied in the logs of ships to which instruments and instructions have been supplied, has been the result; but comparatively little advance appears to have been made in the labour of extracting, collating, combining, and discussing the valuable materials thus obtained. The work, both of collecting further information, and of discussing and arranging for communication to the public the

information already in the office and that which may hereafter be obtained, has been resumed under the general superintendence of the Meteorological Committee of the Royal Society, profiting by the valuable suggestions contained in the Report of the Committee of the Board of Trade. This forms the second portion of the duties which they have taken upon themselves. A third portion consists in the endeavour to make available for the benefit of mariners the information which reaches the office by telegraph early in the day as to the state of the weather at different points of the coast.

A copy of this information is transmitted, by the first post after its reception, to any port which desires to receive it.

If the authorities at any port require any special telegraphic intelligence, it is furnished to them without unnecessary delay, on their agreeing to defray half the cost of transmission of the message, and stating the precise nature of the information required.

Lastly, the Committee are prepared to convey, free of cost, telegraphic intelligence of the existence of any serious atmospherical disturbance which may have come to their knowledge, to all ports to which it appears to them that such information would be of importance. Such a telegram may be, for example :—

"Storm from West at Penzance and South coast."

On the receipt of such a message the local authorities are expected to hoist a drum as a general warning, on seeing which masters of vessels or other interested persons may learn by inquiry at the local office (or by other arrangements) the precise nature of the information received, together with any additional particulars which may have been transmitted from the central office.

It is clearly understood by all parties that any telegraphic message of a warning nature (like the example here mentioned) is merely meant to imply that *there is a serious atmospherical disturbance existing along a certain region of coast, and consequently that there is, or may be, danger impending in other districts.*

Some such arrangement as that which has been now described was the subject of early discussion between the Board of Trade and the Committee of the Royal Society. The arrangement as adopted was proposed by the Committee in a letter dated the 8th of June, being some weeks before the estimates had passed, and consequently before they were authorized to incur any expenditure whatever on the public account. It has been since approved by the Board of Trade, and is now in operation.

The telegraphic messages, which are now limited to a notice of "*existing facts,*" are obviously capable of extension hereafter, in proportion as the basis upon which sound meteorological anticipations may rest shall be enlarged; and this we may reasonably hope for, as one of the fruits of the establishment and action of the "Land Meteorological Observatories."

Meantime a not unimportant preliminary measure has received its due consideration. From an early period the attention of the Committee had

been drawn to the importance of improving, as far as possible, the *quality* of the intelligence received from the coast stations. With this view they gave directions that all the telegraph stations at which observations are made should be inspected—a practice which had never before been carried out. The inspection of all the stations situated in the British Islands has now been completed. It is hoped that, as the result of these measures, the accuracy and consequent value of the reports received will be in future materially improved; and such desirable improvement has indeed already been in part effected.

The four-foot reflector destined for the Melbourne Observatory approaches its completion, with a full prospect of its being ready to proceed to its destination early in the coming year, under the charge of Mr. Le Sueur. The spectroscope and photographic apparatus, which are to be used with it, are in progress. A question has arisen as to the expediency of providing it with some roof or covering which, while admitting of the telescope being directed to any part of the heavens, shall be an efficient protection for it from the weather at all times when not in actual use. Three designs for this purpose, viz. a dome, a sliding roof, and a revolving roof, with the estimated cost of each, have been supplied by Mr. Grubb, and have been sent to Melbourne to be submitted to the choice of the Board of Visitors of the Observatory; their decision may be expected to arrive very shortly, and Mr. Grubb is prepared to carry it into effect with all promptitude. There is therefore full reason to expect that this magnificent instrument will be at work in the splendid field which awaits its operations, in the hands of a thoroughly skilled and competent observer, before our next Anniversary.

The Superintending Committee, whose assistance in this important undertaking has been unremittingly given, have sustained a loss, which all who hear me will appreciate, in the lamented decease of the Earl of Rosse. Deeply as the death of one so highly gifted, and who devoted his gifts to such high objects, is to be deplored, it is some consolation that his son and successor is one who will add to the lustre of their name. He is already known to you by the important paper on the Nebula of Orion which was read at the close of our last session, and is now in course of publication in the Philosophical Transactions. This paper appears clearly to show that, in the course of the last fifteen years, considerable changes have taken place in that remarkable object, such as cannot be attributed either to atmospheric difficulties of vision, or changes in the instrument, or in the observer's eye. It confirms fully the researches of Mr. Huggins, and at the same time explains what had presented some difficulty, the absence of a continuous spectrum when the telescope shows a multitude of stars.

In conformity with the course of proceeding directed by the Melbourne Board of Visitors, in the event of such an emergency as the death of one of the three members of the Committee of Superintendence, I have consulted

with the two surviving members, Dr. Robinson and Mr. De la Rue, and, in agreement with their recommendation, have named the present Earl of Rosse as their associate.

