ANNALS OF THE PHILOSOPHICAL CLUB OF THE ROYAL SOCIETY

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TORONTO

ANNALS
OF THE
PHILOSOPHICAL CLUB
OF THE
ROYAL SOCIETY

WRITTEN FROM ITS MINUTE BOOKS

BY

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PREFACE

THE story of the Royal Society Club has been recently told by a member hardly less eminent for his literary gifts than as a geologist. But though much the senior, this was not the only social club in the Royal Society. A second was founded in 1847, and continued till 1901, when the two were united. Their aims, however, were not identical. The older club had grown up, perhaps without any formal beginning, as a social institution. The younger one, while not by any means repudiating this position, had more definite purposes. It arose from a sense of dissatisfaction, which was felt, rather before the middle of last century, at the condition and management of the Royal Society, by not a few of its more energetic and eminent Fellows. They were convinced that it was not occupying the position or exercising the influence in the country which it ought to be doing, and that this failure was partly due to the way in which its Fellows were elected; in other words, that there was a danger lest it should be said of the Society, as it was formerly of a very attractive College at Oxford, that the chief qualifications for its Fellowship were for the candidate to be 'well-born, well-dressed, and moderately learned [in science].' "The agitation for reform," to quote Sir A. Geikie's words,[1] "became so urgent that, in 1846, the Council appointed a Committee to consider the mode of election of Fellows. The result of the deliberations of the Committee was seen next year in the adoption of a new series of statutes which wrought a revolution in the procedure of the Society in regard to this matter." The

[1] *Annals of the Royal Society Club*, page 349.

election of ordinary Fellows by the general body of the Society was fixed to take place only on the first Thursday in June. Of this meeting ample notice was to be given, and a list of the candidates, proposed by the Council, to be circulated previously among the Fellows. The number of names on this list was not to exceed fifteen, and they were to be carefully selected by the Council. This principle of limitation and selection has lasted to the present day, and has done much to enhance the prestige of the Society. But as danger always exists of enthusiasm flagging and abuses creeping back, the more zealous reformers determined to found a dinner Club, which, instead of being almost wholly social, like the one already in existence, should aim at checking any retrograde tendencies in the Council of the Royal Society, at stimulating the intellectual activity of its members, and at strengthening the influence of Science in Britain. To facilitate the first and second of these purposes, the rules enacted that no strangers, except "scientific foreigners temporarily visiting this country," were to be present at any of the Club meetings; thus securing free discussion of subjects, for which publicity might often be undesirable; while for the third purpose, the chairman was directed, after dinner, to invite any one present to make a communication on some subject which he thought interesting. An abstract of this, with any remarks of importance which it might elicit from other members, was to be entered in the Minute Book and read at the next meeting. These records—the distinctive feature in the Minutes of the Philosophical Club—are preserved in two folio volumes, bound in red-maroon calf: the one presented by Sir H. T. de la Beche, the other (about half-full and ending June 13, 1901) by Sir W. R. Grove. Their interest is great, as I hope to show, but their disconnected nature seemed to me to make a continuous narrative almost impossible. I have therefore decided to arrange the contents of these Minute Books in two sections, corresponding with the purposes mentioned above; the first relating the history of the Club and its members, and of their efforts to increase the influence of the Royal and other Scientific Societies in Britain, and the second section giving summaries of the after-dinner communications.

It remains to add that, when Sir A. Geikie had completed the *Annals of the Royal Society Club*, several of its members thought that the history of the Philosophical Club should also assume the more durable form of print, and in May, 1917, honoured me, as I happened to be the oldest survivor of its members (for I was elected in 1883), by requesting me to prepare its records for publication. It has been a longer task than I had anticipated, and one which, though pleasant from its varied and interesting matter, has been in some respects rather saddening, for so many of those, whose kindnesses I often experienced in my earlier days of membership, have passed away from among us. But now that I too have become a Nestor (at any rate in years) among those who are handing on the torch of science to our still younger generation, the study of these records cheers me with hope for the future, because they show that, since the foundation of the Philosophical Club, science has advanced, with accelerated speed and increasing strength, from a comparatively humble position in the Halls of Learning to one, where its merits are more widely and fully appreciated, and its powers of dissipating the mists of ignorance and illuminating the darkness of superstition are beginning to be acknowledged.

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SECTION I

THE HISTORY OF THE PHILOSOPHICAL CLUB

On April 12th, 1847, twenty-seven Fellows of the Royal Society met at Clunn's Hotel, Covent Garden, and decided on forming a Club. For this the name of the Forty-seven Club was at first suggested, but it was ultimately decided to call it the Philosophical Club. Rules were also proposed, discussed, and adopted, as the Minutes duly record, but I think it needless to print them in full, because some are quite of the usual character. The following, however, are more or less indicative of the special purpose of the Club :

(1) The purpose of the Club is to promote as much as possible the scientific objects of the Royal Society, to facilitate intercourse between those Fellows who are actively engaged in cultivating the various branches of Natural Science and who have contributed to its progress, to increase the attendance at the evening meetings,[1] and to encourage the contribution and discussion of papers.

(2) The Members of the Club shall be limited to forty-seven, of whom thirty-five at least shall be resident within ten miles of the General Post Office. With the exception of scientific foreigners temporarily visiting this country, no strangers are to be present at any of the Meetings.

(3) With the exception of the President of the Royal Society for the time being, those only shall be eligible as Members of the Club who are Fellows of the Royal Society and authors of a paper published in the Transactions of

[1] The Royal Society then met at 8.30.

one of the Chartered Societies, established for the promoting of Natural Science, or of some work of original research in Natural Science.[1]

(4) The Meetings of the Club shall take place once a month, on Thursdays from October to June, both inclusive, except the Anniversary Meeting, which shall take place on the last Monday in April. The chair shall be taken at half-past five o'clock precisely and quitted at one quarter past eight, each Member presiding in turn in alphabetical order. It shall be the duty of the Chairman to regulate and control all ballots and discussions in the Club, to announce to the Meeting, previously to seven o'clock, the subject of the paper to be read at the Royal Society that evening, and to bring forward, or to invite members of the Club to bring forward, any correspondence or scientific subject worthy of consideration. Members will be expected afterwards to attend the meeting of the Royal Society, unless unavoidably prevented. The times of Meeting shall be notified each year by a circular from the Treasurer and also by a note to each Member one week before every Meeting.

The next three rules order the appointment of a Treasurer and a Committee of six to advise on the general management of the Club ; the former to hold office for three years, but to be re-eligible for election, after an interval of one year ; of the latter, three are to retire annually by seniority, but to be similarly re-eligible. The election to be by ballot, at each Anniversary Meeting. Besides the ordinary duties of Treasurer, that officer is to keep a register of all the Meetings of the Club, to make a Minute of all resolutions which may be adopted, and, whenever practicable, furnish the Chairman with the title of the paper to be read at the Royal Society on the evening of the Meeting of the Club.

The eighth rule fixes the annual subscription at twenty shillings, to be paid to the Treasurer at the first Meeting

[1] Unless we interpret the term Natural Science in an unusually wide sense (which evidently was the case), this part of the rule would exclude Fellows distinguished in 'Pure Mathematics.'

of the Session, and enacts that the price of the dinner is not to exceed ten shillings.

The ninth rule prescribes that candidates for election are to be proposed, and the grounds of their eligibility stated, in writing by three members of the Club, not members of the Committee ; sent to the Treasurer, read to the Club at the next meeting and retained till the anniversary. In case of the number of candidates exceeding that of the vacancies, the Committee is to report to the Club the names of those whom they consider most eligible, and these are to be entitled to priority of ballot. In the event of no excess, or the non-election of recommended candidates, the order of proposal is to be that of voting, and in the event of less than fifteen members being present at an Anniversary Meeting, the election shall be adjourned till the next meeting, when that number shall attend. The tenth rule enacts that all new rules must be proposed by at least three members, notified to the Committee in writing, and read to the Club at not less than two meetings before the Anniversary, when they should be considered, put to the vote, and rejected unless four-fifths of those present (fifteen being a quorum) were in their favour.

Of the members present, Mr. Grove was appointed Treasurer of the Club, and Prof. E. Forbes, Prof. Graham, Mr. Horner and Dr. Royle were appointed the Committee of Management with the Treasurer, and were authorised to select and invite Fellows of the Royal Society to join the Club until the number of forty-seven was completed. Those who accepted were to be considered original members of the Club.

At the second meeting, held at Cuttriss' Hotel on May 6th, the Treasurer gave the names of thirteen Fellows who had accepted the invitation of the Committee.[1] Twenty-eight members, including some of those mentioned above, were present at the dinner.

The attendance at the third meeting, held on June 3rd, also at Cuttriss' Hotel, was twenty-three, and it was

[1] See the list printed on next page.

announced that the number of the Club was now complete, seven other Fellows having accepted invitations to join it.

The following is a list of the forty-seven original members of the Club, the first paragraph denoting those present at the first dinner and an obelus those who, though not attending that or either of the other two, must have joined in the project before April 12th :

Mr. Ansted, Sir H. T. de la Beche, Mr. T. Bell, Mr. Bowman, Mr. Broderip, Mr. R. Brown, Sir P. G. Egerton, Dr. Falconer, Prof. E. Forbes, Mr. Gassiot, Prof. Graham, Mr. Grove, Mr. L. Horner, Mr. Lyell, Dr. W. A. Miller, Sir R. Murchison, Mr. Owen, Mr. Partridge, Dr. Pereira, Mr. J. Phillips, Dr. Royle, Col. Sabine, Dr. Sharpey, Mr. Edw. Solly, Mr. Spence, Col. Sykes, Mr. Wheatstone.

(May 6th.) Adml. Beaufort, Mr. S. H. Christie, Mr. Faraday, Mr. J. T. Graves, Sir J. Herschel, Mr. Hopkins, Prof. McCullagh, Mr. W. H. Miller, Mr. Newport, Mr. George Rennie, Sir J. Richardson, Rev. A. Sedgwick, Capt. Smyth.

(June 3rd.) †Major Cautley, †Mr. Fox Talbot, Mr. Goodsir, †Mr. J. H. Green, Sir W. S. Harris, Dr. Hooker, †Dr. Wallich.

The autographs of these and of other members down to Sir J. H. Lefroy (elected in 1879) appear on the first two pages of the first volume of Minutes, but twelve of the names are in pencil, the book not having been actually signed. It was customary at first for the members present at each dinner to write their own names at the beginning of the minutes, and the practice continued till the 18th meeting (Feb. 22nd, 1849), after which the list was written by the Treasurer, but it was resumed on Feb. 26th, 1880, for two meetings only. In the second volume of the Minutes the names are written by the Treasurer, but the autographs of the members, at the date of the Anniversary Meeting, April 26th, 1880, with those afterwards elected, are on the first two pages, one name being duplicated ; three others (down to 1891) are in pencil, after which two names only are written in ink, and the list is evidently incomplete. The list printed above has been copied with a little rearrangement from one on page 14 of the same volume, in the handwriting of

Dr. Allen Thomson, then Treasurer. It also mentions those of them who had died or resigned membership.

That list also gives in addition the names of the members with the date of their election, beginning with the original 47, who are grouped as present at the first meeting, or announced at the second and third meetings, together with those who had been subsequently elected down to 1880. The dates of resignation or decease are also entered (in most cases).

It is hoped these short biographical sketches of the founders of the Club, all of whom have, of course, passed away, may interest readers. Some of them did not attain till after 1847 the positions indicated by the prefixes to their names.

Professor David Thomas Ansted, the first in alphabetical order of the original forty-seven, was born in London in 1814, and went to Jesus College, Cambridge, where he obtained a fellowship. After some years' study of geology he became a professor of that subject at King's College, London, and from 1844 to 1847 was Assistant-Secretary to the Geological Society, being elected a Fellow of the Royal Society in 1844. He then became much occupied in practical work, such as water supply, and for some years was resident at Impington, near Cambridge, dying at Woodbridge, Suffolk, in 1880. He wrote many papers and books on geology, which met with considerable success.

Sir Francis Beaufort, the hydrographer, was born in 1774 at Navan, County Meath, of which place his father, a topographer of some distinction, was rector. In 1787 he entered the Royal Navy, and his ship took part in Lord Howe's victory on June 1st, 1794. In 1800 he was one of a boat's crew which cut out a Spanish battle-ship from under the guns of a fort near Malaga, and received nineteen wounds, sixteen from musket shots and three sword cuts, winning promotion to commander. In 1805 he surveyed the mouth of the Rio de la Plata, and, after convoy duty on the coast of Spain, became post-captain in 1810 and surveyed the coast of Karamania; afterwards publishing an account of it and the adjoining part of Asia Minor. He was badly wounded in a boat attack by Turkish pirates, and had to return to England, where he drew with his own hand the charts of his survey. In 1829 he was appointed hydrographer to the navy, and among the valuable results of his twenty-six years' tenure of office were the scale of wind-force and the tabular system of weather registration. Promoted to rear-admiral in 1846, he was created K.C.B. two years later, and died on Dec. 17th, 1857.

Professor Thomas Bell, well known as a zoologist, was a surgeon's son, born at Poole in 1792, and brought up to his father's profession, who early showed a love of natural history, especially zoology. Qualifying as M.R.C.S. in 1815 (he obtained its fellowship in 1844), he practised in London, paying, however, such attention to zoology that he became Professor of it at King's College, wrote a *History of British Quadrupeds* in 1837, followed by one on *British Reptiles* and another on *British Stalk-eyed Crustacea.* He was Secretary of the Royal Society from 1848 to 1853, and President of the Linnean Society from 1853 to 1861, and was active in securing accommodation for it at Burlington House. At the age of seventy he retired to Gilbert White's house at Selborne, where he gathered about him memorials of that true lover of Nature, dying on March 13th, 1880.

Sir William Bowman, the eminent oculist, was a banker's son, born at Nantwich in 1816, who began medical study at Birmingham, and went on to King's College, London, where he showed great interest in physiological questions. After spending some months in visiting foreign hospitals, he passed as M.R.C.S. in 1839, and worked at King's College Hospital till 1856, when he became full surgeon. But he had already specialized as an oculist, and after 1852 was the recognized head of that branch in London, his great reputation being due to his unrivalled knowledge of the structure of the eye, his skill as an operator, and his sympathy with his patients. No one was so successful as he in cases of glaucoma, cataract, and detached retina. But his additions to the knowledge of general anatomy were also so valuable that he was called the father of it in Britain. He became F.R.S. in 1841, and received next year a Royal Medal, F.R.C.S. in 1844, and was created baronet in 1884. Notwithstanding his professional labours, he found time for public and philanthropic work, retiring ultimately to Joldwynds, Dorking, where he died on March 29th, 1892.

Mr. William John Broderip, a lover of zoology, was born at Bristol in 1789. After graduating at Oxford, he was called to the Bar in 1817, and five years later appointed a police magistrate, first at the Thames Court, then at Westminster, resigning office in 1856. He devoted all his spare time to his favourite science, forming a large collection of shells, now in the British Museum, and writing the articles on zoology in the *Penny Magazine*, contributing others on that subject to various periodicals, besides publishing *Leaves from the Note-book of a Naturalist* and an essay on the Dodo, which contains all the information then known about it. He died in London, Feb. 27th, 1859.

Dr. Robert Brown, a botanist, highly esteemed, was the son of an episcopal minister, born at Montrose in 1773. A medical student at the University of Edinburgh, he lost no opportunity of working at botany, and, after passing his examinations, became assistant-surgeon to a regiment. This ultimately brought him to London, whence, through Sir Joseph Banks, he was appointed naturalist to a ship sent to survey the Australian and Tasmanian coasts. During his four years' absence he formed a large collection of plants, many of them new to science, and, after his return in 1805, became librarian to the Linnean Society, and to Sir Joseph Banks, and devoted himself to working out and publishing the results of these and other investigations. He acquired a high reputation for his researches in vegetable physiology, received the Copley Medal from the Royal Society, and from Oxford the degree of D.C.L., and died Jan. 10th, 1858, loved for the beauty of his character by his many friends.

Sir Proby Thomas Cautley, distinguished both as an engineer and a palaeontologist, was a Suffolk man, born in 1802 at Stratford St. Mary. At the age of seventeen he obtained a commission in the Bengal Artillery, but three years later was attached to Captain Robert Smith, then engaged in reconstructing the Doab Canal, an old irrigation channel, coming from the foot of the Siwalik Hills. From this work he was called away to the siege of Bhurtpore in 1827, and, after the fall of that fortress, returned to the canal, which was opened in 1830. Next year he was placed in charge of it, and he was for twelve years engaged in constructing an upper section—a much more difficult task, because it crossed torrents from the hills, and these were liable to sudden floods, which, however, he succeeded in controlling. The Ganges Canal was a still greater work, for here he had to deal with official opposition as well as natural obstacles. The necessary surveys were begun in 1837, but the construction not till 1843. Then a failure in health obliged him to take a long furlough in Europe, which he utilized in increasing his knowledge. During this interval he must have become a member of the Philosophical Club, for he returned to India in 1848, and the canal was opened April 8th, 1854. Sir Arthur Cotton criticised its plan, to whom Cautley made a vigorous reply, but expert opinion seems inclined to regard the former as more correct in theory, the latter more defensible in practice. This work completed, Cautley returned to England, and was created K.C.B. But while engaged on the Doab Canal, he investigated the geology of the Siwalik Hills, aided by Dr. Hugh Falconer (page 9), who came to Saharanpur in 1832 as superintendent of its Botanical Gardens. They made a very large collection of fossil remains (now in the British Museum), which supplied both with materials for many papers. Cautley also wrote a book on canals, and served on the Council of India from 1858 to 1868, dying at Sydenham, Jan. 25th, 1871.