The year 1868 will be signalized by the occurrence of a total solar eclipse of almost the greatest possible duration, affording therefore more leisure than usual for such observations as can only be made during the brief interval of the totality. The total phase will be visible in India, but elsewhere only in countries practically unavailable. Recent observations on the spectra of the heavenly bodies render spectroscopic observations of the red protuberances and of the corona a matter of peculiar interest at the present time. The President and Council have therefore considered how far they might contribute to a full use of so rare an opportunity in regard to these more especially *physical* phenomena.

Having already experienced, in the case of the pendulum experiments in India reported in my last year's Address, the advantage of acting in concert with the distinguished officer who now holds the post of Superintendent of the Great Trigonometrical Survey, Colonel Walker of the Royal Engineers, and having ascertained his readiness to charge himself with the practical arrangements which would be required for the observation of the eclipse, the President and Council determined on employing a portion of the Parliamentary grant placed at their disposal for the present year in the preparation of the necessary instruments, consisting of a telescope of five inches aperture, by Messrs. Cooke and Sons, mounted as a portable equatoreal with clock movement, and provided with a star spectroscope; and as clouds might interfere with the observations with this instrument at the critical moment, they have added four direct spectroscopes for observing the general character of the spectra of the red protuberances and the corona, and have entrusted them to Colonel Walker, to be placed in the hands of different observers.

It has happened fortunately that a son of Sir John Herschel, an assistant in the Trigonometrical Survey, was about to return to India from leave of absence in this country, and, being applied to, expressed his readiness, subject to the approval of Colonel Walker, to undertake any desired share in the observations, and to make himself acquainted with, and receive instruction in, the use of the instruments before his departure, as well as to take charge of their conveyance to India. This arrangement having received the cordial approval of Colonel Walker, has been duly proceeded with, and Lieutenant Herschel with the instruments is now on his way to India.

Mr. Hennessey, First Assistant on the Indian Trigonometrical Survey, having expressed in a letter to the President his wish to render available for scientific researches, not incompatible with his professional duties, his residence for great part of the year at the elevated station and in the clear atmosphere of Mussoorie (7000 feet above the sea), his offer, which had received the cordial sanction of Colonel Walker, has been embraced:

advice and instructions for the observation of the terrestrial lines of the solar spectrum, and for observations of the zodiacal light (for which the situation is particularly favourable) and for other desirable inquiries have been sent to him; and Lieutenant Herschel is taking out spectroscopes, prisms, actinometers, and other suitable instruments which the Society has provided for his use.

The Society have been already apprised of the desire of the Government of Mauritius to establish in that colony a Magnetical Observatory, working with the instruments and adopting the methods of discussing the results as practised at Kew. Early in the Session a communication was received from the Colonial Office, conveying the Earl of Carnarvon's request for the opinion of the Royal Society regarding the instruments to be employed in, and the plans for the building of, a new observatory, which should be both magnetical and meteorological. After full communication and discussion with Mr. Meldrum, Director of the Mauritius Observatory, who had arrived in England, a reply was returned to the Colonial Office particularizing the remaining instruments still required for the complete equipment of such an observatory, together with plans for the buildings and estimates for the whole, submitted by Mr. Meldrum, and approved by the President and Council. The instruments have been prepared, verified, and practised with by Mr. Meldrum, at Kew, and are ready to proceed to their destination.

The self-recording magnetical instruments prepared and verified at the Kew Observatory by the request of the Government of Victoria have been forwarded to their destination, and are now at work at Melbourne under the superintendence of Mr. Ellery. An application received in the course of the present year from the same colony for self-recording meteorological instruments on the pattern of those at Kew has been already complied with in part, and will be so fully as soon as the present urgent demands for the British Land Meteorological Observatories shall have been supplied.

Since the information conveyed in my last year's Address respecting the Magnetical Observatory at Bombay, Mr. Chambers's application for self-recording instruments, similar to those at Kew, has been received at the India Office, accompanied by the approval and recommendation of the Bombay Government. Happening to arrive about the time when Lord Cranbourne had referred the general subject of the *Astronomical* Observatories in India to the Astronomer Royal, the *Magnetical* Observatory at Bombay was included in the reference, the distinction between astronomical and magnetical observatories not being perhaps very clearly understood. Mr. Chambers's application for efficient instruments seems, however, to have dropped out of consideration, and (to use an ordinary term) was "shelved." A renewal of the application made through Sir Bartle Frere, the Governor of Bombay, caused a second reference to the Astronomer Royal, from

whose official reply, printed by the Bombay Government, I extract the following passage:—

"I should certainly recommend that any new magnetic observatory be furnished with magnetic instruments on the pattern of those at Kew. I would propose that an answer of this tenor be given to the Superintendent of the Bombay Observatory, that the Secretary of State for India in Council, having taken the opinion of the Astronomer Royal, approves highly of his (the Superintendent's) acting in concert with the Kew Observatory."

Still, possibly from inadvertence, Mr. Chambers's application for the instruments required to enable him to obey the instruction of "acting in concert with Kew" yet remains without a reply. In the meantime the cost of the observatory runs on, whilst the very valuable services for magnetical science, approved and recommended by the Astronomer Royal, and which Mr. Chambers, having been educated at Kew, is singularly qualified to carry into execution, are in abeyance for want of the necessary instrumental means to execute them, the whole cost of which would be under £400. We may hope that this oversight will shortly be rectified.

The publication in the last year of the verification and extension of La Caille's Arc of the Meridian in Southern Africa, by Sir Thomas Maclear, Astronomer at the Cape of Good Hope, announces the completion of a national work, pursued unremittingly for above thirty years, and establishing by its result a conclusion too important in its scientific interest to pass without recognition by the Royal Society. Our sole knowledge of the figure of the southern hemisphere rests on the arc of the meridian measured by La Caille, and now remeasured and extended by Maclear. The original measurement, notwithstanding the well-known ability of the great astronomer under whose superintendence it was executed, has not commanded confidence. The degree inferred from it is far too great, and, if accepted, would lead to the conclusion that the dimensions of the two hemispheres are dissimilar. But La Caille's triangles were observed with a quadrant, not with a circle, and were therefore liable to errors of eccentricity and of figure; while the effects of local attraction, if recognized at all, were very imperfectly appreciated. These considerations induced Maclear, shortly after his appointment to the Cape Observatory, to plan the verification which he has now accomplished. Pursuing the still earlier inquiries of Sir George Everest, he succeeded, though with considerable difficulty, in recovering La Caille's terminal stations; and, aided by the advice and encouragement of Sir John Herschel (then at the Cape) and of the Astronomer Royal, he commenced the work of a remeasurement in 1836. The proceedings were necessarily tedious; the measurements of the base, of the triangles, and of the zenith distances were repeated to an extent and with precautions unpractised at the earlier period. The zenith distances were observed with the sector with which Bradley discovered the aberration of light and the nutation of the earth's axis, entrusted to Maclear by the Ad-

miralty; and though made more fit for use in the field by improvements suggested by the Astronomer Royal, the transport of an instrument at once ponderous and delicate, through a wild and rugged country, was an undertaking of no ordinary difficulty; but it was performed without injury. The terrestrial angles were taken with a 20-inch circle by Jones, and a smaller theodolite by Reichenbach, both of remarkable precision. The base, from which all the distances were derived, was measured with the compensation bars used in the Irish Triangulation. Thus, in respect to the means employed, this arc of the meridian may be regarded as inferior to none on record. A full account of the whole was completed in 1866, and has been published by the Admiralty in two quarto volumes. It does not confirm the abnormal value obtained by La Caille, but shows a probable cause for the discordance. La Caille's northern station was in a hollow surrounded by mountains, one of which, half a mile distant to the north, was a mass of rock 2000 feet high, and others, at distances somewhat greater, were still near enough to create disturbance. A station so situated was obviously ill suited to be a terminal station; and the triangulation was extended across an immense plain of sand (the Bushman's Flat) to a point without any visible source of local attraction. By this extension, and by a similar one to the south, Maclear's arc has an amplitude nearly four times as great as that of La Caille, and is on this account, as well as on account of the greater accuracy in detail, far more deserving of confidence. The degree which is derived from it is 1133 feet shorter than that of La Caille; and as La Caille's is 1051 feet longer than that given by the spheroid, which, according to Airy, represents the average of northern arcs, it is evidently a near approximation to the truth. This is even more distinctly shown by the close agreement of the latitudes computed from the geodetic measurements with those given by the sector—that of the north extremity being $0''{\cdot}4$ in defect, that of the south extremity $0''{\cdot}5$ in excess.

The Philosophical Transactions of the past year contain an important memoir by Mr. Abel, F.R.S., to which has been assigned the distinction of forming the Bakerian Lecture for the year. It is a most careful and exhaustive treatise upon the circumstances which influence the *stability* of gun-cotton. He has made numerous experiments, both in the laboratory on small quantities, and in store upon large quantities, of the material; and some of his experiments have been carried on upon the same sample for three or four years. The results arrived at in these investigations show that gun-cotton, purified according to Von Lenk's directions, may be kept either in the open air or in closed vessels, and may be exposed to diffused daylight for very long periods, without undergoing any change. The preservation of the material for between three and four years has been perfect. By prolonged exposure to *sunlight*, ordinary gun-cotton suffers a gradual decomposition, which is somewhat more rapid when the cotton is damp than when it is dry; but, even under these circumstances, the change produced by several months of exposure is of a very trifling nature, and may

be counteracted by very simple means, which in no way interfere with the essential qualities of the material. All ordinary products contain small quantities of organic (azotized) impurities, which are comparatively unstable. It is the presence of these impurities in *ordinary* gun-cotton which gives rise to the development of free acid when the substance is exposed to a high temperature; and the acid thus generated may eventually exert a destructive action upon the pure portion of the mass (or true gun-cotton), and thus establish a decomposition which is materially accelerated by heat. Mr. Abel has, however, arrived at the important practical conclusion that this mischief can be averted by neutralizing the acid as it is liberated; and this is readily effected by distributing through the finished gun-cotton a small quantity, say one per cent., of carbonate of soda. By adopting this precaution, damp gun-cotton may be stored, closely packed, in large quantities, and may be exposed to a heat equal to 212° Fahrenheit in confined spaces for long periods, without undergoing any alteration. The introduction into the finished gun-cotton of one per cent. of carbonate of soda affords, therefore, security to the material against any destructive effects of the highest temperature to which it is likely to be exposed, even under very exceptional climatic conditions.