Professor Samuel Hunter Christie, distinguished for his mathematical and magnetic investigations, was born in 1784, and early showed signs of exceptional ability. He went to Trinity College, Cambridge, was second wrangler in the Mathematical Tripos of 1805, and bracketed for the Smith's Prizes with Thomas Turton, afterwards Bishop of Ely. Appointed a Mathematical Lecturer at Woolwich in 1806, he introduced competitive examinations, and, after becoming Professor in 1838, 'transformed the Academy' before resigning office in 1854. He undertook and published important investigations into the effect of temperature on magnetic forces, on cases of magneto-electric conductivity, and on the direct influence of solar rays on the magnetic needle. A report, made by himself and the Astronomer Royal (G. B. Airy) on Magnetic Observatories, led the Government to establish several such in the British Islands. Professor Christie died at Twickenham on Jan. 24th, 1865.

SIR HENRY THOMAS DE LA BECHE, not the least eminent of that group of geologists who, in the earlier half of the nineteenth century, were the 'makers' of that science in England, was born in a suburb of London in 1796. The last of an ancient family, he lost his father early, and passed his boyhood at Ottery St. Mary and Lyme Regis, where the fossils attracted him to geology. Later on, he went from a military school into the army, but gave up that profession after the peace of 1815, and found employment in the Geology of Dorset. After 1817 he spent four or five years chiefly in Switzerland and France, studying the Alps and increasing his knowledge of minerals and rocks. In 1819 he published his first paper, *On the Temperature and Depth of the Lake of Geneva*, which was quickly followed by one on *The Secondary Formations of the Southern Coast of England*. In 1824 he visited Jamaica, where he had inherited an estate, and, as a result, gave the first description of its rocks. Realizing the great importance of laying down the results of a systematic survey of British geology on the new Ordnance Map (on the scale of an inch to a mile), he did this, at his own expense, for the mining districts of Devon and Cornwall, and the Report on *The Geology of Cornwall, Devon, and West Somerset*, published in 1839, is a lasting monument to his powers as a geologist. His map, however, had so strongly impressed the Government that they decided to carry on the work, granted a sum of money and a house in Craig's Court, and appointed De la Beche, in 1835, director of the Ordnance Geological Survey. A larger space for specimens and staff was soon wanted, and the present building in Jermyn Street was opened by Prince Albert in 1851, which enabled De la Beche to carry out his idea of establishing a School of Mines. Elected F.R.S. in 1819, he became President of the Geological Society in 1847, received its Wollaston Medal in 1855, was made a knight in 1848, and died, after three years of declining health, on April 13th, 1855. His *Researches in Theoretical Geology*, published in 1834, and his *Geological Observer*, in 1853, are among the classics of the science.

Sir Philip de Malpas Grey Egerton, tenth baronet of that line, was born at Oulton Park, Tarporley, Cheshire, on November 13th, 1806. From Eton he went to Christ Church, taking his degree in 1828, and while at Oxford worked at Geology with Buckland and Conybeare, and began to collect fossil fishes with his friend Viscount Cole, afterwards Earl of Enniskillen. For that purpose they travelled together in Germany, Switzerland, and Italy. He was elected to Parliament in 1830, and till his death represented, except for three years, some constituency in Cheshire, for notwithstanding his devotion to science he took an active interest in local and public affairs. He became F.R.S. in 1831, and received the Wollaston Medal of the Geological Society in 1873. He died after a short illness on April 5th, 1881.

Dr. Hugh Falconer, eminent for his botanical and still more for his palaeontological work in India, was born at Forres on Feb. 29th, 1808, showed in early life much interest in languages as well as in natural science, and took the M.A. degree at Aberdeen University in 1826. Then, after medical study at Edinburgh, he became an M.D. in 1829, after which he went to Bengal as an assistant-surgeon of the East India Company, and soon after reaching Calcutta attracted notice by identifying some fossil bones from Ava. Stationed next year at Meerut, he became acquainted with Dr. Royle, of the Botanic Gardens, Saharanpur, whom he shortly afterwards succeeded, and introduced the tea-shrub, with other valuable plants, into that part of India. Becoming acquainted with P. T. Cautley (page 7), he joined him in making a great collection of fossils, largely vertebrate, from the Siwalik Hills. Falconer's botanical investigations in 1838 took him across the mountains into Balkistan and on to the glaciers at the head of the Shiggur tributary of the Indus. In 1842 he came to England, bringing with him great collections, botanical and palaeontological, which occupied him till his return to India in 1847, when he was placed in charge of the Botanical Gardens at Calcutta. In 1855 he retired to resume his palaeontological work in England, and a few years later was one of the first to realize the importance of the palaeolithic flint implements discovered in the valley of the Somme. Falconer wrote many valuable memoirs, but as he died July 31st, 1865, he did not live long enough to finish his great store of materials. But what he accomplished sufficed to prove him a man of first-rate ability, attractive disposition, and high character.

Michael Faraday, a 'particular star' among the physicists of this country, was born in humble circumstances at Newington Butts on September 22nd, 1791, and at the age of fourteen was apprenticed to a bookbinder and stationer, with whom he remained for eight years, and contrived to acquire so much knowledge of science that a customer gave him tickets to four of Davy's lectures at the Royal Institution. Faraday took notes, and sent a copy of them to the lecturer, asking his help in obtaining a less mechanical employment. On Christmas Day, 1812, Davy engaged him as laboratory attendant at twenty-five shillings a week (see section II.), and was not long in discovering his exceptional talents, for he took Faraday next summer as a sort of personal attendant to himself and Lady Davy on a tour in France, Switzerland, and Italy, and introduced him to his scientific friends. On their return Faraday was again engaged at the Royal Institution, and began next year to publish papers on science. In 1821 he took two important steps, the one marrying, the other joining a small religious body called Sandemanians. He began two years later a set of experiments which suggested that all gases are the vapours of liquids with very low boiling points, and in another two years he discovered benzol and attempted to obtain a highly refractive optical glass. In the later part of 1831 he began his great series of discoveries in magneto-electricity, the incessant labour on which so affected his health that he was obliged to take a long rest on the continent. Restored to vigour by the Alpine air, he discovered the effect of magnetic and electrical currents on the polarization of light, and then dia-magnetism. Further investigations suggested doubts whether the atom itself might not be capable of disruption, the demonstration of which is one of the most important of recent advances. Faraday's scientific position might have brought him wealth, but he sacrificed that to the delight of discovery, till he died on Aug. 25th, 1867, worthy of the eulogium, "that as water in crystallizing excludes all foreign ingredients, however minute, so in the making of him beauty and nobleness coalesced to the exclusion of everything vulgar and low."

PROFESSOR EDWARD FORBES, a first-rate naturalist, was a banker's son, born in 1815 at Douglas in the Isle of Man. At the age of sixteen he went to London as an art student, but finding little encouragement, entered at Edinburgh University as a medical student, where, however, he soon won distinction for his practical knowledge of natural history, his keen insight, and his power of generalization, so that these studies gradually drew him away from medicine. After graduating in 1839 he went to the Levant as naturalist on the survey-ship *Beacon*, where he dredged much, especially on the coast of Asia Minor, and made archaeological discoveries in Lycia. On returning to London in the autumn of 1842 he was elected Professor of Botany at King's College, and two years later became Palaeontologist to the Geological Survey, and a Fellow of the Royal Society when only thirty years old. When the Survey moved to Jermyn Street, he became its Professor of Applied Natural History, till in 1854 the Chair of Natural History at Edinburgh took him from London. But his health, never strong, was beginning to fail, and the end came on Nov. 18th, 1854. As a teacher and writer (his memoirs were numerous), he was clear, stimulative, and interesting; he was an excellent draughtsman, had an inexhaustible fund of humour, enlivening, as one result of this, the British Association by founding the Red Lion Club, and yet was a most industrious worker. The old, it was said, loved him as a son, the younger as a brother.

John Peter Gassiot, a liberal promoter of science and successful pioneer in electricity, was born in London, April 2nd, 1797. After some service as a midshipman, he entered the Spanish wine trade, married early, and settled on Clapham Common. Becoming deeply interested in electrical investigations, he acquired the best instruments that could be made, and constructed batteries of exceptional power, which he often placed at the service of his less wealthy acquaintances. His writings chiefly deal with electricity, and prove among other things that the static effect of a battery increases with its chemical action, that an electric spark meets with no extra resistance from water under a pressure of 447 atmospheres, but cannot pass through an exhausted vacuum tube, and they record some important investigations of the dark bands in electric discharges. He was one of the founders of the Chemical Society, initiated the Scientific Relief Fund of the Royal Society, and was Chairman of the Kew Observatory Committee till his death in 1877.

Professor John Goodsir, a slightly eccentric but able Professor of Anatomy in the University of Edinburgh, was a doctor's son, born at Anstruther, Fife, in 1814, who began, when only twelve years old, to study at St. Andrews. There he was attracted to metaphysics and became a follower of Coleridge. In Nov. 1830 he was apprenticed to a surgeon-dentist in Edinburgh, and there showed great skill in dissecting, but after passing the Scotch College of Surgeons, in 1835, he spent the next five years in practising with his father at Anstruther, while he made and published scientific investigations. Returning to Edinburgh in 1850, he shared lodgings with Edward Forbes (page 10), taking pupils in Anatomy till he was appointed Professor of that subject in 1846. He was an enthusiastic and suggestive teacher, indefatigable in dissecting and in enriching his museum. In later years he suffered from an affection of the spinal cord, and lived a recluse life, without even one servant, till his sister joined him in housekeeping. He died March 6th, 1867, having written about thirty papers, in some of which he sought to prove that a triangle was the ground plan of all organic forms, and to unite crystals with living organisms.

Professor Thomas Graham, a chemist of note, ultimately Master of the Mint, was a merchant-manufacturer's son, born at Glasgow, Dec. 20th, 1805, and educated at its University till in

1824 he migrated to Edinburgh. Here he continued his scientific studies for ten years, till he returned to his native city as Professor of Chemistry at Anderson's University College. But in 1837 he went to London as Professor of Chemistry at University College. Here he had a distinguished career, making valuable researches on phosphorus, hydrogen, and the passage of gases through films and small apertures, and discovering the law of the diffusion of gases. Among his books his *Elements of Chemistry* received high praise. In 1855 he was appointed Master of the Mint, and held that office until his death (unmarried) in Gordon Square, Sept. 11th, 1869.

Professor John Thomas Graves, a distinguished mathematician, was born in Dublin, Dec. 4th, 1806, and educated at Trinity College, where he showed excellence as a classic. Then incorporating at Oxford, he took the degree of M.A., and in 1831 was called to the English Bar, going on the Western Circuit. He was elected Professor of Jurisprudence at University College, London, and wrote on legal subjects, but won his chief distinction as a mathematician, for he aided Sir W. Rowan Hamilton in his work on conjugate factors, elaborating the newly discovered quaternions and the icosian calculus. He died in 1870, after writing many papers on these and similar subjects, and left his very valuable mathematical library to University College, London.

Sir William Snow Harris, also distinguished for electrical researches, was a solicitor's son, born at Plymouth, April 1st, 1781, who studied medicine and for a time was in practice at his native place. But his growing interest in electricity led him, after his marriage in 1824, to give up professional work, for he had already devised a new form of lightning conductor for ships and made improvements in the mariner's compass. His conductor, after encountering official opposition, was adopted by the Navy in 1841, and he received an annuity of £300. Six years later he was knighted and obtained a grant of £5000 for this and other services, and was appointed in 1860 scientific adviser to the Government. Elected into the Royal Society in 1831, he was awarded the Copley Medal in 1835, and died at Plymouth on Jan. 22nd, 1867.

Sir John Frederick William Herschel, the great astronomer, was a son of an equally distinguished father, Sir William Herschel. He was born at Slough on March 7th, 1792, and went, at the age of seventeen, to St. John's College, Cambridge, where he graduated in 1813 as Senior Wrangler and First Smith's Prizeman, and obtained a Fellowship. As an undergraduate, he was intimate with William Whewell, George Peacock, and Charles Babbage, and made a resolution with the second and third to leave the world wiser than they found it. This they did, for, by introducing the differential notation and continental methods of analysis, they restored mathematical science in England. Herschel, after a trial of the Law, devoted himself to astronomical science, first working at optical and chemical questions, and then 'taking up star-gazing' in his father's observatory at Slough. He was already an F.R.S., having read his first paper while still an undergraduate, and received the Copley Medal in 1821, to be followed by a Royal Medal in 1836. The Royal Astronomical Society also, in the foundation of which he co-operated, gave him their gold medal. Meanwhile he carried on his father's observations of double stars, publishing a catalogue including 380 of them. During visits to the Continent in 1820 and the following year he ascended the Pennine Breithorn, measured barometrically the height of Etna, and made experiments on solar radiation from the Puy de Dome. In 1825 he applied a telescope, devised by himself and his father, with a reflector 20 feet from the object glass, to the study of the nebulae. His catalogue (published in 1833, and illustrated by 800 elaborate drawings) included 2307, nearly a quarter of them discovered by himself. In 1830, after having been Secretary to the Royal Society, he was strongly supported for the Presidency, but a majority of its fellows preferred Royal birth to scientific distinction, and elected the Duke of Sussex. Next year, however, Herschel received the K.C.H. In 1834 he boldly transported his great telescope and other instruments to the Cape of Good Hope, in order to study the stars of the Southern Hemisphere, and established an observatory near Cape Town. Before his return in 1838, in which year he was created a baronet, he had largely added to his discoveries of nebulae and double stars, and had done much for the cause of education in the colony. In England also he took an active part in public work, holding, besides other positions, that of Master of the Mint from 1850 to 1855. To enumerate even his more notable memoirs, articles, and books would be impossible, for he worked indefatigably till his death on May 11th, 1871, when he was buried in Westminster Abbey, near the grave of Newton; like to whom, as was justly said, "he was eminent for knowledge, simplicity, and humility."

Sir Joseph Dalton Hooker, born at Halesworth, Suffolk, on June 30th, 1817, is another instance of a son inheriting a father's talent. After taking the degree of M.D. at Glasgow in 1839, he at once joined Sir James Ross' Antarctic expedition as assistant-surgeon on the *Erebus*, thus obtaining, during the three years' voyage, the materials for his three volumes on the *Flora of the Antarctic, New Zealand, and Tasmania*. From 1847 to 1851 he investigated the botany of part of the Himalayas, and during a journey in Sikkim[1] was taken prisoner, ill-treated, and in danger of being murdered. During this journey he obtained materials for valuable memoirs on the rhododendrons of Sikkim and on the

[1] See Section II.

Indian flora, and for a very interesting book, *The Himalayan Journals*. He became Assistant-Director at Kew in 1855, and Director ten years later on the death of his father Sir William. Elected F.R.S. at the early age of thirty, he received the Royal, Copley and Darwin Medals, and became President in 1873. But notwithstanding his many duties, he still found time for scientific travel, for in 1860 he visited Palestine, in 1871 journeyed through Morocco to the crest of the Great Atlas, and in 1877 went to the United States. His memory will always be inseparable from that of Charles Darwin, whom he stimulated and aided in writing the *Origin of Species*, of which book he was a stalwart champion. Vigorous and indefatigable, Hooker wrote many memoirs and books, among which it must suffice to mention his *Genera Plantarum* and the *Flora of British India*, on the completion of which he was created G.C.S.I., having been made Knight Commander in 1877 and C.B. in 1869; his many other distinctions being crowned, at the age of ninety, by the O.M. On resigning his post at Kew he retired to The Camp, an attractive residence near Sunningdale, but continued his botanical work almost to the end, which came in sleep, Dec. 10th, 1911.

William Hopkins, distinguished for his mathematical knowledge and power of teaching, was born at Kingston, Derbyshire, Feb. 2nd, 1793, and brought up as a farmer. But in that calling, after an experience near Bury St. Edmunds, he was not successful, and a love of mathematics attracted him to Cambridge, where he graduated from Peterhouse as seventh wrangler in 1827. Settling there as a private tutor, he met with extraordinary success, for he could state in 1849 that nearly 200 of his pupils had been wranglers, 17 of them seniors and 44 in one of the first three places, though he endeavoured to make them lovers of mathematics rather than anxious for its rewards. Attracted to Geology by Sedgwick about 1833, he applied mathematical methods to its physical questions, such as the movement of glaciers and the condition of the earth's interior, in acknowledgment of which he received in 1850 the Wollaston Medal from the Geological Society. A man of many interests, of high character, and attractive nature, he died at Cambridge, Oct. 13th, 1866.

Leonard Horner, geologist and educational reformer, was born in Edinburgh, Jan. 17th, 1785, and educated at its University, where he studied chemistry, subsequently extending his scientific knowledge, especially of mineralogy. After becoming a partner in his father's linen factory, he went to London, where he married and acquired many congenial friends, joining the Royal Society in 1813, and becoming President of the Geological Society in 1845 and 1860. Though a cautious generalizer, he put forward views about the palaeozoic strata which were subsequently confirmed by Sedgwick and Murchison. Business recalled him to Edinburgh in 1817, where he took a leading part in Whig politics and in educational reform, especially among the working classes; but in 1827 he returned to London to organize the London Institution, and next year became Warden of the newly established University of London. But a failure of health compelled him to resign and live for a time at Bonn. On his return he was appointed a Commissioner to enquire into the employment of children in factories and the chief inspector under the Factory Act, from which he retired in 1856 and died in London, March 5th, 1864. He wrote much on both educational and geological subjects, one of the most important of his investigations being an attempt to estimate by borings the rate of accumulation in the Nile delta.