Actual immersion in water is not necessary for the most perfect preservation of gun-cotton. The material, if only damp to the touch, does not sustain the smallest change even if closely packed in large quantities. If as much water as possible be expelled from wet gun-cotton by the centrifugal extractor, the cotton is obtained in a condition which, though only damp to the touch, is perfectly non-explosive. It is therefore in this condition that all reserve stores of the substance should be preserved, and that it should be transported to distant places. The proper proportion of the carbonate of soda may be conveniently introduced by being dissolved in the water by which the gun-cotton is wetted.

It is in this immunity from danger in storage and in transport that properly prepared gun-cotton possesses so great an advantage over gunpowder.

Mr. Abel has also elaborately investigated the effects of various kinds of defective preparation of gun-cotton, combined with systematically varied circumstances of exposure to heat, moisture, and light of the products so obtained. It is seen by these investigations that modifications in the processes of conversion and purification, which appear at first sight of a very trifling nature, exert most important influences on the composition and purity, and consequently on the stability, of the product. It is shown by Mr. Abel that to such causes are to be attributed the conclusions condemnatory of gun-cotton which had been drawn by foreign chemists of considerable note.

The distrust, not unreasonably entertained at the time, of the stability of the material, was a principal cause of the desire on the part of Her Majesty's Government to refer the subject of gun-cotton to a Committee which should include some scientific members taken from the Royal Society. This great and primary question being now satisfactorily solved, the remaining secondary

questions regarding the best forms or modes of adaptation of this material to some of the varied exigencies of the naval and military services, in which its employment might be preferable to that of gunpowder, may be regarded as more properly belonging to the executive professional officers of Her Majesty's Navy and Army.

I have the great satisfaction of stating, on the part of the Committee, that no injury to life or limb has taken place in the course of their experiments.

At the Nottingham Meeting of the British Association, the sum of £100 was granted to a Committee for the purpose of exploring the Tertiary Plant-beds of North Greenland. The collections of fossil vegetable remains from the arctic regions which had been brought to this country and presented to various museums by Sir Leopold M'Clintock, Capt. Inglefield, and others, have all been sent to Prof. Oswald Heer, of Zurich, so well known for his researches into the Tertiary Fossil Flora of Europe. The similar collections which were preserved in the museums of Denmark and Sweden had also been submitted to the same authority; and the results of his investigation seem to show that North Greenland enjoyed, during part of the Tertiary epoch, a climate very much milder than that which is now experienced in those latitudes.

The description of the fossils is in process of publication by Prof. Heer; and in order to procure additional information on this very interesting subject, the grant was made by the Association.

The Greenland Committee, finding that Mr. Edward Whymper, one of their members, was proceeding to Greenland in the summer of 1867, handed the entire sum over to him; and finding that additional funds would be requisite, they made application to the Royal Society, who gave £200 from the Government Grant Fund, placed at the disposal of the Society.

Mr. Whymper has now returned from Greenland with a large and valuable collection of specimens. These will at once be subjected to examination; and when this work has been effected, a complete series of specimens will be deposited in the British Museum, according to the conditions of the grant, as made by the British Association and by the President and Council of the Royal Society.

I proceed to the award of the Medals.

The Copley Medal has been awarded to Karl Ernst von Baer of St. Petersburg, For. Memb. of the Royal Society, for his discoveries in Embryology and Comparative Anatomy, and for his contributions to the Philosophy of Zoology.

Forty-one years ago it was believed by all the great authorities in anatomy and physiology that the embryos of man and of other *Mammalia* originated in quite a different manner from those of oviparous animals. As to the latter, everyday observation of fowls, snakes, frogs, and fishes had been

sufficient to demonstrate, even without special scientific investigation, that their young arose within eggs, and that these eggs were preformed within the body of the virgin female. Further, the researches of Fabricius, of Harvey, of Haller, of Caspar Friedrich Wolff, of Cruikshank, of Döllinger, of Pander, of Prevost and Dumas, and of Dutrochet and Cuvier had traced back the embryos of the *Ovipara* to a very early stage, and had thrown much light upon the changes undergone by those of the *Mammalia*. But the earliest condition of the mammalian embryo was unknown. Haller's authority was still predominant; and Haller's researches had enabled him to discover in the mammalian uterus, shortly after impregnation, nothing more than a semifluid substance, in which, it was imagined, the embryo appeared by a kind of crystallization. The origin of this semifluid embryonic matter was sought for in a mixture of the seminal fluid of the male with the contents of the remarkable vesicles long before discovered by De Graaf in the ovary of the female, and called after him the Graafian follicles.