Sir Charles Lyell, a truly philosophic geologist, was born on Nov. 14th, 1797, the son of a Forfarshire laird, himself noted as a botanist and a Dante scholar. Charles, however, was brought up in England, whither his parents migrated, going in due course to Oxford, where Buckland attracted him to Geology. He graduated in 1819 with a second class in Classics, after having travelled in his vacations on the Continent, where he saw the effects of the flood caused by the burst barrier of the Giétroz Glacier, and in the western part of Scotland. He then entered at Lincoln's Inn, but was obliged by a weakness of the eyes to desist from study, went to Rome, and on his return worked at geology in the southern part of England, reading his first paper to the Geological Society in February 1824. This was followed by longer excursions—to Cornwall, the north of Scotland and Paris, till after four years' rest his eyes improved, he was called to the Bar, and got some business. About 1827 the ideas began to germinate which were afterwards worked out in the *Principles of Geology*, and he set off next year for a long continental tour, with the Murchisons (page 16), through Auvergne, Southern France, and Northern Italy. Parting from his companions, Lyell went southward to study the volcanic district of Naples and ascend Etna. On his return to London in February 1829, he began *The Principles*, the first volume of which was published next year, while he was making a geological tour in the Pyrenees and the volcanoes of Catalonia. The second volume appeared in 1832, in which year he married Miss Mary Horner, and the third in 1833. The book was afterwards recast and divided into two, *The Principles* and *The Elements*, published in 1840. Geological travel in Europe had gone on steadily, but in the following summer Mr. and Mrs. Lyell crossed the Atlantic and travelled for a year in Canada and the United States, enlarging geological experience and getting so far as Southern Carolina. *Travels in North America* describes their journey. In 1845 they undertook another tour in Canada and the States, this time reaching the Gulf of Mexico, the results of which were described in *A Second Visit to North America*. Though Lyell twice returned to that continent, went to Madeira and the Canary Islands, and continued his excursions in Europe, this was the last of his long wanderings for the study of Nature. Honours now came more thickly. He was thrice President of the Geological Society, was awarded its Wollaston Medal and the Royal and Copley Medals of the Royal Society, was President of the British Association, received honorary degrees and foreign orders, was made a knight in 1848, and a baronet ten years later. Intimate with Charles Darwin, he did not immediately accept his theory of the 'Origin of Species,' but afterwards became a convert, for which he gives his reasons in his last great book, *The Antiquity of Man*, published in 1863. So life passed in unflagging work till early in 1873 he had the misfortune to lose Lady Lyell; then his own health declined, and on Feb. 22nd, 1875, he passed away, and was laid in Westminster Abbey near the grave of Woodward, one of the pioneers of British Geology. His thirst for knowledge, with the singular openness and perfect fairness of his mind, impressed all who knew him. Two maxims regulated his work, the one "Go and see"; the other, "Prefer reason to authority."

Dr. William Allen Miller, a distinguished chemist, was born at Ipswich, Dec. 17th, 1817. Educated for the medical profession, he passed through King's College, London, at which, after holding a subordinate position, he was elected in 1845 Professor of Chemistry. Notwithstanding his official duties and the preparation of his important *Elements of Chemistry*, he spent the night hours in investigating, with his neighbour at Tulse Hill, William Huggins, stellar spectra, in which method of analysis he had already become expert. Besides these he aided in a report on the London Water Supply, and in a Kew Committee to provide for uniformity in weights and measures, invented a thermometer for deep-sea soundings, and was assayer to the Mint and Bank of England. He took the degree of M.D. in London University in 1842, and received honorary degrees from Edinburgh, Cambridge, and Oxford. "Indefatigable in work, cautious but clear in judgment, and sincerely religious," he died of apoplexy from brain fatigue at Liverpool on Sept. 30th, 1870, while attending a meeting of the British Association

Sir Roderick Impey Murchison, a leader in geological and geographical circles in London, was born on Feb. 19th, 1792, at Tarradale in County Ross; a descendant of an old Highland family. He lost his father early, and obtained a commission as ensign in 1807. Going with his regiment to Portugal, he was in the battle of Vimiero and the retreat of Corunna. On returning to England, it was kept at home, much to Murchison's chagrin, and after Waterloo he married and retired from the army. He was already slightly interested in science, but for the next two years paid much more attention to art and antiquities, studying in Rome and other Italian cities. On his return, for some five years, fox-hunting was his chief occupation, and not till late in 1824 did he settle in London and begin to work at Geology. Yet in the spring of 1826 he became F.R.S.![1] He went to Yorkshire, where he saw how William Smith worked in the field, and then took a long tour in Scotland, returning thither with Sedgwick (page 22) next year, which had for its result a paper on the Old Red Sandstone. In 1828 Murchison and his wife were joined by Lyell (page 15) in a tour through Central France, and then went to the Austrian Alps. Next year Murchison returned to them with Sedgwick, and much valuable work was embodied in a joint paper, and he made a third journey to them in 1830. But next year the two friends attacked a geological 'no man's land,' as it might be called, the region of 'greywacke,' underlying the Old Red Sandstone, and supposed to be a barren, unfossiliferous tract. It occupied, as then understood, a large part of Wales and the Lake District, with most of Devon and Cornwall. The last region was attacked by Murchison and Sedgwick in 1836, and in the course of three years brought into order. Sedgwick explored the Lake District, and the two made separate attacks on Wales; Murchison, in the summer of 1831, working from the edge of the Old Red Sandstone westward to the more disturbed central region, Sedgwick from the Menai Strait in a more or less southward direction. They communicated their advances to the Geological Society, and late in 1838 Murchison published his great work, *The Silurian System*. We may pass over the subsequent controversy, which ultimately estranged the two friends, because the main facts are now inseparable from the history of British stratigraphy, and remark that the book was a wonderful accomplishment for one man, even though much aided, as Murchison was, by friends. In 1841 he made a long journey in Russia, studying its geology and getting as far east as the Ural Mountains and south as the Sea of Azov, the result being another important book, *Russia and the Ural Mountains*, published in 1845 after another visit to that country. Murchison continued for some years to travel rather extensively, though within narrowing limits, and in 1855, on the death of Sir Henry de la Beche (page 8), succeeded him as Director-General of the Geological Survey. He was again elected, in 1863, President of the Royal Geographical Society, and so, always busy with official and consequent social duties, with the revision of his books and preparation of addresses, he continued his ever industrious life, till in 1869 his helpmate Lady Murchison was taken from him, and after a stroke of paralysis, late in the following year, he quietly passed away on Oct. 22nd, 1871.

[1] A frank remark of the President, quoted in Geikie's *Life of Murchison*, vol. i. p. 129, justifies the agitation for reform in the Royal Society, of which the Philosophical Club was one outcome.

He received many honours: the Presidency of the Geological and Geographical Societies, of the British Association, the Wollaston, the Royal, and the Copley Medals; valuable presents and an Order from the Czar of Russia, honorary degrees, knighthood, and then a baronetcy in his own country.

Sir Richard Owen, a master in vertebrate palaeontology, was the younger son of an India merchant, born at Lancaster on July 20th, 1801. At its grammar school his chief hobby was heraldry, but when apprenticed to a surgeon, this gave place to anatomy. Passing through Edinburgh University and St. Bartholomew's Hospital, he became M.R.C.S. in August, 1826. After practising for a short time near Lincoln's Inn, he was appointed Assistant-Conservator to the Hunterian Museum, visited Paris in 1831 to study under Cuvier and at the Jardin des Plantes, and then, next year, published his memoir on the Pearly Nautilus, which "placed him at a bound in the first rank of anatomical monographers." In 1834 he became F.R.S., and next year married Miss Clift, daughter of the Hunterian Conservator, whom he succeeded in 1842, and was elected Professor of Comparative Anatomy at the Royal College of Surgeons. He had now gained a position in science and in society, was esteemed by Prince Albert, and in 1842 received a Civil List pension. Ten years later the Queen gave him Sheen Lodge in Richmond Park. But nothing distracted him from the documents and specimens in the Hunterian Museum and his palaeontological work. In 1856 he became Superintendent of the Natural History Department in the British Museum, to the removal of which from Bloomsbury he was favourable. (It was accomplished in 1881.) But in this post his career was hardly so successful, though it afforded facilities for his scientific work. To enumerate his papers and books would be impossible—by 1843 he had written 200 of the former; it must suffice to mention his works on the *Mylodon* and Gigantic Sloths of South America, and on the Dodo of New Zealand, which started from a fragment of a thigh bone. He received honorary degrees, the Wollaston, Royal and Copley Medals, was created C.B. in 1873 and K.C.B. in 1884. He died at Sheen, Dec. 18th, 1892.

Professor Richard Partridge, a noted surgeon, was born at Ross, Jan. 19th, 1805. Beginning his medical training in Birmingham, he went on to St. Bartholomew's, and became M.R.C.S. in 1827. Afterwards he was connected with the hospitals at Charing Cross and King's College, being elected, in 1836, Professor of Anatomy at the latter. He was admitted into the Royal Society in 1837, was Professor of Anatomy at the Royal Academy, and, though he did not publish much, was highly valued as a teacher. He died March 25th, 1873.

Dr. Jonathan Pereira, who won great repute for his knowledge of pharmacy, was born in Shoreditch on May 22nd, 1804, and at an early age was articled to a general practitioner in the City Road. Working hard at Chemistry and Materia Medica, he passed the Society of Apothecaries in his nineteenth year, and was appointed to their dispensary. Before qualifying as a surgeon in 1825, he taught and published three useful students' manuals, and after that began to lecture and prepare for his great work, *The Elements of Materia Medica*, which was published in 1839-40. An early riser, with an iron constitution, he could work sixteen hours a day, lecturing and writing on Food and Diet, treating these from a scientific point of view. Erlangen gave him the degree of M.D., he became F.R.S. in 1838, F.R.C.P. in 1845, and died, as the result of an accident, on Jan. 20th, 1853.

PROFESSOR JOHN PHILLIPS, nephew and pupil of William Smith, the founder of British Stratigraphy, was born at Marden, Wilts., Dec. 25th, 1800. Brought up by his uncle, they were, as he said, "for years never separated in act or thought" till 1824, when he was appointed to an office at the York Museum, which during his time was transported to its present site in the Abbey Gardens. He quitted that city for a post on the Geological Survey, and was for some years Professor of Geology at King's College, London. But in 1844 he left that for the same office in Dublin, from which he came to Oxford in 1853 as Deputy for Buckland, whom he succeeded as Professor in 1857. For over thirty years he was Assistant-secretary to the British Association, of which he was President in 1865. He wrote not a few valuable memoirs, received many well-deserved honours—F.R.S. in 1834, honorary doctorates and the Wollaston Medal of the Geological Society, and he died, in consequence of a fall, at Oxford on April 24th, 1874.

PROFESSOR JOHN FORBES ROYLE, son of a captain in the East India service, was born at Cawnpore in 1799, and went to Edinburgh High School. At Addiscombe he acquired such a regard for botany that he qualified as a surgeon and went to India, in 1819, on the medical department of the Company's army. There, four years later, he was placed in charge of the Botanic Garden at Saharanpur, where he brought together in it a fine collection of plants economically valuable. He also examined the drugs sold in the bazaars, many of which he identified with medicine used by the ancient Greeks, and urged the Government to introduce the chinchona plant, which, however, was not done till two years after his death. He published, after returning to England, an important book on the *Botany and Natural History of the Himalayas*, was elected, in 1837, F.R.S. and Professor of Materia Medica in King's College, London, and was placed, at the India House, in charge of the museum and correspondence relating to vegetable products. An author of many books and papers of scientific and economic value, he died at Acton on Jan. 2nd, 1858.

General Sir Edward Sabine, son of a Hertfordshire squire, was born at Dublin on Oct. 14th, 1788, and obtained from Woolwich a commission in the Royal Artillery. After Gibraltar and home service, he was taken on his way to Canada, in May 1813, by an American privateer. But an English frigate recaptured his vessel, and he obtained credit during active service on the Niagara frontier. On his return to England, he studied astronomy, terrestrial magnetism and ornithology, accompanied as astronomer Sir John Ross to Greenland, and wrote a book on its birds and the Esquimaux of its western coast. In 1819 he went away for a year and a half with Captain Parry on another Arctic expedition, having become F.R.S. the previous year. His next task was to ascertain the variations in the length of the seconds' pendulum at different places, in order to determine the earth's figure. Then he joined Sir J. Herschel in observing the exact difference in the longitudes of the Greenwich and Paris observatories, followed by ascertaining the relative lengths of the seconds' pendulum at Greenwich, London, Paris, and Altona, and the absolute length at the first place. Recalled to military duties in 1834, he was still able, while stationed in Ireland, to continue scientific work, the result being the first magnetic survey of the British Isles and the establishment of magnetic observatories by our Government in different parts of the globe. Elected to the Royal Society in 1818, he received its Copley Medal, and, after serving as Foreign Secretary and Treasurer, was President from 1861 to 1871. In the army he rose to the rank of General, and was created K.C.B. in 1869. Full of years and well-earned honours, he died at Richmond on June 26th, 1883.

Professor William Sharpey was born on April 1st, 1802, at Arbroath in Forfar, though his father was from Kent, passed through the University of Edinburgh, and, after further study in London and Paris, took the M.D. degree there in 1823. Returning to Arbroath, he was in practice for about three years and then abandoned it for science, starting on a long journey through France to Naples, and back by Venetia, Austria, and Prussia, halting at the chief centres for study. Settling in London, he began to teach, and was appointed, in 1836, Professor of Anatomy and Physiology in University College, where he attracted large classes. He was admitted to the Royal Society in 1839, and served as its Secretary from 1853 to 1872. Resigning his chair in 1874, he died in Torrington Square on April 11th, 1880, a man remarkable for his varied knowledge, his accurate memory, and his sound discrimination.

Professor Edward Solly was born in London, Oct. 11th, 1819, studied chemistry in Berlin, and began early to lecture in London and to write. In 1843 he was elected into the Royal Society, and two years later appointed Professor of Chemistry at Addiscombe. He was also noted for his wide genealogical and literary knowledge and formed a large library, dying at Sutton, Surrey, on April 2nd, 1886.

PROFESSOR JAMES SPENCE was the son of an Edinburgh merchant, born in that city in 1812, and educated at its University, and admitted to its College of Surgeons in 1832. After two voyages to Calcutta as surgeon to an East Indiaman, he began to practise and lecture in Edinburgh, ultimately becoming Professor of Surgery in 1864. He was noted as a skilful dissector and operator, with a preference for the older methods of treatment. He died in Edinburgh on June 6th, 1882.

COLONEL WILLIAM HENRY SYKES, a member of an old Yorkshire family, was born in that county on Jan. 25th, 1790, and obtained a commission from the East India Company. After the siege of Bhurtpur in 1805, he had experience of active service in the Deccan from 1817 to 1820, and then returned home to spend four years in continental travel. On resuming work in India, he was employed for the next few years on its statistics and natural history, both resulting in valuable reports. After this, in 1831, he returned to England as Lieutenant-Colonel (finally retiring as a full Colonel), and was employed in various capacities, dying in London on June 16th, 1872. He was a zealous and scientific observer, with wide interests, especially in zoology and mineralogy, antiquities and statistics.

SIR CHARLES WHEATSTONE, remarkable for his scientific ability and inventive powers, was the son of a Gloucester music-seller, born there in February 1802. At the age of twenty-two he began business as a musical instrument maker in London, and obtained valuable results from a scientific study of sound. Turning next to light and optics, he invented the stereoscope, and showed (in 1835) that the spectrum of the electric spark consisted of rays of different refrangibility, and the lines thus produced would reveal the presence of even a minute portion of any metal. Another invention was a polarization clock; then, soon after being appointed Professor of Experimental Physics at King's College, came inventions which made the electric telegraph available for the public transmission of messages, which were followed by experiments on submarine cables. He was also a most ingenious reader of hieroglyphs and despatches in cipher. He became F.R.S. in 1836, received honorary doctorates from Oxford and Cambridge, was knighted in 1868, and died in Paris, Oct. 19th, 1875.

MR. WILLIAM HENRY FOX TALBOT, one of the pioneers of photography, was a man of good family, born at Chippenham, Wilts., on Feb. 11th, 1800. From Harrow he went to Trinity, Cambridge, won a Porson Prize, and graduated as twelfth wrangler and second Chancellor's Medallist in 1821. After two or three mathematical papers, he was one day using a camera lucida by the Lake of Como, when the idea occurred to him of making its pictures permanent. Wedgwood, indeed, had already produced evanescent 'sun pictures' on sensitized paper, so he adopted that method, and had all but succeeded when Daguerre did this by another process. Talbot, however, went on with his experiments, the result of which was the so-called Talbotype, patented early in 1841, which soon ousted the daguerrotype. Then he devised methods for taking instantaneous pictures and for photographic engraving. Besides his successes in mathematics and photography, he was a good archaeologist and among the first to decipher the cuneiform inscriptions from Nineveh. Elected into the Royal Society in 1831, he received a Royal Medal in 1838 and the Rumford in 1842, and died at Lacock Abbey (his birthplace), Sept. 17th, 1877.

Professor Adam Sedgwick, a geologist of real genius, was son of a Yorkshire dalesman, born at Dent on March 22nd, 1785. From Sedbergh school, after study under John Dawson, a self-taught but first-rate mathematician, he went to Trinity, Cambridge, graduated in 1808 as fifth wrangler, was elected a Fellow in 1810, and appointed assistant-tutor five years afterwards. Ordained in 1816, he was elected in 1818 Professor of Geology, though hitherto he had not seriously worked at that subject. But he began at once to travel for that purpose in Great Britain, and to produce papers, becoming F.R.S. in 1830 and President of the Geological Society in 1829. Beginning in southern and eastern England, he then attacked the magnesian limestone and associated red rocks of the north-east, after which he went with Murchison (page 16) to examine the red sandstones on the western side of Scotland. With him also, in 1829, he made a long journey through Mid-Europe as far as Trieste, and worked at the Eastern Alps. Important papers were the outcome of these studies, but he was now becoming keenly interested in the problems offered by the ancient rocks of Britain. With those of Cornwall and Devon he had to some extent the help of Murchison; in the Lake District he worked single-handed, and in 1831 they attacked, though separately, the difficulties of Wales—Murchison working westward from the Severn, Sedgwick in a more or less south-easterly direction from the north-western coast. Papers, read from time to time, announced their progress, till in 1839 Murchison published his important book, *The Silurian System.* Further work in Wales convinced Sedgwick that his friend had confused two distinct sandstones. He communicated the results to the Geological Society, and in 1852 read a paper criticizing a map of North Wales, issued by the Geological Survey, which placed in the Silurian almost the whole of the Formation which he had named Cambrian. The Society, as Sedgwick thought, did not deal fairly with that paper, which brought about another estrangement. After the later part of the decade his papers became fewer; for advancing age and increasing engagements made work in the field more difficult, and though in some ways vigorous, he was often out of health, and had more serious illnesses and accidents than most men. "From 1813 to his death he could never count upon robust health for even a day." Infirmities increased more rapidly during his last fourteen years, till life ebbed away in his rooms at Trinity in the early morning of January 27th, 1873. He had received the Wollaston Medal from the Geological Society and the Copley from the Royal, the honorary degree of LL.D. from Cambridge, and a canonry at Norwich. To children he was devoted, to younger students ever kind and stimulating; his wonderful memory, fund of stories, varied recollections, and sense of humour made him the most delightful of companions; in fact his geology was not his only faculty which bore the stamp of genius.