But in 1827 all such speculations were at once abolished, and the identity in mode of origin between the embryos of the *Mammalia* and those of other animals was demonstrated by a young Professor in the University of Königsberg, whose unwearied patience, sagacity, and sharpsightedness had enabled him to trace back the fœtus, step by step, to the minute egg, not a hundredth of an inch in diameter, to demonstrate that the Graafian follicle is simply the chamber in which that egg is contained, and to prove that the first step in mammalian generation, as in that of other animals, is the detachment of the egg from the organ of the parent in which it is developed.

This capital discovery forms one of the grounds upon which the Copley Medal is to-day awarded to the sometime Professor in Königsberg, but now, and for many years past, the honoured Academician of St. Petersburg, Karl Ernst von Baer.

Von Baer's great discovery was not the result of accident, but was the reward of long-continued and most laborious investigations into the development, not only of the chick and of the mammalian embryo, but of other animals. The first part of a great work entitled "Ueber Entwickelungsgeschichte der Thiere. Beobachtungen und Reflexionen," embodying some of the results of these inquiries, and mainly of the investigations into the development of the chick, appeared in 1828; the second part, in which the mammalia are chiefly treated of, was published in 1837.

It is impossible to overestimate the value of this remarkable book, or to doubt the great influence which it has exerted, and still exerts, upon the growth of a sound philosophy of Biology.

At the time of its appearance there was nothing that could be compared with it, as a special monograph upon the formation of the chick, or as a treasury of accurately observed facts respecting the development of the *Vertebrata* in general, or as an exposition of the significance of development and of the bearing of the study of embryology upon classification. And, as a whole, it may be safely said that it remains at the present day, though

surrounded by the splendid works of Rathke, Bischoff, Remak, Coste, and others, *primus inter pares.*

It is to Von Baer that we owe the great generalization that all development is a progress from the general to the special—a law which has its application in wide regions not contemplated by its author. It is to him that we are indebted for the truth that zoological affinity is the expression of similarity of development, and that the different great types of animal structure are the result of different modes of development.

The authorship of the 'Entwickelungsgeschichte der Thiere,' and of the 'Beiträge zur Kenntniss der niederen Thiere' (1824–26), would have sufficiently justified the award of the Copley Medal to Von Baer had he not been the discoverer of the mammalian ovum.

Besides these labours of primary importance, the energy, versatility, and wide learning of Von Baer have been shown in multitudinous other directions—in numerous memoirs on Comparative Anatomy, Systematic Zoology, and Zoological Distribution, in most valuable and original essays on Anthropology and Ethnology, and in scientific expeditions to different parts of the widespread Russian Empire, from Nowaja Zemlja to the Caspian.

Von Baer was born in Esthonia in the year 1792. His father was a gentleman of landed property and "Ritterschafts-Hauptman" of Esthonia. Two years ago, on the occasion of the fiftieth anniversary of the venerable Academician's Doctorate, the nobility of Esthonia, headed by their present Ritterschafts-Hauptman, the Baron von der Pahlen, formed themselves into an association for the purpose of celebrating the occasion; and as a memento of proceedings honourable alike to their eminent countryman and to themselves, published the autobiography which he wrote at their request with all the accessories of typographic luxury. Thirty-six years ago the Académie des Sciences of Paris, at the instance of Humboldt, and on the report of Cuvier, awarded Von Baer a medal. In 1854 he was chosen a Foreign Member of the Royal Society.

We may rejoice that it is not yet too late to offer the highest honour at the disposal of the Royal Society of London to a man who has so long been recognized on the continent as one of the great lights of biological science, who will take his place hereafter beside Cuvier, Wolff, and Harvey.

Professor Miller,

I will request you, on the part of the Society, to transmit this Medal to our venerated colleague, Dr. von Baer, and to express to him our hope that this testimonial of the very high esteem in which the labours of his life are held in England will be a welcome and valued addition to the honours which fitly crown his latter years.

The Council have awarded a Royal Medal to Messrs. John Bennet Lawes and Joseph Henry Gilbert for their researches in Agricultural Chemistry.

Messrs. Lawes & Gilbert have been engaged for the last twenty-four

years in a systematic series of researches upon Agricultural Chemistry, with a view of determining, by exact experiments, the principles, chemical and physiological, which are involved in the general and fundamental processes of successful agriculture.

These investigations have embraced :—

1. Researches into the exhaustion of soils, including experiments on wheat, on barley, on turnips, on clover, and leguminous crops.
2. Researches on the principles of rotation and fallow.
3. On the mixed herbage of grass-land.
4. On the process of vegetation generally, including researches upon the action of manures.
5. On the origin of nitrogen in plants (Phil. Trans. 1861).
6. Researches on the feeding and fattening of animals (Phil. Trans. 1859).