Professor William Hallowes Miller, whose name is inseparable from mineralogy, was born at Felindre near Llandovery on April 6th, 1801. Going to Cambridge, he got a high place in the Mathematical Tripos and a Fellowship at St. John's College, and was elected, in 1832, Professor of Mineralogy. For this science he developed a system of Crystallography simpler and better adapted than any previous one to mathematical calculation. When the burning of the Houses of Parliament in 1834 destroyed the standards of length and weight, he took a leading part in reconstructing them, and in all his scientific work showed a great power of obtaining precise results by simple means. Elected to the Royal Society in 1838, he was awarded a Royal Medal, was made LL.D. by Dublin and D.C.L. by Oxford, and received more than one foreign order. He died at Cambridge, after a gradual failure of health, on May 20th, 1880, much esteemed for his wide and accurate knowledge and his unselfish nature.

Mr. George Newport, who rose from a humble origin to be a high authority as a scientific entomologist, was born at Canterbury on July 4th, 1803. Beginning a medical training at Sandwich, he obtained the M.R.C.S. in 1835 and an appointment at Chichester, but devoted all his spare time to studying insects, more especially those of his native county, and communicated papers to the Royal and other Societies, becoming F.R.S. in 1846 and receiving a Royal Medal. He then settled in London, where also he practised, but in his later days had a Civil List pension, and died on April 7th, 1854.

Mr. George Rennie, sculptor and politician, born in Haddingtonshire in 1802, was a nephew of the distinguished engineer, John Rennie. He studied sculpture in Rome, exhibiting his works from

1828 to 1837, when he turned to politics in the hope of advancing education, and was for some time member for Ipswich. Late in 1847 he was appointed Governor of the Falkland Islands, where his administration was successful. Returning to England in 1855, he died in London on March 22nd, 1860.

Dr. Nathaniel Wallich was a Dane, born on Jan. 28th, 1786, at Copenhagen, where he took the degree of M.D., and in 1807 went as surgeon to Serampore, then belonging to his country. But when it was transferred to England, he entered our service, and soon became an active discoverer and collector of new plants and a contributor to the *Flora Indica*. He was sent in 1820 to explore Nepal, and published the results. In 1825 he inspected the forests of Western Hindostan, and in the next two years those of Ava and Lower Burma. Invalided to England in 1828, he brought with him about 8000 specimens, and distributed the duplicates among important herbaria. The results of his labour appeared, 1830-32, as three handsome volumes, with figures, on *Unpublished East Indian Plants*. He was elected F.R.S. in 1829, and, after another period of service in India, returned to England in 1847, settled in London, went on working out his specimens, and died in Bloomsbury, April 28th, 1854.

Professor Joseph Henry Green, noted for his skill in surgical operations, especially lithotomy, was the son of a city merchant, born at London Wall, Nov. 1st, 1791. Apprenticed to an uncle, after three years' study in Germany, he passed the College of Surgeons at the close of 1815, and began to practise near Lincoln's Inn. Already connected with St. Thomas' Hospital, he gave instruction there, and in 1820 was appointed surgeon. In 1824 he became Professor of Anatomy at the College of Surgeons and to the Royal Academy in the following year (also that of his election as F.R.S.). Finally he became Professor of Surgery at King's College. But besides this he was a student of philosophy, who had gone, even in 1817, to Berlin to attend lectures on that subject, and an early acquaintance with S. T. Coleridge ripened into such friendship that he was left in 1834 literary executor to the latter. In the same year Green's father died, bequeathing him a large fortune, which enabled him to give up private practice, though he continued to write papers and addresses. In the later part of his life he lived at Hadley, near Barnet, where he died of gout on Dec. 13th, 1863. He was considered to be a fine operator, an assiduous teacher, a most painstaking student, and a thoughtful, though rather nebulous, writer.

Professor James McCullagh was a farmer's son, born at Glenellie, Tyrone, in 1809, who went in 1824 to Trinity College, Dublin, where he obtained a fellowship and was elected Professor of Natural Philosophy in 1843. He quickly proved himself not less stimulating as a teacher than zealous as a student, devoting himself especially to higher geometry and to electrical physics. He was also very helpful to the Museum of the Royal Irish Academy. But overwork told upon his health, and in October, 1847, he put an end to his life, while temporarily insane, thus being the most short-lived of the original members of the Philosophical Club.

Sir John Richardson, the distinguished Arctic explorer, was born in Dumfries, where his father was a prominent citizen, on Nov. 5th, 1787. He entered Edinburgh University as a student of medicine, and after qualifying as M.R.C.S. was appointed in February, 1807, to be assistant-surgeon on a frigate. After being present at the bombardment of Copenhagen, he continued on active service till 1815, when he retired on half-pay, and returned to Edinburgh to study natural science and take the degree of M.D. in the following year. But in 1819 he was appointed surgeon and naturalist to Franklin's polar expedition. It wintered at Cumberland House on the Saskatchewan River, and after travelling 1350 miles spent the next winter at Fort Enterprise. Then a canoe voyage down the Coppermine River took them to the coast, when they explored parts of Bathurst Inlet and Melville Sound. After being reduced to great straits, the expedition, by the help of Indians, reached Fort York in the following June, and returned to England in October, 1822, after having travelled 5550 miles. Richardson wrote the scientific part of the *Narrative*, and afterwards described the birds and mammals collected by Parry on his second voyage, 1821-3. In 1825 he accompanied Franklin on his second expedition to the mouth of the Mackenzie River, when he explored with a separate party 900 miles of coast between the mouth of that and the Coppermine River. Then he made a voyage round the Great Slave Lake, and ultimately met Franklin at Cumberland House in June, 1827, returning to England in the following September, after which he worked out and published the scientific results of the expedition. In 1838 he was appointed physician to the Haslar Royal Hospital, and two years later Supervisor of Hospitals. But in 1848 he was chosen to conduct a search expedition for Franklin, and reached the estuary of the Mackenzie River by way of Cumberland House, after leaving Liverpool on March 25th. Early in September ice floes obliged him to abandon his boats near Cape Kendall. After wintering by the Great Bear Lake, he left his second, John Rae, in command, having kept, by his wise measures, the members of his expedition in excellent health, and reached Liverpool on Nov. 6th, 1849, publishing the results of his journey in 1851. He retired after forty-eight years' service in 1855 and resided generally at a house near Grasmere, where he accomplished much literary and scientific work and helped his poorer neighbours with his medical knowledge, dying there on

June 5th, 1865. He was elected F.R.S. in 1825, and received a Royal Medal in 1856, and the degree of LL.D. from Dublin in 1857. In 1846 he was knighted and in 1850 created C.B.

Admiral William Henry Smyth was born in Westminster on Jan. 21st, 1788, entered the Navy and saw much service in Indian, Chinese, and Australian waters, after which he made valuable charts of the North Sea, French, Spanish, and Mediterranean coasts, till he retired from active sea life as a post-captain in 1824, and devoted himself to science, being elected F.R.S. in 1826. At an observatory which he had established in Bedford, he carried out systematic work on the stars, publishing the results in the *Philosophical Transactions*, and made various contributions to scientific periodicals. Attaining the rank of rear-admiral in 1853, he became full admiral in 1863, and died at Aylesbury, to which place he had removed, on Sept. 9th, 1865.

Sir William Robert Grove, whose name is inseparable from the history of the Philosophical Club, was the son of a Glamorganshire landowner, born at Swansea, July 11th, 1811. He graduated from Brazenose College, Oxford, in 1832, having already become a student of Lincoln's Inn. Ill-health at first impeded his career at the Bar, so he devoted himself to science and especially electricity, inventing the particular form of battery which bears his name. In 1840 he was appointed Professor of Natural Philosophy at the Royal Institution and elected F.R.S. In both capacities he soon manifested his powers, producing some most important papers and working for reform in the latter body, from which he received a Royal Medal in 1847, having published in the previous year his great treatise, *The Correlation of Physical Forces*. His health had now greatly improved, so that he resigned his chair at the Institution and resumed active work at the Bar, quickly acquiring a large practice, especially in patent cases. In 1853 he took silk, and was appointed a judge and knighted in the winter of 1871, being transferred to the Queen's Bench about nine years afterwards. Late in 1887 he retired and was made a Privy Councillor, when he returned with zest to his scientific studies. He received honorary degrees from Oxford and Cambridge, was noted as a man of remarkable energy and originality of mind, and died at his house in Harley Street on Aug. 1st, 1896.

We now proceed to give an outline of the history of the Philosophical Club, with short biographical notices of its new members,[1] and of its efforts to promote the interests

[1] As the list of these overlaps the beginning of the present century, many on it must be well known to all readers interested in science, so that I have written much shorter notices of them than of the original forty-seven.

of science by stimulating and co-ordinating the activities of the Royal and other societies.

At the 6th meeting (Nov. 25th, 1847), Mr. Grove raised the question whether a closer union between the different scientific societies of the metropolis was not desirable, in order to concentrate their labours, unify their publications, and diminish rivalry. Assuming that to be the case, he thought any measure designed to effect it must be moderate in character; and with that intent made the following suggestions for the consideration of the Club. (1) That all its members, who are also members of the Councils of the different societies, should endeavour to get these societies brought into a single locality. Then their libraries might be joined (each society retaining its own property), when they would form one of the most valuable scientific libraries in Europe, and a single room, if each society selected a different day in the week, would suffice for their meetings. (2) That, in order to obtain an annual publication, embracing the most important branches of science, the Council of each of the principal societies—say, the Astronomical, the Chemical, the Geological and the Linnean—should be at liberty to forward each year to the Council of the Royal Society, papers—say, not exceeding two in number—for publication in the Philosophical Transactions; the right being reserved to the several Councils of printing these papers also in their own Transactions, and to that of the Royal Society of accepting or rejecting them.

Sir H. T. de la Beche fully agreed with the general aim of the first proposal, but doubted the feasibility of the second, though he thought that science and scientific men suffered from want of mutual co-operation. Dr. W. A. Miller suggested the publication, weekly or monthly, of a *Compte Rendu* of Proceedings by the different societies, and it was generally felt that the subject required further discussion. That was resumed at the next meeting (Dec. 23rd), when six members of the Club were appointed a committee to consider and report upon the question on Jan. 27th, 1848.

They presented a report to this effect: that the Presidents of the following societies—the Royal, the Linnean, the Geological, the Astronomical, the Chemical, and the Geographical—be requested to form a deputation to the Government and impress upon it the importance of bringing those societies into juxtaposition for the above-named purpose, and suggest at the same time the grant of the apartments in Somerset House vacated by the Royal Academy. The Report also recommended that two members of the Philosophical Club should wait on the Presidents of the above-named societies, represent to them the advantages of juxtaposition, and request their co-operation in the endeavour to obtain it. In discussing this Report, some members considered the societies proposed to be too few, and certain of them suggested the inclusion of bodies, such as the Royal Society of Literature, not devoted to Physical Science, while others, who agreed with this limitation, favoured the inclusion of certain Minor Societies, as they might be called. The locality proposed was criticized as not affording sufficient accommodation, and, besides this, unlikely to be granted, because the Government already were desirous of obtaining the whole of Somerset House for an extension of Public Offices. Hence it would be better to apply for a building large enough to afford ample accommodation to the various societies. In reply to these criticisms, it was urged that any attempt to enlist too many societies at the outset was likely to be unsuccessful, because of the variety of opinions which would have to be consulted and the greater likelihood of disappointing those societies which would still have to be omitted ; there was also a risk that the Government, in the state of finance, either at present or probably within a reasonable time, would be more likely to accede to a request for moderate accommodation than to a more ambitious scheme. That proposed, as one of the front wings of Somerset House was already occupied by scientific societies, only asked for half the space which would be required if they also were included in an application. That mentioned would, at any rate, suffice for some time to come, and it was used at present only for temporary purposes, viz. by the London University, which was already applying for other rooms. Supposing, however, their request were refused on those grounds, that would give them good grounds for applying to Government for a new building, possibly on a more comprehensive plan.

The discussion was resumed at the meeting on March 23rd, when some of the members present urged the importance of bringing together the libraries of scientific societies and the advantage of preparing a list of the books in which they were deficient.

At the first Anniversary Meeting on April 24th, all the time was occupied by business proper to the occasion, and a rule, of which due notice had been given, was passed, that in the event of a member of the Club being absent from the United Kingdom for a whole year and notifying the fact, he could be considered a supernumerary member and excused the payment of his subscription. On his return he would be entitled to attend the dinners, as if he were a member, until a vacancy occurred, when he should be restored by the Committee to actual membership.

The two vacancies made by the death of Professor McCullagh and the retirement of Mr. Fox Talbot were filled by the election of Mr. T. Galloway and Mr. G. R. Porter.

Mr. Thomas Galloway was born in Lanarkshire on Feb. 26th, 1796, and early showed mathematical ability, which was fostered by learning the continental methods of treating those subjects from two French prisoners of war who were residing near his home. After taking the M.A. degree at Edinburgh in 1820 he taught for a time at Sandhurst, but became actuary to the Amicable Life Assurance Company in 1836, and held that office till Nov. 1st, 1851, when he died of spasm of the heart at his house in Torrington Square, London. He wrote several memoirs on astronomical and other subjects, the most important being one on the *Proper Movement of the Solar System*, for which he was awarded a Royal Medal in 1830, having been elected a Fellow in 1829.

Mr. George Richardson Porter was a Londoner, born in 1792. After an unsuccessful attempt at a business career, he devoted himself to economics and statistics, on which he wrote many papers. After making a valuable digest of Parliamentary Reports, he was appointed

Supervisor of the Statistical Department of the Board of Trade, then of its Railway Department, and lastly Joint Secretary of the Board. He married a daughter of Abraham Ricardo, author of the *Principles of Political Economy and Taxation*, and died at Tunbridge Wells, on Sept. 3rd, 1852, from blood-poisoning caused by a gnat's sting.

At the meeting on May 25th, the discussion on the Report of the Committee (see page 27) was resumed, and it was resolved that the Presidents of the societies cultivating different branches of Natural Knowledge should be asked to request the Government to grant apartments to them, or such other societies as it should think fit, as trustees for carrying out their objects.

At the meeting on June 22nd, the members considered what societies should send their Presidents to form the deputation named in the above-mentioned report, a doubt having arisen about the inclusion of the Chemical Society, because it had not a charter. On it being explained that this was in the way of being remedied, the Club resolved that the societies represented should be the Royal, the Linnean, the Geological, the Astronomical, the Chemical, and the Royal Asiatic.

The Club preferred not to enter on the discussion of that part of the Committee's second recommendation which concerned the *locale* of the apartments, but passed on to the third recommendation, and appointed Lt.-Col. Sabine, Mr. Owen, and Mr. Grove to be members of a Committee to wait on the above-named Presidents, represent to them the advantages of the proposed juxtaposition, and request their co-operation in bringing it about.

1849. At the meeting on April 30th, the second anniversary, the four vacancies, caused by the absence from England of Major Cautley, Dr. Falconer, Dr. Hooker, and Sir J. Richardson, were filled by the election of Dr. H. Lloyd, Dr. Lyon Playfair, the Earl of Rosse, and Lord Wrottesley.

Of the four new members, Dr. Humphry Lloyd was son of a Professor of Natural and Experimental Philosophy in Trinity College, Dublin, and was born in that city on April 16th, 1800. After a distinguished University career, he obtained a fellowship, and in 1831 succeeded his father as Professor, devoting himself more especially to researches in light and magnetism, and the oversight of the Magnetic Observatory, when founded. He became Provost in 1867, but continued his scientific researches and took an active part in reorganizing the disestablished Irish Church till his death on Jan. 17th, 1881.

Dr. Lyon Playfair, son of the Chief Inspector of Hospitals in Bengal, was born at Chunar in that province on May 21st, 1818. He studied chemistry and medicine, first at St. Andrews, then at Glasgow. After a short return to India, owing to a breakdown in health, he worked at University College, London, where his former teacher Graham had become Professor, and then at Giessen, where he became Ph.D. Liebig was then engaged on applying organic chemistry to agriculture and vegetable physiology. His views strongly attracted Playfair, who, after returning to England, drew attention to them, and was employed more and more by the Government. He was appointed in 1845 Professor of Chemistry in the Royal School of Mines, was of much service to the Great Exhibition of 1851, won the esteem of the Prince Consort, became Secretary of Science for the Department of Science and Art, and took an active part in organizing the Royal College of Science. He became in 1858 Professor of Chemistry at Edinburgh, but resigned the chair in 1869, having been elected member of Parliament for that University and St. Andrews. From 1880 to 1883 he was Chairman and Deputy Speaker of the House of Commons, and was created K.C.B. on resigning that position. From 1885 to 1892 he sat for South Leeds, and was then raised to the peerage as Baron Playfair, three years later becoming G.C.B. Elected F.R.S. in 1848, he was President of the British Association in 1885, and died in Onslow Gardens, London, on May 29th, 1898.

The Third Earl of Rosse was born at York on June 17th, 1800, and graduated from Magdalen College, Oxford, after obtaining a first-class in Mathematics, and sat for King's County, Ireland, from 1823 to 1834, when he resigned to secure more leisure for study. At his home, Birr Castle, he began a series of experiments to perfect reflecting telescopes, constructing everything needed on the spot and taking workmen from the neighbourhood. In 1828 he invented an alloy of copper and tin for the mirrors and a machine to grind and polish them. His first great success was in 1839, when he made a speculum 3 feet in diameter, but in 1842-3 he constructed another of twice that diameter, mounted in a tube 58 feet long and 7 feet in diameter. Both were set up, side by side, in front of Birr Castle, and he employed them especially in observing nebulae. Elected into the Royal Society in 1831, he received a Royal Medal in 1851, and was its President from 1849 to 1854. He received several distinctions, both English and foreign, among them the K.P. In the famine of 1846-7, he worked hard for the poor and against murderous societies, and it was justly said of him when he died at Monkstown on Oct. 31st, 1867, "Estimable in all the relations of life, he pursued, without pretension or self-seeking, the combined careers of a philosopher, a patriot, and a philanthropist."

Sir John Wrottesley, Second Baron Wrottesley, was born at Wrottesley Hall, Staffordshire, on Aug. 5th, 1798, took the B.A. degree from Christ Church, Oxford, and was called to the Bar. Having built an astronomical observatory at Blackheath, he paid especial attention to certain small fixed stars, and published, through the Royal Astronomical Society, a catalogue of the right ascensions of 1318, for which he received their gold medal in 1839. In 1841 he was elected F.R.S., and, on the death of his father in the same year, transferred his observatory to Wrottesley, with the addition of a large equatorial telescope. He was President of the Royal Society from 1854 to 1857, and of the British Association in 1860, dying at Wrottesley on Oct. 27th, 1867.

1850. A statement by Mr. Bell, at the meeting on Jan. 24th, that the Government had at the present time two or three large vacant houses, which possibly might be obtained for the use of scientific societies, raised the question of bringing these into juxtaposition, and the Committee appointed on June 22nd, 1848, was requested to meet, to take such action as seemed desirable, and to report the results to the Club.

The union of scientific societies was again discussed on Feb. 28th, Sir H. T. de la Beche mentioning the beneficial results of bringing together men of science at the meetings of the British Association, and pointing out how desirable occasional meetings of that kind would be in London. Dr. Playfair remarked that as a large building would have to be constructed for the Exhibition of 1851, part of it might be of a more permanent character, and be apportioned to scientific societies, and yet might again be used for a general exhibition, if another were held. Sir P. Grey Egerton suggested that scientific societies in London should occasionally hold evening joint meetings in order to bring about a greater amalgamation of views.

At the meeting on March 28th, Sir H. T. de la Beche, on behalf of a Committee appointed Feb. 28th, said its members had consulted several men of science, most of whom had cordially received the proposal of occasional meetings, and were continuing their enquiries. Mr. Hopkins and Mr. Grove thought that conversational soirées would do little good unless they had the definite aim of advancing that union of different societies which had been already so frequently discussed. Sir H. T. de la Beche considered that the main object of these meetings would be to pave the way to a more permanent juxtaposition or consolidation of scientific societies.

At the third Anniversary Meeting (April 29th), Dr. Royle was elected Treasurer in place of Mr. Grove, who retired under Rule VII., but, as ill-health obliged the former to resign at the next anniversary (April 28th, 1851), Mr. Grove was then re-elected.

1852. The Committee on the Juxtaposition of Societies submitted to the Club, at its meeting on Feb. 26th, a memorandum which they recommended should be forwarded to the President of the Royal Society, and of which the following is a summary. Beginning by recapitulating the advantages of bringing together the societies cultivating Natural Knowledge, while retaining their independent action and existence, it states that these would require a suite of apartments to contain their several libraries, and three or four rooms of different sizes, in which their meetings might be held on different days in the week, an arrangement which would combine the advantages of devotion to a special object with those of concentration. These libraries also, while retaining their individual distinctness, would become virtually parts of one library of science, and be more available for reference than when dispersed as at present. This arrangement would also diminish the expenses of the societies. Certain members of the Club[1] were requested to ascertain the views of the above-named four societies on this question.

At the meeting on March 25th, Dr. Hooker reported that he had consulted about two dozen members of the Linnean Society, including the President, who were unanimously

[1] Six for the Linnean and the Geological, four for the Chemical, and three for the Astronomical Society.

in favour of juxtaposition. Mr. Newport stated that he had found, on investigating the financial question, the saving to that society would be about £150 a year. Professor E. Forbes had consulted many Fellows of the Geological Society, who were unanimously in favour of the proposed juxtaposition, and did not apprehend any opposition. Dr. Allen Miller read a copy of a resolution, passed by the Council of the Chemical Society (Dr. Daubeny being in the chair), which stated their entire concurrence with that adopted by the Philosophical Club, welcoming the proposal for juxtaposition, and expressing their readiness to join with the other chartered societies in an application to the Government. Captain Smyth said that the Council of the Astronomical Society had also passed a resolution in favour of the juxtaposition of the scientific societies, as proposed by the Philosophical Club.

At the fifth Anniversary Meeting on April 26th, the Committee recommended that a copy of the original lithographed memorandum, prepared for the instruction of the members of the Philosophical Club in making the above-named enquiries, together with the results of the latter, be forwarded to the Earl of Rosse, with the request that he would take, in consultation with the Council of the Royal Society, the Presidents of the afore-named societies, and the Government, such steps as may appear to him and them most desirable for accomplishing the object in view.

Dr. William Benjamin Carpenter was elected into the vacancy caused by the death of Mr. Galloway. He was born at Exeter on Oct. 29th, 1813, and went from his father's school to University College, London, as a medical student. Moving to Edinburgh, when qualified, he began a series of papers on physiological questions, ending with his great work—much in advance of the time—*Principles of General and Comparative Physiology*, published in 1839. In 1844 he returned to London as Professor of Physiology at the Royal Institution, and was elected F.R.S. in the same year. After holding two or three other educational posts, he became Registrar of the University of London in 1856, for the development of which he worked assiduously till he retired, and was created C.B. in 1879. He died on Nov. 19th, 1885, "one of the last examples of an almost universal Naturalist," besides which, he was an excellent lecturer, an advocate of vaccination and other good causes, besides being a fair musician and well versed in literature.

The next section of these Minutes illustrates the diversity of his scientific interests, among them being the construction and uses of microscopes, which led to his book on that subject, the first edition appearing in 1856. He received a Royal Medal in 1861, the degree of LL.D. from Edinburgh in 1871, the Lyell Medal of the Geological Society in 1883, and was President of the British Association in 1872.

At the meeting on June 24th, during a conversation about the juxtaposition of Scientific Societies, certain members of the Council of the Royal Society stated that it was considering that subject, and had consulted the Presidents of the four societies mentioned in the Minutes of March 25th last.

The subject was again discussed at the meeting on Oct. 21st, when it was stated that many eminent men of science, who belonged to provincial scientific societies, considered that a union of the metropolitan societies would not suffice for the wants of science, so that some of the more important of these provincial societies would wish to be represented if juxtaposition were effected. Colonel Sabine mentioned that, at the recent meeting of the British Association, this project had been discussed, and many of its members had expressed themselves favourable to it, and thought that the matter had been too long delayed. At that meeting a committee had been formed to endeavour to reorganize scientific publications so as to bring them, if possible, into one form. The issue of a quarterly or monthly publication, to contain the more important papers from this country and the Continent, was also contemplated. Dr. W. A. Miller undertook to bring forward at the next meeting a definite plan for establishing and editing such a periodical.

At that meeting (Nov. 25th) it was stated that the Council of the Royal Society would meet next day to consider the reports of the other societies which had been consulted; also, that the Government were contemplating the erection of a building at Kensington for the fine arts and industrial purposes, in which rooms would be allotted to several scientific societies, should they desire it. The opinion was strongly expressed that Kensington, from its distance and other inconveniences, would be quite unsuitable for the meeting of scientific societies, and the feeling was general that, so far as the Royal Society was concerned, to remain in its present apartments would be the wiser plan, unless a change would result in some general benefit to science, such as that contemplated by the juxtaposition of societies.

1853. At the meeting on Jan. 27th, Mr. Grove suggested the preparation, by members of different societies, of a memorial in favour of juxtaposition, which should then be presented to the Government. The Club requested Col. Sabine and Mr. Grove to draw up such a memorial.

This was read at the meeting on Feb. 24th, and unanimously adopted. It recapitulated the reasons, already stated, in favour of the juxtaposition of, and a central position for, the aforesaid societies, and impressed on the Government the fact that the present dispersion of the societies engaged in promoting the science of the country was prejudicial to its progress.

On March 24th, Sir H. T. de la Beche suggested convening a public meeting of the signers of the memorial in favour of juxtaposition, Sir R. Murchison remarking that this, if it were done, should be as soon as possible.

At the Anniversary Meeting on April 25th, Sir P. Egerton, Col. Sabine, and Mr. Grove were appointed a committee to draw up and issue a request to the memorialists to meet and appoint a deputation to present to H.M. Government the memorial in favour of juxtaposition. Dr. Hofmann and Dr. Bence Jones were elected members of the Club.

Dr. August Wilhelm von Hofmann was born at Giessen on April 8th, 1818, and after studying philosophy, was attracted to chemistry by Liebig. After teaching that science at Bonn, he came to London in 1845 as Professor at the Royal College of Chemistry, where his classes were attended by several men who soon began to make their mark. His talents and attractive personality made him popular. He became F.R.S. in 1851, Warden of the Mint in 1856, and President of the Chemical Society in 1861. He returned to Germany in 1865 to superintend the erection of a chemical laboratory at Berlin and organize the system of instruction in that subject. To this great work, and to carrying on researches in organic chemistry and on aniline dyes, the later part of his life was devoted. His death occurred in that city on May 5th, 1892.

Dr. Henry Bence Jones was a member of a good Suffolk family, born in that county in 1814, who graduated as B.A. from Trinity College, Cambridge in 1836 and M.D. in 1849. After studying chemistry under Prof. Graham of University College, London, he worked under Liebig at Giessen, then practised as a physician in London, obtaining much repute in diseases of the stomach and kidneys. Elected F.R.S. in 1846, he was Secretary of the Royal Institution from 1861 nearly till his death, which occurred on April 20th, 1873. He was a man keenly interested in the general advance of science, whose genial nature won him many friends, especially among scientific men at home and abroad.

The minutes for May 26th contain a copy of a letter from Lord Rosse to Lord Aberdeen, read at the meeting, which requested the latter to appoint a time for receiving a deputation of those (about 200 in number) who had signed the memorial in favour of the juxtaposition of scientific societies. Among them were included many of the scientific men most eminent in their different departments, the few who had not signed abstaining because they feared the memorial might result in locating the scientific societies in a position neither central nor convenient. To the reasons given in the memorial this also might be added, that "The present, disjointed, ill-situated, and ill-appointed scientific institutions" offered nothing "to attract young men who emerge from our Universities highly trained, and ready at once to take a prominent part in scientific research. As it is, University honours are the object, and the examination over, science is seldom thought of; it has been learnt to be forgotten. With us, therefore, scientific men are not numerous and science rests on a narrow basis. This state of things is perhaps not quite creditable to the country. and certainly it has placed us under a disadvantage in the application of science to the development of the national resources." Mr. Grove stated that, on the 23rd, Lord Aberdeen had received the deputation most courteously, and had promised to consult the Chancellor of the Exchequer as to the means of carrying out the proposed objects.

1854. At the meeting on Jan. 25th, the Club considered how to increase the utility and widen the circulation of the *Proceedings of the Royal Society.* Dr. Sharpey suggested that the different scientific societies should be invited to send notes of their communications to the Royal Society, which should take means to provide for their circulation. The result, he thought, would be a sort of *Comptes Rendus*, issued (say) once a fortnight. A small subscription from Fellows of the Royal Society and others interested in science would, he believed, make it possible to issue the improved proceedings with regularity. Mr. Wheatstone and others thought that, besides papers sent to the Royal Society and intended for appearance in the *Philosophical Transactions*, communications of a shorter character should be more frequently made, and accounts of noteworthy scientific facts, observed on the Continent, should occasionally be given to the Society. Dr. Plücker, he said, from whom he had received a letter, saw some difficulty in a regular issue, owing to the Long Vacation. Mr. Grove then remarked that the difficulty, if the project were well launched, might be overcome by keeping back some communications which did not demand immediate issue. Dr. Carpenter suggested that it would be highly advantageous if a list of contemporaneous papers, published in foreign *Transactions*, were inserted in these *Proceedings*.

On Feb. 23rd, Dr. Sharpey stated that the Council of the Royal Society was anxious to make improvements in the publication of its *Proceedings* and thus encourage the communication to its meetings of notices and papers not intended for the *Philosophical Transactions*. Mr. Grove considered that some changes should be made in the rules to facilitate the publication of such papers, because production now went on so rapidly that authors would suffer by waiting for publication in the *Transactions*. Dr. Sharpey thought that the *Proceedings* might offer a means for rapid publication of the fundamental points in a discovery; the details being reserved for the *Transactions.* Mr. Grove referred to his proposition, made Nov. 25th, 1847, and laid stress on the importance of the *Philosophical Transactions* containing the main papers in all branches of physical science.

At the meeting on March 23rd, the first number of the new form of the Royal Society's *Proceedings* was exhibited, and Mr. Horner stated that the Geological Society had determined to print in their *Quarterly Journal* not only a list of lately published books and papers on their subject of study, but also an abstract of the contents.[1]

Sir R. I. Murchison suggested that the societies should co-operate in applying to Government for the formation of a Scientific Committee to accompany the British army to the Black Sea.[2]

On April 24th (anniversary), Dr. Hooker was elected Treasurer in place of Mr. Grove. Mr. Charles Darwin, the Rev. Baden Powell, and Colonel Portlock were elected members of the Club.

The first of these, Charles Robert Darwin, is such an historical figure in the records of Natural Science that it is needless to give more than a bare outline of his biography. Born at Shrewsbury on Feb. 12th, 1809, educated at its noted school and Christ's College, Cambridge, he accompanied Captain Fitz Roy from 1831 to 1836 as naturalist on the voyage of the *Beagle* to South America, publishing the results, after his return, in the well-known *Voyage.* After his marriage in 1839, permanent ill-health obliged him to live in retirement at Down, where he worked out his idea of the *Origin of Species*, the publication of which, in 1859, was accelerated by its having independently occurred to A. R. Wallace. Of the controversy excited by this book and one or two that followed, it is needless to speak; enough to say that its author died on April 19th, 1882, and was buried in Westminster Abbey near the grave of Isaac Newton.

Professor Baden Powell, who also much agitated unscientific people, was born at Stamford Hill on Aug. 22nd, 1796, won distinction

[1] This will be found (separately paged) under the title "*Translations and Notices of Geological Memoirs*" in the volume (Xth) for 1854, and it was continued as a section of the *Journal* till the volume for 1873.

[2] The Crimean War began March 28th, 1854.

in Mathematics at Oxford, and was elected in 1827 Savilian Professor in Geometry, which post he held till his death on January 11th, 1860. Ordained in 1820, he wrote on theological as well as mathematical subjects, and was prosecuted (without success) for a contribution to *Essays and Reviews*.

MAJOR-GENERAL JOSEPH ELLISON PORTLOCK was born at Gosport on September 30th, 1794, and obtained in 1813 a commission in the Royal Engineers. After good service in the Canada war, he returned to England in 1822, and was employed in surveying Ireland, paying much attention to its geology and zoology. Then, after employment in Corfu, he returned to Ireland in command of the Cork district. In 1851 he became Inspector of Studies at Woolwich, doing good work as an educational reformer, till he retired with the rank of Major-General in November, 1857. He was M.R.I.A. as well as F.R.S., and died at Blackrock, near Dublin, on Feb. 14th, 1864.

A letter from Sir R. I. Murchison to Lord Raglan was read, which stated that the Presidents of the Geological and Linnean Societies, with Dr. Hooker, Col. Portlock, and himself, were empowered to request H.M. Government to attach a few competent men of science to the army under his command, which was about to be sent to the east of Europe or to the immediately adjacent countries. This, as the letter pointed out, had been done by the French Government in past times, with valuable results, and by that of the United States, both along the Rocky Mountains and in Southern California. The writers, however, were anxious to ascertain Lord Raglan's views on the question before applying to the Duke of Newcastle, Secretary of State for War. Lord Raglan's secretary had replied that it would be better, in his Lordship's opinion, to wait till the destination of the army had been settled, and it had been some little time in the field, when he hoped to be able to forward their views on the subject.

Reverting on May 25th to the housing of scientific societies, Lord Rosse stated that Sir W. Molesworth, to whom he had applied, had informed him he had no doubt the Government, though it had not officially stated its intentions in regard to Burlington House, intended to provide in it for the accommodation of the scientific societies. Colonel Sabine recommended that the three societies (Royal, Linnean, and Geological) now accommodated in Somerset House should be prepared with a statement of the space which they occupied, and Lord Rosse remarked that Burlington House would not afford sufficient room for the scientific societies as well as for the University of London, without building additional wings.

1855. On Jan. 25th, a proposed modification of the bye-law about elections was referred to the Committee, and the progress made by the Royal Society in preparing scientific instruments for the Exhibition in Paris was mentioned. Lord Wrottesley informed the Club that Government had granted £500 towards the expenses, and the services of four sappers had been requested from the Board of Ordnance for security in packing.