It is difficult to give in a short compass the practical conclusions arrived at from a series of investigations upon a number of subjects each so complicated in its nature, so important in its object, and continued systematically over so protracted a period. At the time your medallists commenced their experiments it was generally supposed that certain saline bodies, or so-called *mineral constituents*, were essential to the growth and development of the plant, and that such substances must be furnished to it by the soil. The necessity of a certain quantity of nitrogen was also recognized; but it was imagined, since wild plants could thrive without any artificial supply of nitrogen, that a sufficient amount of this element existed in the atmosphere (in the form chiefly of salts of ammonia) to render it unnecessary to take any steps for increasing this supply; and it was supposed that the fertility of a soil might be maintained for an indefinite period if the different mineral constituents carried off by the crop were annually returned in due quantity as mineral manure to the soil.

This *mineral-ash theory*, as it was termed, was proposed by Liebig; but it has been proved by Messrs. Lawes & Gilbert to be erroneous, as it embraces a part only of the truth.

The field experiments upon which this conclusion rests were commenced in 1843. Fourteen acres, divided into about twenty plots, were devoted to experiments upon wheat, and seven acres, divided into about twenty-four plots, to experiments upon turnips. Subsequently similar experiments were made upon beans, clover, barley, and the mixed herbage of permanent meadow-land. The general plan of the field experiments consisted in selecting fields in a condition of agricultural exhaustion, that is, in a state in which a fresh supply of manure was needed to fit the soil for the growth of another crop. Upon this exhausted soil each of the most important crops in the rotation were grown, year after year, upon the same spot, both without manure and with many different descriptions of manure, each of which was, as a rule, applied year after year to the same plot. By this means it was possible to determine the point of relative exhaustion or excessive supply of any of the constituents of the manure.

Wheat, for example, was grown year after year upon the same land for twenty-four years; turnips (with an interval of three years) for twenty-five years; and in the experiments on rotation (which comprised the "four course" of turnips, barley, leguminous crop [or fallow], and wheat) the last of the fifth "four course" rotation was completed, comprising twenty years in all.

Parallel with the field experiments, records relating to the fall of rain, atmospheric pressure, temperature of the air, and of the dew-point were kept or collated, so as to enable the observers to ascertain the effects of the varying season upon the quantity and quality of the field produce.

It soon became evident that much remained to be done in perfecting the methods of chemical analysis before comparative analyses could afford much assistance in determining the relative productiveness of different soils; and to this object our medallists addressed themselves both with skill and success.

The practical value of these experiments may be seen from the fact that, taking the results of twenty years, the annual average produce in bushels of wheat per acre without manure was $16\frac{1}{4}$, with farmyard manure exactly double, and with artificial manures $35\frac{3}{4}$ bushels, the latter being considerably more than the average produce of Great Britain when wheat is grown in the ordinary course.

The produce of wheat grown successively on the same plot without manure scarcely altered from year to year, whilst that of the turnips became reduced to nothing; the effect of a manure of superphosphate being most marked upon the turnips, whilst the employment of salts of ammonia mixed with alkaline salts and phosphates was most suitable for wheat, although these are not the manures indicated by a simple analysis of the ashes of the two crops. The authors remark, "Indeed the whole tendency of agricultural investigation seems to show the fallacy of alone relying upon the knowledge of the composition of a crop, as directing to the constituents probably more especially required to be provided for it by manures; and rather that the elucidation of agricultural principles must be looked for from a due consideration of Vegetable Physiology, as well as Chemistry, of the special functional peculiarities and resources of different plants, as well as their actual percentage composition."

The investigation into the feeding of animals was even more laborious; but it was a necessary complement to the experiments upon the growth of crops. It was directed to the solution of the following among other important problems:—

1. The amount of food consumed, and its several constituents, in relation to the production of a given live weight, for different animals.

2. The comparative development of the different organs in the fattening of animals, and their composition.

3. The relation of the manure produced, both in quantity and quality, to the food consumed.

4. The expenditure or loss, by respiration and exhalation of the animal, considered as a meat-producing and manure-making machine.

It is impossible to go into detail in this portion of the inquiry, the principal results of which are given in a paper published in the Philosophical Transactions for the year 1850.

It may be sufficient to sum up these remarks by stating that the various inquiries to which a brief reference has been made, have been conducted with a skill, perseverance, and success which have placed their authors, by general consent, at the head of those who have pursued this important branch of experimental inquiry.

Mr. Lawes and Mr. Gilbert,

Receive this Medal in testimony of the Royal Society's recognition of your joint labours, and of their approval of the object to which those labours have been directed,—which, while not outstepping the wide limits of a Society devoted to the promotion of natural knowledge, is yet in an unusual degree connected with the supply of man's primary wants. It will, I trust, be more especially prized by you as marking the Society's high appreciation of the long devotion, the patient unbiassed desire for truth, and the sound scientific manner of proceeding which have characterized your investigations.

The Council have awarded a Royal Medal to Sir William Logan for his geological researches in Canada, and the construction of a geological map of that colony.

Sir William Logan was early known to English geologists for very meritorious work in the Coal-fields of South Wales, which was highly approved at the time by the authorities of the English Geological Survey, and is understood to have furnished the model for similar surveys in other British Coal-fields.

In 1843 he undertook the direction of the Geological Survey of his native country, Canada, instituted by the Provincial Government. The results of this survey have been published in Annual Reports; and a large and important volume was published in 1863, condensing the whole of the geological and palæontological information which had been amassed by Sir William and the assistants who acted under his direction.

Under difficulties of which British geologists acquainted with both countries affirm that little idea can be formed here, he has made clear the relations of all the formations of Canada to each other. These consist of Lower and Upper Laurentian rocks, Huronian, numerous divisions of the Lower and Upper Silurian strata, and the Devonian series. Most of these he correlated as far as possible with the European series and with the subdivisions described by the American geologists of the United States.

One of the most important services that Sir W. Logan has rendered to geological science was the discovery of the relations of the Laurentian rocks to each other and to the later formations. These Laurentian rocks had

been previously only called granite and gneiss, and vaguely confounded with granitic and gneissic rocks of Silurian age. Sir William first proved their great antiquity by showing that they consist of strata which had been intensely disturbed and metamorphosed before the deposition of the oldest Silurian beds. Next, he showed that the Laurentian rocks consist of two series of metamorphic strata, and that the Upper Laurentian strata or gneiss lies quite unconformably on the Lower Laurentian masses. Thirdly, he made the important discovery of the *Eozoon Canadense* in the Limestone beds of the Lower Laurentian series.

The great importance of this discovery becomes manifest when we consider the evidence of the enormous antiquity of the strata thus proved to be fossiliferous, compared with the Lingula-flags and Cambrian sarata, in which the oldest previously known fossils had been found. It has seriously modified the speculative opinions of many geologists and zoologists.

Professor Ramsay,

I will beg you to transmit this Medal to Sir William Logan, in testimony of the appreciation by the Royal Society of his arduous labours in the accomplishment of the great work of the Geological Survey of Canada, of the critical skill and acumen which he has manifested in its course, and of the high scientific importance of the discoveries which have been established by his investigations.

On the motion of Dr. Alderson, Coll. Reg. Med. Præses, seconded by by Mr. Cæsar Hawkins, it was resolved,—"That the thanks of the Society be returned to the President for his Address, and that he be requested to allow it to be printed."

The Statutes relating to the election of Council and Officers having been read, and Mr. Curling and Mr. Hogg having been, with the consent of the Society, nominated Scrutators, the votes of the Fellows present were collected, and the following were declared duly elected as Council and Officers for the ensuing year :—

President.—Lieut.-General Edward Sabine, R.A., D.C.L., LL.D.

Treasurer.—William Allen Miller, M.D., LL.D.

Secretaries.— { William Sharpey, M.D., LL.D.
George Gabriel Stokes, Esq., M.A., D.C.L., LL.D.

Foreign Secretary.—Professor William Hallows Miller, M.A., LL.D.

Other Members of the Council.—Frederick Augustus Abel, Esq.; William Benjamin Carpenter, M.D.; Prof. A. Cayley, LL.D.; J. Lockhart Clarke, Esq.; John Evans, Esq.; Capt. Douglas Galton, C.B.; John Peter Gassiot, Esq.; John Hall Gladstone, Esq., Ph.D.; Sir Rowland Hill, K.C.B., D.C.L.; William Huggins, Esq.; Prof. Thomas Henry Huxley, Ph.D.; Prof. John Phillips, M.A., LL.D; Prof. Andrew Crombie Ramsay, LL.D.; Colonel William James Smythe, R.A.; Lieut.-Col. Alexander Strange; Thomas Thomson, M.D.

The thanks of the Society were voted to the Scrutators.

Receipts and Payments of the Royal Society between December 1, 1866, *and November* 30, 1867.

	£	s.	d.
Balance at Bank and on hand	666	1	6
Annual Subscriptions, Admisssion Fees, and Compositions...	1647	16	0
Rents	253	8	0
Dividends	1497	18	1
Ditto, Trust Funds	283	0	6
Sale of Transactions, Proceedings, &c.	425	19	3
Sale of Land at Acton (23½ poles)	100	0	0
Repayments	57	19	8
	£4932	3	0

	£	s.	d.	£	s.	d.
Salaries, Wages, and Pension				1031	10	0
Purchase of £600 Consols				567	0	0
The Scientific Catalogue				289	2	6
Books for the Library and Binding				250	1	9
Printing Transactions and Proceedings, Paper, Binding, Engraving, and Lithography				1509	5	0
General Expenses (as per Table subjoined)				351	15	10
Rumford Medal Fund	136	16	3			
Donation Fund	251	0	0			
Wintringham Fund	35	8	0			
Copley Medal Fund	4	15	5	437	17	8
F. A. Abel, Bakerian Lecture	4	0	0			
Rev. T. S. Evans, Fairchild Lecture	2	19	0			
Dr. Sanderson, Croonian Lecture	2	19	0			
				4436	12	9
Balance at Bank				483	16	0
Balance of Catalogue Account				9	17	3
„ Petty Cash Account				1	17	0
				£4932	3	0

WILLIAM ALLEN MILLER,
Treasurer.