At the Anniversary Meeting on April 30th, it was resolved that new members should be elected at the first meeting in November as well as at the Anniversary Meeting. But as only fourteen members were then present, the election was postponed till May 10th. At that meeting the Treasurer announced six vacancies: Sir H. T. de la Beche, Professor Forbes, Dr. Wallich by death, Mr. Brown, Mr. Christie, Mr. Goodsir by resignation. Sir Proby Cautley was replaced on the list. Mr. Busk, Mr. Huxley, Prof. Stokes, and Prof. Tyndall were elected, the sixth vacancy not being filled.[1]

Mr. George Busk, highly distinguished in more than one branch of science, was born at St. Petersburg on Aug. 12th, 1807, and showed in his schooldays a love of Natural History. He studied medicine at St. Thomas' and St. Bartholomew's Hospitals, and after qualifying became assistant surgeon on the *Grampus*, hospital ship at Greenwich, and then full surgeon on the *Dreadnought*. Retiring in 1855 he settled in London to devote his whole time to scientific work. In this he covered a wide field, for his writings deal with the pathology of cholera, the treatment of scurvy, the lowest forms of life, the polyzoa (the second volume of his Report on those collected by the *Challenger* being finished during his last illness), palaeolithic implements, and the noted Moulin Quignon jawbone (in 1863), after which he visited Gibraltar, working there and elsewhere at the fauna of caves, besides taking an active part

[1] A candidate was proposed, but not elected.

in public service. He became F.R.S. in 1850, and received a Royal Medal in 1871, as well as the Lyell Medal of the Geological Society in 1878 and its Wollaston Medal in 1885. He died at his house in Harley Street, August 10th, 1886.

Professor the Right Honourable Thomas Henry Huxley was son of a schoolmaster, born at Ealing on May 4th, 1825. He became a medical student in 1841, and soon afterwards suffered from blood-poisoning, the result of which was chronic dyspepsia. Matriculating at the University of London in 1842, he graduated as M.B., with the gold medal for anatomy and physiology, in 1845. From the end of the next year to November, 1850, he was attached to the *Rattlesnake*, then surveying the sea between Australia and the Great Barrier Reef. Here his studies of floating hydrozoa, especially the medusae, tunicata, and perishable mollusca, enabled him to place their classification on a sound basis. As a result he was elected F.R.S. in 1851, and in the following year was awarded a Royal Medal. On obtaining, in 1854, permanent work in teaching at the Royal School of Mines, he soon showed that his powers of exposition equalled those of investigation, and proved to be great in organization on its removal to South Kensington. An intimate friend of Charles Darwin, he was a champion of the *Origin of Species*, and his chastisement of Bishop Samuel Wilberforce, who had unwisely attacked it at the Oxford Meeting of the British Association in 1860, will not readily be forgotten. With all this work, especially on Cartesian criticism, during the ten years previous to 1870, his 'output' of scientific literature was surprising. So great was his influence on the public mind that he went on the School Board for London. In 1871 he had to take a long holiday, but became Secretary of the Royal Society, and President in 1881. From this, however, failing health obliged him to retire in 1885 and to give up all public work. In 1890 he removed to Eastbourne, where he died on June 29th, 1895, and was buried at Finchley. He received the Copley Medal in 1888 and the Darwin in 1894, besides honorary degrees and other distinctions, among them that of a Privy Councillor (he refused knighthood) in 1892.

Sir George Gabriel Stokes, son of the Rector of Skreen, County Sligo, was born there on Aug. 13th, 1811. He went to Pembroke College, Cambridge, where he was senior wrangler and first Smith's prizeman in 1837, and obtained a Fellowship. Elected in 1849 to the Lucasian Professorship of Mathematics, he won distinction in many departments, among his notable researches being those on the motion of fluids, including viscous, the dynamical theory of diffraction, and the general theory of the propagation of disturbances, the development of spectrum analysis, which, as his correspondence proved, he had foreseen before it was actually investigated by Bunsen and Kirchoff, the phenomena of sound, the variation in gravitation; in fact, his range on the borderland of mathematics and physics was exceptionally wide. Elected F.R.S. in 1859, he was one of its Secretaries from 1854 to 1885, and President from the latter year to 1890, receiving the Rumford Medal in 1852 and the Copley in 1893. Besides honorary degrees and other marks of appreciation, he sat in Parliament from 1887 to 1891 as a member for his University, was created a baronet in 1889, and was elected to the mastership of his College a few months before his death on Feb. 1st, 1903. In addition to his wide range in science, he took much interest in theological questions, as is shown by his Gifford Lectures and other writings. To celebrate his jubilee as Professor, many eminent men of science from all civilized countries gathered at Cambridge.

Professor John Tyndall, a lecturer exceptionally distinguished, was born on August 2nd, 1820, at Leighlin Bridge, Carlow, where his father owned a little land. After working on the Ordnance Survey and as a railway engineer, he accompanied Frankland to Marburg, where he obtained, after only two years' study under Bunsen, the degree of Ph.D., proceeding afterwards to Berlin. On returning to Queenswood College in 1851, his increasing reputation obtained him after two years the professorship of Natural Philosophy at the Royal Institution. His investigations on slaty cleavage and the veined structure of glaciers led him to become one of the most energetic of Alpine climbers. His laboratory investigations on radiant heat in relation to gases and on the effects of minute dust on light, and incidentally on the question of spontaneous generation, were all highly valuable. For seventeen years he was scientific adviser to the Trinity House, and made important experiments on fog-signalling. His address as President of the British Association at its Belfast meeting excited much criticism from its anti-theological character. After giving up work at the Royal Institution he resided at Hindhead, where he died on Dec. 4th, 1893.

The Committee, to whom a proposed alteration in the bye-law about elections was referred on Jan. 25th, reported that it was not prepared, at present, to recommend more than the first clause in the proposal, namely, that the elections in future should be held twice in a year, viz., on the anniversary and on the first meeting in November. This recommendation was put to the meeting and adopted. The Committee left for further consideration the second clause, that two-thirds of the votes should constitute election.

Col. Sabine announced that Sir R. I. Murchison (unavoidably absent) had mentioned the juxtaposition of societies to Prince Albert, who had expressed himself in favour of the idea, but said it must be remembered that Burlington House was a site equally suitable for the Royal Academy, and that, as he had been informed, certain London tradesmen objected to transferring the latter to so distant a position as Kensington Gore. The Prince thought that the five chartered societies would do well to press for the Burlington House site. Mr. Horner suggested that the Committee, which had waited on Lord Aberdeen, should be called together, and Lord Wrottesley directed attention to a paper, stating the *desiderata* of these societies and urging juxtaposition, which he had laid before Parliament and should bring before the British Association at Glasgow.

May 24th. The above-named Committee, said Lord Wrottesley, had met, and he had spoken about juxtaposition to Lord Harrowby and the Duke of Argyll, but neither they, nor Sir W. Molesworth, nor Sir C. Eastlake, had heard anything of the report mentioned by Prince Albert. He had asked them to inform Lord Palmerston that the desire of the chartered societies for juxtaposition and for the Burlington House site was unabated, but, failing that, they would be glad to be lodged in the buildings now occupied by the Royal Academy. The Treasurer said it was important to watch the present opportunity, for no sites so eligible as Burlington House or Trafalgar Square were likely to be available, and Mr. Solly added that the idea of transferring the National Gallery and the Royal Academy to Kensington Gore had been abandoned. The subject was continued at the meetings on June 21st and October 25th, when Lord Wrottesley announced the result of communications with Lord Palmerston, and stated that Government had not yet formed definite plans about Burlington House.

Mr. Grove, at the meeting on November 22nd, proposed that at an election the Committee should lay before the Club a complete list of the candidates, placing at the head the names of those they recommended. His reason for the change was that he thought the present method deterred some distinguished men of science from becoming candidates.

The two vacancies in the Club were filled by replacing Dr. Falconer on the list and electing Colonel James. Colonel Sabine announced that the Government had placed £1000 at the disposal of the Royal Society.[1]

SIR HENRY JAMES, Director-General of the Ordnance Survey, was born near St. Agnes, Cornwall, in 1803. He passed from Woolwich into the Royal Engineers in 1825, and in the following year was appointed to work on the Ordnance Survey, and then to be local superintendent, under Sir H. T. de la Beche, of the Geological Survey of Ireland. Detached in 1846 for Admiralty work, he returned after four years to the Ordnance Survey, of which he became Director-General in July, 1854, reaching the rank of Lieut.-Colonel in the following December. During his tenure of office great changes were made; the scales adopted for the maps were finally settled, photography was employed in the reduction from one scale to another, and photozincography in printing the results. The Director also took part in connecting the British survey with those of neighbouring countries, and arranged for the survey of Jerusalem and the Sinai district. Elected F.R.S. in 1848, he was knighted in 1860, became Lieut.-General in 1876, resigned office owing to failing health in August, 1875, and died on June 14th, 1877.

On Dec. 20th, Mr. Grove's proposal for a change in the mode of election was discussed, but dropped, as it appeared not to meet with general support.

Lord Wrottesley intimated such progress as had been made in regard to housing the scientific societies at Burlington House, and Colonel Sabine, with Dr. Lyon Playfair (who had proffered his services), were requested to press the matter on the Government.

1856. At the meeting on January 24th, the former stated the result of an interview with Sir Benjamin Hall, who had said that the Board of Trade had not received any information of the Government's intentions about Burlington House. The University of London had been permitted to occupy it, but whether temporarily or permanently he did not know. He had, however, recommended that Lord Wrottesley, as President of the Royal Society, should

[1] This is apparently the institution of the "Government Grant Fund," which has been very helpful in scientific research. See *Year Book of the Royal Society*.

address a letter to the Treasury stating what the scientific societies desired, which letter would be sent to the Board of Works in the regular course of business. He had assured Sir R. I. Murchison, to whom he had spoken, that, if their desires could be met, he would warmly support them. Lord Wrottesley had accordingly written a letter to the Treasury, which, by his permission, Colonel Sabine communicated to the Club.[1] This letter, after recapitulating the history of the movement for placing the Royal Society, with the four chartered societies, in a more suitable and central position than they then held, referred to the occupancy of Burlington House by the University of London, by which, however, as he believed, large accommodation was required on only two or three distinct occasions annually, so that arrangements might be made to meet its needs and those of such societies as could be located in the building. Copies of this letter had been sent to the Duke of Argyll and Lord Harrowby, who had given assurances of warm support; also to Lord Granville and Lord Stanley of Alderley. The next step desirable, Dr. Playfair and Colonel Sabine had thought, was to inspect the accommodation at Burlington House, which the Board of Works had permitted them to do. They found that the University of London had occupied the whole of the central building or mansion house. The wings, still free, are detached buildings between 70 and 80 feet long, of a corresponding breadth and height, the west one fitted up as a kitchen and offices, the east one as a private residence. Supposing the occupancy of the University of London to be continued, there would not be accommodation for the chartered societies with the present arrangements. But they thought that by certain rearrangements of the central block, by converting the west wing into a large hall, and by altering the east one, there might be room for the University of London, and some, if not all, of the societies. These alterations the Board of Works considered practicable. As it appeared important to avoid giving any offence to the University of London, Col. Sabine

[1] A copy of it is inserted in the Minutes.

and Sir R. I. Murchison had obtained an interview with its Vice-Chancellor, Mr. Shaw Lefevre, and discussed the project. This he had promised to bring before the University, and hoped it would appoint a committee to co-operate with Lord Wrottesley in pressing the matter on the attention of the Government. A conversation followed, in which hopes were expressed that Colonel Sabine and Dr. Playfair would continue to watch the progress of the movement for juxtaposition. The prospects were favourable, for two-thirds of the Cabinet were pledged to support it.

On February 22nd, Dr. Sharpey informed the Club that the officials of the University of London had been requested to state what accommodation they desired, and that after referring the matter to the University, had communicated with him. He had replied by suggesting the conversion of the west wing of Burlington House into a large hall for examinations, the appropriation of the east wing to the University, and of the central building to such scientific societies as it would accommodate. But the members of the Club, then present, thought it would be a wiser course for the Royal Society not to move unless it could obtain better quarters than it now occupied and space sufficient to accommodate the other chartered societies under the same roof with itself.

Dr. Hooker referred to the appointment of a Parliamentary Committee to enquire how the Government could best forward the interests of science, and asked whether the above-named subject had been brought to its notice. Lord Wrottesley replied that the Committee, after consideration, was not then in favour of bringing it before the House.

At the Anniversary Meeting on April 28th, two motions for altering the mode of election into the Club, of which Colonel Sykes and Mr. Gassiot had previously given notice, were put to the vote, but the one was rejected and the other failed to obtain a sufficient majority.

1857. On Feb. 5th, Mr. Bell stated that the Linnean Society, as a body, was strongly in favour of meeting in Burlington House on the same evening as the Royal Society.

This difficulty, as Dr. Sharpey had kindly suggested, could be overcome by the latter society arranging that papers presented to it might be read on evenings when the former one did not meet. He also expressed the deep sense of obligation felt by the Council and Fellows of the Linnean Society for the efforts made on their behalf by the Royal Society.

At the Anniversary Meeting on April 27th, Dr. W. A. Miller was elected Treasurer in the place of Dr. J. D. Hooker, and two alterations, of which the Committee had given notice on Jan. 15th, were proposed and carried: (1) that one black ball in five instead of one in three should exclude a candidate; and (2) that the Committee should consist of seven members instead of four, three instead of two retiring annually.

Mr. J. C. Adams was elected into the vacancy made by the resignation of Mr. Green.

Professor John Couch Adams, the discoverer of Neptune, was born on January 5th, 1819, at Lidcot, near Launceston. A farmer's son, he began at an early age to study astronomy, and showed exceptional mathematical talent. Entering St. John's College, Cambridge, he was senior wrangler and first Smith's prizeman in 1843. While still an undergraduate, he resolved on trying to discover the cause of the perturbations in the orbit of Uranus, and took the result of his calculations to the Greenwich Observatory in October, 1845. The story of the official delays, which prevented him from obtaining the full credit for his discovery of Neptune, is too well known to need repetition. Elected Lowndean Professor of Astronomy in 1858, he became Director of the Observatory three years later, and spent his whole life at Cambridge, dying on Jan. 21st, 1892. Of him it was truly said that in few men were the moral and intellectual qualities more evenly balanced. His work on the secular acceleration of the moon's motion and on the Leonid meteors was hardly less notable than his discovery of Neptune. He was elected F.R.S. in 1849, having been awarded the Copley Medal in the previous year, and received not a few other distinctions, British and foreign.

On May 14th, Mr. Horner announced that the Geological Society had applied to the Government for accommodation at Burlington House, and Mr. Hardwick had put forward a plan (to which he believed the Government was favourable) for the erection of a building, at a cost of about £3500, which would not interfere with the present front of that mansion.

On Nov. 19th, the Club decided to dine in future at the 'Thatched House,' because the present place of meeting was inconveniently distant from Burlington House; the landlord undertaking to provide a dinner of two courses, with dessert, tea, coffee, and attendance, for nine shillings a head—wine, ale, and spirits being charged according to quantity consumed, sherry at six shillings and port at seven shillings a bottle.

Mr. Horner stated at the meeting on Dec. 17th that the Government had declined for the present to accommodate the Geological Society on the site of Burlington House, because the house which it now occupied was not as yet required for public purposes.

1858. The vacancy caused by the death of Dr. Royle was filled at the Anniversary Meeting on April 26th, by the election of Mr. Paget.

SIR JAMES PAGET, the eminent surgeon, was born at Great Yarmouth on Jan. 11th, 1814, and studied medicine at St. Bartholomew's Hospital, during which time he discovered, while dissecting, the minute but often fatal parasite *Trichina spiralis*. Becoming M.R.C.S. in 1836 and obtaining the Fellowship in 1843, he held various posts till he became full surgeon in 1861. Before this, he had gained a high position in his profession, and in 1871 attended the Princess of Wales (afterwards Queen Alexandra) when lame from rheumatism. As a surgeon he was skilful and clear-sighted; as a teacher, facile and prompt; as a speaker, eloquent; and as a man, universally respected and beloved. He was elected F.R.S. in 1851, received many degrees and distinctions, among them a baronetcy in 1871, and died in London on December 30th, 1899.

Towards the end of the year the attendance of members had perceptibly decreased, and the Treasurer, on December 16th, was directed to write to those who had been absent for two years.

On November 25th, only eight were present, so the election had to be postponed till Dec. 16th, when seventeen members dined, and Sir B. C. Brodie was elected to fill the vacancy made by the retirement of Mr. Spence.

Sir Benjamin Collins Brodie, the elder of that name, was born at Winterslow, Wilts., of which his father was rector, in 1783. He studied medicine in London, held various posts at St. George's Hospital, and carried out important physiological investigations, especially on vegetable poisons, being made F.R.S. in 1810, and receiving the Copley Medal next year. In 1819 he became Professor of Comparative Anatomy at the Royal College of Surgeons, took part in removing a scalp tumour from George IV., and attended the king, who held him in much regard, during his last illness. He was highly esteemed as a successful operator, with a quick eye and a steady hand, an accurate observation and a retentive memory. His scientific papers were important, and his work on diseases of the joints, published in 1818, reached a fifth edition. He died at Broome Park, Surrey, on Oct. 21st, 1862.

1859. Dr. Carpenter informed the Club on Feb. 24th, that Lord J. Manners, during an inspection of Burlington House, had requested the University of London to state what accommodation they would require in the new building which the Government was about to erect. Dr. Carpenter thought that the scientific societies ought to be watchful against arrangements being made prejudicial to their interests. Mr. Grove then gave reasons in favour of the societies making an effort to obtain an independent building, where they could meet without interference on the part of the Government, but Dr. Sharpey said he could not accept some of these reasons, though agreeing, with Sir R. I. Murchison, Admiral Smyth, and Mr. Bell, that the matter called for the earnest attention of the members of the Club and the societies.

At the Anniversary Meeting on April 18th, the vacancies caused by the retirement of Mr. Ansted, Mr. Graves, and Sir J. Herschel were filled by the election of Dr. Daubeny, Dr. Frankland, and Dr. Lindley.

Dr. Charles Giles Bridle Daubeny was born at Stratton, Gloucestershire, on Feb. 11th, 1795, and went from Winchester School to Magdalen College, Oxford, where he obtained a fellowship which he held for the rest of his life. Devoting himself to chemistry and geology, he passed some three years under Professor Jameson at Edinburgh, and then travelled in Auvergne and other volcanic districts of Europe, the result of which was his valuable book, *Description of Active and Extinct Volcanoes*, the first edition of which appeared in 1826 and the second (enlarged) in 1848. He was elected Professor of Chemistry at Oxford in 1822, to which, twelve years later, was added the Chair of Botany, and in the interval he took the degree of M.D. and practised as a physician, so his work covered a wide field and yet was good, for he wrote valuable papers on the chemical side of geology and on vegetable physiology. After his death on Dec. 13th, 1867, Professor J. Phillips remarked, "His earnest spirit gained him great influence in the Oxford of his time. No project of change ever found him indifferent, prejudiced, or unprepared." He was elected into the Royal Society in 1822.

PROFESSOR SIR EDWARD FRANKLAND was born at Churchtown, near Lancaster, on Jan. 18th, 1825. From its noted Grammar School he went to study at the Museum of Practical Geology in London, under Professor Lyon Playfair. After teaching chemistry at Queenswood College, Hants., he worked in 1847 under Bunsen at Marburg, and, after graduating as Ph.D., proceeded to Giessen to be under Liebig. In 1850 he returned to England as Professor of Chemistry at Putney College, going on next year to Owens College, Manchester, where he continued his important researches in theoretical and applied chemistry, so that, after being elected F.R.S. in 1853, he obtained a Royal Medal in 1857. In the summer of 1859, when the Thames water at London became "horribly offensive,"[1] he was called upon by the Board of Works to join Professor Hofmann, whom he afterwards succeeded at the Royal College, in reporting on the deodorization of the sewage. In August 1859 he spent a night with Professor Tyndall on the summit of Mont Blanc, where he made interesting experiments. In 1865 he became analyst of the Metropolitan drinking water, after serving on the second Commission about the Pollution of Rivers, and contributed largely to scientific literature. He gave up his Professorship in 1885, going to reside at his house at Reigate. He received many honours, and was ultimately created K.C.B. in 1897. On Aug. 9th, 1899, he died after a short illness at Golaa in Gudbrandsdalen, to which country he had gone as usual for salmon fishing.[2]

DR. JOHN LINDLEY, the son of a nurseryman, was born near Norwich on Feb. 5th, 1799, and early showed a love for botany and antiquities. From Norwich Grammar School he went to Belgium as agent for a seed merchant, and began to write on

[1] The writer had full experience of this, for he was then a Master at Westminster School and lodged at the lower end of Great College Street. One night the stench was so bad that he was driven to mask it by screwing up a lot of tobacco in a newspaper and thus fumigating his sitting room. The water was a dark brown tint, seemingly full of a minutely granular curd.

[2] His body was brought back to Reigate, where the writer, who had often experienced his kindness, read the funeral service.

botanical subjects, then came to London as assistant librarian to Sir Joseph Banks, was befriended by W. J. Hooker, was elected F.R.S. in 1828, and in 1857 was awarded a Royal Medal. He did good service to the Horticultural Society's Garden at Chiswick, of which he was superintendent, and was Professor of Botany in University College, London, from 1829 to 1860. The Government frequently consulted him on questions of food cultivation, and especially on the noted potato famine in Ireland. He wrote many botanical papers and books, and died after a long illness on Nov. 1st, 1865.

A project, which engaged the attention of the Club for some little time, was started by a memorandum from Mr. Gassiot, read at the meeting on March 24th. This suggested the establishment of a fund for assisting scientific men or their families when in need of money. The Minutes contain a copy of this memorandum, which, after stating fully the purpose of the fund, recommends entrusting the administration of it to the President and Council of the Royal Society, and investing the capital of the fund in Government securities in their names, the receipts and disbursements appearing in the annual financial statement of the Society. No application for assistance is to be entertained unless it be made by the President of the Astronomical, the Chemical, the Geological, the Linnean, or the Royal Societies. If granted, the accommodation must be entered on the Minutes of the Council, which are open to the inspection of Fellows, thus preventing misappropriation, and the expenses necessarily incurred by ordinary charitable societies. It was agreed that the Treasurers should send a circular letter to each member of the Club asking for his opinion on this subject.

At the next meeting (April 18th), when sixteen members were present, letters were read from eight others. The general opinion seemed in favour of establishing a fund, to be supplementary to, not a substitute for, the pensions awarded by Government to men of science, and some of the Fellows promised contributions. A Committee, including Mr. Gassiot, was appointed to draw up a report. This was presented on May 26th as a draft scheme, and is entered in the Minutes. It suggests the name Scientific Relief

Fund, and puts the above recommendations in more formal terms, empowering the Council of the Royal Society to appoint committees or make the necessary arrangements for managing the matter.

At the meeting on November 24th, Dr. A. Farre and Professor A. C. Ramsay were elected in the places of Professor J. Phillips and Admiral Smyth, who had resigned. A modification of the rule about the admission of visitors (No. II.) was suggested by Mr. Horner. It was discussed at the December meeting, but a resolution, brought forward on January 26th, 1860, was withdrawn by him, as it did not appear to be favourably regarded by a majority of those present.

DR. ARTHUR FARRE, son of a noted London physician, was born on March 6th, 1811. From Charterhouse he went to Cambridge, where he took the degree of M.D. in 1841, becoming F.R.C.P. two years later, and holding important positions in medical education. He had a great reputation in obstetrical cases, and wrote valuable papers on that and microscopical subjects, dying on December 17th, 1887. He was elected into the Royal Society in 1839.

SIR ANDREW CROMBIE RAMSAY, son of a Glasgow manufacturing chemist, was born in that city on Jan. 31st, 1814. Having attracted notice by a model of the Isle of Arran, exhibited at the meeting of the British Association in 1840, he was placed on the Geological Survey by Sir R. I. Murchison, and was employed mainly in Wales, but held the Professorship of Geology at University College, London, from 1847 to 1852, when he became lecturer at the School of Mines. On the Survey he succeeded Murchison in 1871 as Director-General, and was knighted on retiring in 1881. A man of great activity, mental and bodily, he overtaxed his strength, and died at Beaumaris after a slow failure on Dec. 9th, 1891. He was elected F.R.S. in 1862, President of the Geological Society in the same year, and of the British Association in 1880, receiving a Royal Medal from the first and a Wollaston Medal from the second. His contributions to physical geology were numerous; the most noteworthy being those on certain river courses, on the denudation of South Wales, and on the glacial origin of lake basins in the Alps and the Black Forest.

1860. At the Anniversary Meeting on April 23, Dr. Carpenter succeeded Dr. W. A. Miller as Treasurer, but there was no vacancy in the Club.

On June 21st, Sir R. Murchison read a letter from M. de Verneuil deprecating the division of the British Museum, and pointing out that much space might be gained by so re-arranging the Natural History collection as to restrict the portion displayed to the public, but to make it more available for their instruction. Professor Huxley remarked that, in giving evidence to a Parliamentary Committee, he had expressed similar views, and that subsequent careful measurements had confirmed his statements, which at the time were founded on general impressions.

At the meeting on Nov. 22nd, Mr. Lubbock, Mr. Prestwich, and Professor Williamson were elected into the vacancies made by the death of Prof. Baden Powell, and the resignations of Mr. G. Rennie and Mr. E. Solly.

Lord Avebury, better known as Sir John Lubbock, was born at High Down, Kent, in November, 1834, and left Eton at a rather early age to enter the bank in which his father was a leading member, succeeding him as fourth baronet in 1865. He was a leader among men of business, wide in his culture, remarkable for his varied activities, combining a grasp of principles with an unflagging care for details. His books on *Prehistoric Times* and *Primitive Culture* were very valuable, together with his contributions to certain branches of entomology, and his *Scenery of England* and *Scenery of Switzerland* must not be forgotten. His more popular little books, the *Pleasures of Life*, the *Use of Life*, the *Beauties of Nature*, were highly successful. He sat in Parliament from 1870 to 1900, for the last ten years as representative of the University of London. There he concentrated his energies on social and educational questions, *Bank Holidays* being his popular memorial. He had probably presided over more societies than any other man, received not a few honorary degrees and other distinctions, and in 1900 was created Baron Avebury (taking his title from the noted Wiltshire circle of megaliths). Regretted by all who knew him, he died on May 28th, 1913.

Sir Joseph Prestwich, son of a wine merchant, but of an old Lancashire family, was born at Clapham near London on March 12th, 1812. At the age of eighteen, after two years in Paris to learn French, he entered his father's office, but devoted all his spare time to science, especially geology, soon making his mark by two excellent papers on the Carboniferous Rocks of Coalbrook Dale, and then devoting himself to working out the Tertiary and Post-Tertiary deposits of southern and eastern England. He was also among the first to investigate the evidence for early prehistoric man, and paid much attention to the question of water-supply. In 1872 he retired from business to live near Shoreham, where, six years before, he had built an attractive house, but was appointed Professor of Geology at Oxford in June, 1874, and held that office till 1888. He contributed largely to the literature of geology, dealing chiefly with stratigraphy and certain physical questions, among which was advocating the effect of great floods. He was President and Wollaston medallist of the Geological Society, was elected F.R.S. in 1853, received a Royal Medal in 1865, and an Hon. D.C.L. from Oxford, was gazetted knight in January, 1896, and died on June 23rd of that year.

Professor Alexander William Williamson was born at Wandsworth on May 1st, 1824. After his father, who was a clerk in the India House, retired, the family spent some time abroad, and the boy was at school in Dijon and Paris. In 1881 he went to Heidelberg to study medicine, but was attracted to chemistry, and in 1884 went on to Giessen to work under Liebig. Here he began to make his mark by important discoveries in regard to bleaching salts. Then came experiments on ozone and very valuable researches into the composition of Prussian Blue. After work in Paris from 1846 to 1849, he returned to London, and was appointed in the latter year Professor, first of Practical, then of General Chemistry at University College. After the publication of his remarkable papers on etherification (1850-2), his contributions to Chemical Science diminished in quantity, for his time was so fully occupied by the direct and indirect duties of his office, but as a teacher he was eminently stimulative and suggestive, implanting ideas which his students developed. He became F.R.S. in 1855, received a Royal Medal in 1862, was President of the British Association at Bradford in 1873, retired from work in 1887, and died at High Pitfold, Haslemere, May 6th, 1904.

1861. On May 30th, the Club received notice that the 'Thatched House' would cease to be carried on as a tavern, and at the next meeting (June 20th) it decided to dine at the St. James' Hall, if the Treasurer could make satisfactory arrangements.

On Nov. 28th, the vacancy caused by the resignation of Prof. Bell was filled by the election of Mr. W. Spottiswoode.

Dr. William Spottiswoode, whose father was head of the firm of Eyre & Spottiswoode, Queen's Printers, was born in London, Jan. 11th, 1825. After Eton and Harrow, he went to Oxford and took a first class in Mathematics from Balliol College in 1845, obtaining two University scholarships in that subject. In 1846 he succeeded his father as Queen's printer, without, however, abandoning his mathematical studies. In 1856 he made a rather long journey in Eastern Russia, of which he published an account in the following year, and in 1860 visited Croatia and Hungary. His first treatise on Mathematics, *Meditationes Analyticæ*, appeared in 1847, but he wrote many papers on contacts of curves and surfaces and the higher branches of analytical geometry, also publishing in 1851 the first elementary treatise in determinants. Twenty years after that he undertook experimental research in physics, at first on the polarization of light, then on electrical discharges in rarified gases, besides which he had an unusual knowledge of languages, European and Oriental. He received honorary degrees from Oxford and Cambridge, Edinburgh and Dublin, was elected F.R.S. in 1853, and became President in 1878, but died of a fever on June 27th, 1883, leaving the reputation not only of a brilliant mathematician and physicist, but also of a highly accomplished and singularly attractive man.

1862. At the Anniversary Meeting on April 28th, no election was made for want of a quorum, which was not obtained till June 19th, when Mr. Sclater and Colonel Yorke were elected into the vacancies caused by the resignations of Sir Proby Cautley and Sir J. Herschel.

Dr. Philip Lutley Sclater, a member of a Hampshire county family, was born in November, 1829. From Winchester he went to Corpus College, Oxford, where he obtained a First Class in mathematics and a Fellowship, but already had begun to collect birds. He was called to the Bar, and for some years went on the Northern circuit, but after making a rather long journey in North America in 1857 and visiting Tunis in 1859, he became in that year Secretary to the Zoological Society, which soon felt the stimulus of his energy. When he resigned in 1902, the number of its Fellows had risen from about 1300 to 3000, new offices had been erected in Hanover Square, and the animals mostly housed in new buildings. He became F.R.S. in 1865, a Ph.D. of Bonn, and an Hon. D.Sc. of his own University, dying on June 27th, 1913, after writing many valuable papers on birds and mammals. His fine collection, containing over 3000 species of certain orders of American birds, is now in the British Museum.

Lt.-Col. Philip James Yorke, distinguished as a chemist, was son of a Prebend of Ely and a descendant of the first Lord Hardwicke, born Oct. 13th, 1799. From Harrow School he obtained, about 1816, a commission in the Scotch Fusilier Guards, retiring about 1852 with the rank of Lieutenant-Colonel. He was President of the Chemical Society, 1853-5, and elected F.R.S. in 1849. His most important researches were on the solution of metallic lead by the action of water, and he made a laborious comparison of the readings of a barometer at his house at Ross (Monmouth) and of the one at the Royal Society. He died Dec. 14th, 1874.

On Nov. 27th, the vacancy caused by the death of Sir B. Brodie was filled by the election of Dr. Thomas Thomson.

He was born in Glasgow, where his father was a Professor of the University, on Dec. 4th, 1817, and when only seventeen discovered and described the fossil mollusca in the Clyde beds. Next he did good work in chemistry, and then became engrossed in botany. After taking the degree of M.D., he went to India as assistant-surgeon in the Company's service. Here he was sent to Ghuznee, and when it fell was taken prisoner, but bribed his captor to convey him with others to the British army of relief. He was thus enabled to study the botany of the Sutlej region, after which his duties as a boundary commissioner between Kashmir and Tibet gave him the opportunity of botanical work up to the crest of the Karakorams. He spent 1850 in travelling with Sir J. D. Hooker in the Sikkim forests, the Khasi Hills, and the neighbouring districts. Illness sent him to England in 1851, but he returned in 1854, being made F.R.S. next year, to be superintendent of the Botanic Gardens at Calcutta. In 1861 bad health obliged him to resign. He spent the rest of his life at Kew and at Maidstone, dying April 18th, 1878.

1863. At the Anniversary Meeting, April 27th, Mr. Busk was elected Treasurer, and a new rule was proposed, according to which a member of the Club ceased to belong to it, if wholly absent from one anniversary to the next, though capable of being restored, after the usual formalities, at the next anniversary. The proposed rule, of which notice had previously been given, was discussed, but not put to the vote.

1864. At the Anniversary Meeting, April 25th, the vacancies caused by the resignations of Mr. Darwin, Dr. Daubeny, and Dr. Lindley, and the deaths of Mr. L. Horner and Col. Portlock, were filled by the election of Sir B. C. Brodie, Sir G. Everest, Prof. J. C. Maxwell, Mr. Archibald Smith, and Mr. J. J. Sylvester.

Sir Benjamin Collins Brodie, the younger, was born in London in 1817, and went from Harrow to Balliol College, Oxford, where he devoted himself to Natural Science, especially chemistry. His papers on some of its more abstruse questions indicate well-devised experiments and close reasoning. His studies of the allotropic forms of carbon led him to ascertain the atomic weight of graphite, and to regard it as an independent mineral, while suggesting at the same time a process for purifying it of economic value. He was elected F.R.S. in 1849 and Professor of Chemistry at Oxford in 1865, was made an Hon. D.C.L. in 1872, and died in 1880.

Sir George Everest, whose name is inseparable from the survey of India, was born July 4th, 1790, at Gwernvale, Brecknock. After passing through Woolwich he obtained a commission in the Bengal Artillery in 1806, and was selected, after seven years' service in India, to make a survey of Java. This occupied him for two years, and he was employed after his return on engineering work until he was appointed chief assistant to the great trigonometrical survey of India. The state of his health made necessary a visit to England in 1825, and while there he was elected F.R.S. (in 1827). After returning to India he measured an arc of the meridian 21° long. In December, 1843, he retired with the rank of Lieutenant-Colonel, to publish, four years afterwards, his great work—an account of that measurement. In 1861 he was made C.B. and knighted shortly afterwards. He died in London on Dec. 1st, 1866.

Professor James Clerk Maxwell was the son of a Scotch laird, born in Edinburgh on November 13th, 1831. He showed early signs of exceptional power in mathematics, and went from its University to Cambridge, where he graduated from Trinity College as second wrangler and bracketed for the Smith Prize in 1854. He was made F.R.S. in 1861, and received the Rumford Medal in 1860. After holding Professorships at Aberdeen and in King's College, London, he devoted himself from 1865 to 1871 to mathematical and physical work till in the latter year he was elected to the newly founded Chair of Experimental Physics at Cambridge. Here he laboured, lecturing, organizing the laboratory built by the Duke of Devonshire, and adding to his scientific writings on such subjects as the theory of compound colours (that all these are made by a due mixture of three primary colours), the stability of motion in Saturn's rings, the kinetic theory of gases, Faraday's lines of force, and the nature of electricity and magnetism. His health failed rather rapidly in the summer of 1879, and he died in Cambridge on November 5th, regretted as a brilliant and sympathetic teacher, a delightful companion, blending grave with gay, and a man with wide interests and a deep sense of religion.

Archibald Smith, successful at the Bar and as a mathematician, was son of a Glasgow merchant born at Greenhead, near that city, on Aug. 10th, 1813. From its University he went to Trinity College, Cambridge, where he was senior wrangler and first Smith's prizeman in 1836. After election to a Fellowship at his College, he went to the Bar, and obtained an excellent practice in questions connected with real property; but did some very important scientific work on wave surfaces and the effect of iron in a ship on its compasses. Elected F.R.S. in 1856, he was awarded a Royal Medal in 1865, and received, in the previous year, an honorary LL.D. from Glasgow. He died in London on Dec. 26th, 1872.