Estates and Property of the Royal Society, including Trust Funds.

Estate at Mablethorpe, Lincolnshire (55 A. 2 R. 2 P.), £126 0*s.* 0*d.* per annum.
Estate at Acton, Middlesex (34 A. 2 R. 27½ P.), £109 10*s.* 0*d.* per annum.
Fee Farm near Lewes, Sussex, rent £19 4*s.* per annum.
One-fifth of the clear rent of an estate at Lambeth Hill, from the College of Physicians, £3 per annum.
£14,000 Reduced 3 per Cent. Annnities.
£29,569 15*s.* 7*d.* Consolidated Bank Annuities.
£513 9*s.* 8*d.* New 2½ per Cent. Stock—Bakerian and Copley Medal Fund.

Scientific Relief Fund.

Investments up to July 1865, New 3 per Cent. Annuities..... £6052 17 8

£6052 17 8

Dr. *Cr.*

	£	s.	d.		£	s.	d.
Balance	213	14	10	By Grants	200	0	0
Donation	5	0	0	Balance	197	6	0
Dividends	178	11	2				
	£397	6	0		£397	6	0

Statement of Income and Expenditure (apart from Trust Funds) during the Year ending November 30, 1867.

	£	s.	d.		£	s.	d.
Annual Subscriptions	1099	16	0	Salaries, Wages, and Pension	1031	10	0
Admission Fees	160	0	0	The Scientific Catalogue	289	2	6
Compositions	388	0	0	Books for the Library	149	3	3
Rents	253	8	0	Binding ditto	100	18	6
Dividends on Stock (exclusive of Trust Funds)	997	3	10	Printing Transactions, Part II. 1866, and Part I. 1867	475	4	1
,, on Stevenson Bequest	500	14	3	Ditto Proceedings, Nos. 87–95	320	13	9
Sale of Transactions, Proceedings, &c.	425	19	3	Ditto Miscellaneous	63	14	11
Sale of Land at Acton	100	0	0	Paper for Transactions and Proceedings	278	16	0
Chemical Society, Tea Expenses £18 0 0				Binding and Stitching ditto	77	18	6
Linnean Society, Tea Expenses 14 0 0	43	0	0	Engraving and Lithography	292	17	9
Zoological Society, Tea Expenses 11 0 0					1509	5	0
Geographical Society, Gas at Evening Meetings 8 4 8				Fittings, Cleaning, and Repairs	51	16	1
Cambridge Local Examination Committee, Gas 5 0 0	14	19	8	Miscellaneous Expenses	57	17	1
Sundry Petty Receipts 1 15 0				Coal, Lighting, &c.	107	10	0
				Tea Expenses	58	1	9
Income available for the Year ending Nov. 30, 1867	3983	1	0	Fire Insurance	28	11	6
Expenditure in the Year ending Nov. 30, 1867	3431	15	1	Taxes	8	19	2
				Advertising	11	9	6
Excess of Income over Expenditure in the Year ending Nov. 30, 1867	£551	5	11	Postage, Parcels, and Petty Charges	27	10	9
					£3431	15	1

WILLIAM ALLEN MILLER,
Treasurer.

The following Table shows the progress and present state of the Society with respect to the number of Fellows:—

	Patron and Royal.	Foreign.	Compounders.	£2 12s. annually.	£4 annually.	Total.
November 30, 1866.	5	49	302	3	267	626
Since elected			+6		+10	+16
Since compounded..			+2		−2	
Since deceased		−1	−12	−1	−11	−25
November 30, 1867.	5	48	298	2	264	617

"Observations on the Anatomy of the Thyroid Body in Man." By George W. Callender, Lecturer on Anatomy at St. Bartholomew's Hospital. Communicated by James Paget, Esq. Received June 8, 1867*.

By examination of the thyroid body in the fœtus, we learn that it has from an early period, much the same relations and appearances as belong to it in childhood, and during the adult condition, and we observe those diversities of its parts which are exceptionally recognized during the later periods of life. We may thus trace out the origin of such exceptional conditions, and notice, more especially, how the isthmus of Eustachius and the pyramid of Lalouette are connected with the formation of the thyroid, and depend for their after characters upon early changes during development of size.

As I have reason to believe that the formation of the thyroid in man may be fairly reexamined, I shall venture to refer, in the first place, to some of the opinions advanced with regard to its earliest appearances.

The late Mr. Gray† has alluded to the views of Huschke, Arnold, Bischoff, and Goodsir, respecting the development of this body. It is enough for my present purpose to state that Arnold considered the thyroid to be developed from the membranous air-tube, where the larynx is formed, whilst Goodsir‡ thought that it originated in that portion of the membrana intermedia of Reichert which remains in connexion with the anastomosing vessels between the first and second aortic arches, or carotid and

* Read June 20, 1867: see abstract, p. 24.

† Philosophical Transactions, 1852.

‡ Philosophical Transactions, 1846.