1865. At the Anniversary Meeting, April 24th, the vacancies caused by the death of Dr. H. Falconer and the resignation of Mr. W. Hopkins remained unfilled for want of a quorum, but on May 18th, Mr. Hirst and Colonel R. Strachey were elected.

Professor Thomas Archer Hirst, son of a woolstapler at Heckmondwike, Yorkshire, was born on April 22nd, 1830. Educated as a surveyor, he went with J. Tyndall to Marburg University, where he remained three years and took the Ph.D. degree, passing on to Göttingen and Berlin. After work as a teacher of mathematics in England, he was appointed in 1865 Professor at University College, London, becoming ultimately Director of Naval Studies at Greenwich. Weak health obliged him to resign this post in 1883, but he lived till 1892, dying on Feb. 16th in London. He made many important contributions to abstract geometry, was elected F.R.S. in 1861, and received a Royal Medal in 1883.

General Sir Richard Strachey was a member of a good Somerset family, born at Sutton Court on July 24th, 1817. From Addiscombe he obtained a commission in the Bombay Engineers, and was transferred to work under Sir P. T. Cautley on the Ganges Canal. This was interrupted by the Sikh war, and he was present at the battles of Aliwal and Sobraon in 1846. After returning to canal work, he was obliged to take a long holiday in the Kumaon Himalayas, where he explored the ranges west of Nepal and Tibet, striking the upper waters of the Sutlej some 14,000 feet above sea-level, and made large botanical and geological collections. In working out these he was occupied in England from 1850 to 1855, when he went back to India, rendering valuable services during the Mutiny. He retired with the rank of Lieutenant-General in 1876, but was sent back from 1877 to 1879 for organization of the railways and investigation of the causes of famine. Elected F.R.S. in 1854, he received a Royal Medal in 1897, became C.S.I. in 1866 and G.C.S.I. in 1897. After many valuable services to science and to his country, he died at Hampstead on February 12th, 1908.

On Nov. 23rd, the vacancy caused by Prof. Hofmann's return to Germany was filled by the election of Dr. Rolleston.

Dr. George Rolleston was born on July 30th, 1829, at Maltby Hall, near Rotherham, went to Pembroke College, Oxford, and won a first class in classics. On obtaining a Fellowship he turned to medicine, taking the degree of M.D. in 1857. In that year he was elected Physician to the Radcliffe Infirmary, Oxford, and Lee's Reader in Anatomy, obtaining in 1860 the Professorship of Anatomy and Physiology. He made a special study of the brain, about which he took Huxley's side in the controversy with Owen, and examined barrows, publishing a book on that subject in 1877. Active in local questions, especially sanitation, his strenuous life told upon his health, and after spending a winter on the Riviera, he died at Oxford on June 16th, 1881, having earned the reputation of a man "deeply learned in his special branch of study and well informed on all subjects."

1866. Dr. Thomas Thomson was appointed Treasurer at the Anniversary Meeting on April 30th, but there was no vacancy in the Club.

On Nov. 29th, the vacancies made by the resignation of Professor Faraday and the return of Colonel Strachey to India were filled by the election of Professor Flower and Mr. Simon.

Sir William Henry Flower was born at Stratford-on-Avon, and studied at University College, London, taking the degree of M.B. in that University in 1851. He accompanied the British army to the Crimea, but on his return became Demonstrator of Anatomy at the Middlesex Hospital till 1861, when he was made Curator of the Museum of the College of Surgeons, which he augmented by many new specimens and illustrated by his memoirs. He became Hunterian Professor in 1870, was elected a Fellow of the Royal Society in 1864, and received a Royal Medal in 1882. Two years afterwards he succeeded Sir R. Owen as Director of the Natural History Museum at South Kensington, which also developed and prospered under his rule. He was an Hon. LL.D. of Dublin and Edinburgh and a D.C.L. of Durham, President of the British Association in 1889, and received a Prussian order. He was created C.B. in 1887 and K.C.B. in 1892. In 1898 failing health compelled him to retire, and he died on July 1st, 1899. He made the Museum serviceable to students, yet interesting to the general public, working especially on whales, marsupials, and monotremes, and making valuable contributions to anthropology. His numerous scientific writings are distinguished by caution and reticence in generalization.

Sir John Simon was of French ancestry, born in London, Oct. 10th, 1816, studied medicine at its hospitals and was appointed Professor of Surgery at King's College, where he was noted as a leader and teacher in pathology, and was appointed medical officer for the City of London. A man of wide culture, he fought the battle of sanitation in many important reports, till, in 1876, official opponents brought about his retirement, with a C.B. and a special pension. He was elected F.R.S. in 1845, received the Buchanan Medal in 1897, and honorary degrees from Oxford, Cambridge and Dublin, was promoted to K.C.B. in 1887, and died after a period of failing health at his house in Kensington on July 23rd, 1904.

1867. At the Anniversary Meeting, Mr. J. B. Buckton was elected into the vacancy made by the death of Sir G. Everest.

He was born at Hornsey, near London, on May 24th, 1818, the son of a law-proctor, and was crippled in childhood by an accident. After studying chemistry under Professor Hofmann, he made some important researches on platinum compounds, and was elected F.R.S. in 1857, but when he removed to Haslemere on his marriage in 1865, he devoted himself to entomology, especially the life history of aphides and other minute insects, besides working at astronomy in an observatory which he had erected, where also he had a fall, breaking his leg in two places. He died on Sept. 25th, 1905.

On Nov. 28th, the vacancies caused by the deaths of the Earl of Rosse and Lord Wrottesley were filled by the election of Sir W. G. Armstrong and Mr. J. Evans.

Sir William George Armstrong (afterwards Baron Armstrong), the son of a corn-merchant of Newcastle-on-Tyne, was born there on Nov. 26th, 1810. He early showed great interest in mechanism, to which he was drawn away though trained as a solicitor. His invention of a hydroelectric machine, followed by an hydraulic crane, brought him into notice. He was elected F.R.S. in 1846, and next year began the Elswick works. The Crimean War turned his attention to artillery, and he invented the breech-loading Armstrong gun. When, at last, this received official approval, he presented his patents to the nation, for which he was created knight and C.B. In 1863 the British artillery was the finest in existence, but officials preferred muzzle-loaders to breech-loaders, and by the end of fifteen years the contrary had become true, for other nations had gone on buying from Elswick. A shipbuilding company was also started there, and in 1897 came the combination with the Whitworths. Armstrong, created a baron in January, 1887, was a most liberal benefactor to Newcastle and to science in general, and died at Craighead, his country seat, on Dec. 27th, 1900.

Sir John Evans, son of the Rev. Dr. Evans, was born at Britwell Court, Burnham, on Nov. 17th, 1823, and in his eighteenth year entered the paper-making business at Nash Mills, Hemel Hempstead, where he became a partner in 1850. Few men have combined so much practical ability with such wide interests in science and archaeology.

He was successful in business, took a leading position in county affairs and in scientific societies, was a collector of and authority on coins, especially Roman gold and British, tracing the development of the latter from the stater of Philip, joined Prestwich in investigating the palaeolithic implements of the Somme valley, and formed collections on which were founded first his classic work, *Ancient Stone Implements*, and then that on *Ancient Bronze Implements*; in fact he was a most expert and judicious collector, not only in the above-named lines. As a geologist he did some valuable work on water-supply. Elected F.R.S. in 1864, he was Treasurer from 1878 to 1889, was President of the British Association in 1897, was a D.C.L. of Oxford, LL.D. of Dublin and Toronto, and Sc.D. of Cambridge. In 1892 he was created K.C.B., and continued vigorous in mind till his death at Britwell, where he had built a house, on May 31st, 1908, regretted as a man quite exceptional for his kindly spirit, ready wit, and extensive knowledge.

At the meetings in 1868 and the Anniversary one in the following year, there were no vacancies, but at the last Dr. P. L. Sclater succeeded Dr. T. Thomson as Treasurer.

1869. On Nov. 25th, Professor Odling was elected to fill the vacancy made by the death of Mr. Graham.

PROFESSOR WILLIAM ODLING, Waynflete Professor of Chemistry in the University of Oxford from 1872 to 1912, was born in London in 1829, and now rests from his hard labours on behalf of science at his home in that city, where he is a Fellow of Worcester College.

1870. The vacancy caused by the resignation of Professor J. C. Adams could not be filled at the anniversary on April 25th for want of a quorum, but on May 26th Mr. Huggins was elected.

SIR W. HUGGINS, son of a London silk-mercer, was born at Stoke Newington on Feb. 7th, 1824, and, after a few years in business, built an observatory at Tulse Hill, studying at first more especially the belts of Jupiter and the rings of Saturn. In 1862 he was attracted to spectrum analysis, at which he worked with Dr. W. A. Miller,[1] and discovered that some nebulae, at any rate, were luminous gas. Elected F.R.S. in 1865, he was awarded next year a Royal Medal, afterwards receiving the Rumford and the Copley Medals. Continuing his work on nebulae, he showed his earlier inference to be justified, and extended his investigations to comets. He also aided in making it possible to study the prominences of the solar photosphere under ordinary circumstances, and applied photography to recording

[1] See page 16.

spectra. He received honorary degrees from Oxford, Cambridge, Edinburgh, St. Andrews, and Dublin, with many foreign distinctions, was President of the British Association in 1891 and of the Royal Society from 1900 to 1906. Created K.C.B. in 1897, he received the O.M. in 1902. His death occurred in London on May 12th, 1910.

In a conversation on June 30th which Dr. Miller started by an enquiry about the results of the Government Commission on Scientific Aids, Mr. Grove expressed a strong objection to Government support for anything in the shape of Academies, quoting as an example the French Academy, which tended to foster antiquated notions and to repress the free expression of opinions. Sir John Lubbock called attention to inconveniences in communicating with the Government, which arose from too frequent changes in the Council of the Royal Society. Professor Huxley said that he always objected to the Royal Society giving advice to the Government, and thought it would be better for the latter to request the Royal Society, when its advice was needed, to name committees of experts to consider the question. He also expressed the opinion that the tenure of the Presidency in the Royal Society should be shorter than at present, to which Mr. Grove replied that the Council in 1849 had passed a minute recommending a period of four years. Sir John Lubbock advised the formation of a permanent Board to watch over educational movements or questions, and Dr. Carpenter thought that Mr. Foster's Act contemplated some such Board or Council. With regard to its composition, Sir J. Lubbock suggested the inclusion of members representing the Royal Society and the British Association, and Dr. Williamson thought that each University might appoint a member, but that, in regard to research, the Government Grant Committee was sufficient.

On Nov. 24th, Mr. Gassiot called the attention of the Club to a paragraph in the Minutes of June 30th (which he had not done when it was read on Oct. 27th[1] because a stranger was present) about limiting the tenure of the Presidency of the Royal Society. He considered the course

[1] The day of the month has been omitted from the Minutes.

taken by Messrs. Grove and Huxley to be disrespectful to the present President of the Royal Society, and regretted that the paragraph recording it should have been placed on the Minutes. He also referred to a member of the Club having made a similar statement at a Council Meeting of the Royal Society. Professor Williamson said he had done the latter, but on his own responsibility and without making any reference to what had passed at the Philosophical Club. Mr. Grove said that he had not expressed any opinion on the matter, but had merely mentioned that the Council of the Royal Society had once passed a minute in favour of a limitation of tenure. He had, however, no hesitation in expressing his concurrence with Prof. Huxley, and vindicated the course which had been followed, by showing that it was " one of the primary objects of the Philosophical Club to discuss these and similar questions." The Treasurer, in accordance with a request from Professor Huxley (who was unavoidably absent), read a letter which the latter had addressed to Mr. Gassiot, in reply to one announcing the intention of bringing forward the subject. In this letter Professor Huxley stated that, had he been present, he should have been disposed to question Mr. Gassiot's right to open any discussion on minutes already confirmed, but he was nevertheless quite ready that any opinion of his recorded on the minutes should be discussed in his absence, so he requested the Treasurer to make an extract from them of the passage referred to and bring it before the Club as new matter.

The vacancy caused by the death of Dr. W. A. Miller was filled by the election of Mr. C. W. Siemens.

Sir Carl William Siemens was born at Lenthe, Hanover, in 1823, the second of four brothers who were closely associated in practical scientific work. After passing through the University of Göttingen he came to England in 1823, when at first he made but slow progress in business. This improved with his invention of a water-meter and a ' regenerative furnace ' especially applicable to melting steel. Naturalized in 1859, he was elected F.R.S. in 1862. He then turned his attention to electricity, and especially to submarine cables. He laid that from Dover to Calais in 1851, and was concerned with the direct Atlantic cable of 1874, besides the long-distance land cable from Prussia to Teheran. Also he was a strong supporter of the transmission of power by electricity. He also made experiments on electric lighting, and its effect on the growth of plants, with other things too numerous to mention. He received honorary degrees from Oxford, Dublin, and Glasgow; sundry foreign orders; was President of the British Association, 1882, and was knighted in 1883, dying on Nov. 18th of that year, "a born inventor, a shrewd man of business, who made a large fortune and was a generous giver."

1871. On Nov. 23rd, the vacancy caused by the death of Sir R. I. Murchison was filled by replacing General Strachey on the list, who had now returned from India.

1872. At the Anniversary Meeting on April 22nd, Professor Flower was elected Treasurer in the place of Dr. Sclater.

On Dec. 19th (since there was no quorum at the meeting on Nov. 21st), the vacancy made by the death of Colonel Sykes was filled by the election of Professor Allman.

Professor George James Allman was born in Cork in 1812, and graduated as B.A. in 1839 and as M.D. in 1847 at Trinity College, Dublin, studying at first for the Bar, but ultimately leaving it and medical practice for Natural Science, when he devoted himself to marine zoology, more especially the hydrozoa and polyzoa. Elected Professor of Botany in 1844 at Dublin, he obtained the Professorship of Natural History at Edinburgh in 1854, and became F.R.S. in the same year. He described the collections of medusae and other hydrozoa made on the *Challenger* expedition, and continued working energetically at science after retiring from the Professorship in 1870. He was President of the British Association, 1879, and after settling at Parkstone, Dorset, died there on November 24th, 1898.

1873. On March 27th, General Strachey asked the Club to consider the following suggested changes in the rules for the election of Fellows into the Royal Society: (1) that Persons of Royal birth, Peers, and Privy Councillors should be elected under the same rules as ordinary Fellows; (2) that the election should be held on a single day—that for the election of ordinary Fellows; (3) that, like these, they should be proposed by the Council, instead of by any Fellow, as at present; (4) that in future their qualification shall be "ascertained special power and disposition to forward the aims of the Society, derived from exceptional personal or official advantages of position"; (5) that the number annually elected should be limited to that determined by the average of the last eight or ten years—say, not more than three. The effect of these changes would be to bring the election of the above-named personages more nearly under the rules governing the election of ordinary Fellows and remove all appearance of privilege.

At the Anniversary Meeting on April 28th, Sir W. Grove referred to General Strachey's suggestions, and said that the subject of election to the Fellowship of the Royal Society had been very fully discussed prior to the changes made some years ago, when it had been decided not to make any alteration in the rules governing the election of privileged persons.

The vacancies, caused by the deaths of Dr. Bence Jones, Mr. Partridge, and Mr. Archibald Smith, were filled by the elections of Mr. Francis Galton, Dr. Günther, and Professor Henry Smith.

Sir Francis Galton, son of a banker, who had married a daughter of Dr. Erasmus Darwin, the grandfather of Charles Darwin, was born in Birmingham on Feb. 16th, 1822, and went to Trinity College, Cambridge. Here weak health prevented severe study, but he was preparing to enter the medical profession when the death of his father in 1844 enabled him to devote himself to scientific pursuits. After travelling in Syria and to Khartum on the Nile, then a more difficult journey than it has since become, he landed at Walfish Bay in 1850, and explored parts of Damara Land, hitherto unknown, encountering serious hardships and dangers. These permanently affected his health, but they produced two books, *Tropical South Africa* (in 1853) and *The Art of Travel* (in 1855), each of them deservedly popular. In meteorology he did valuable work on anticyclones, and before 1865 began his studies on the laws of heredity, in which he showed that quantitative as well as qualitative measures are applicable to many personal attributes, a by-product of which was his discovery of the permanence of finger-prints, which has become of the highest value for the identification of individuals. He was a strong advocate of eugenics, and wrote many important contributions to this and other branches of science, not the least interesting being the *Memories of My Life*. Elected F.R.S. in 1856, he received a Royal Medal in 1876, the Darwin in 1902, and the Copley in 1910. Oxford made him an Hon. D.C.L. in 1894 and Cambridge an Hon. Sc.D. in the following year. In 1909 he was created a knight. A hard worker, but a good talker and most pleasant companion, his mind remained clear to the end, though bodily infirmities, especially deafness, increased, till he died at Haslemere on Jan. 17th, 1911.[1]

Dr. Albert Charles Lewis Gotthilf Günther was born on Oct. 3rd, 1830, at Möhringen in Würtemberg and educated at Tübingen and Bonn, afterwards qualifying as a physician in London and taking the degree of M.D. at Tübingen in 1862. He devoted himself to the study of zoology, especially fishes, and was engaged at the British Museum from 1855, becoming Keeper of Zoology twenty years later, from which post he retired in 1895. While thus engaged he prepared ten volumes of the *Catalogue of Colubrine Snakes, Batrachia, and Fishes*, and contributed important memoirs on the last to the series of *Challenger Reports*. He became F.R.S. in 1867, and received a Royal Medal in 1878, with other well-earned honours, dying at Kew on Feb. 1st, 1914.

Professor Henry John Stephen Smith was the son of an Irish barrister, born in Dublin on November 2nd, 1826, but brought up in England. He won a scholarship at Balliol, Oxford, in 1844, but spent the greater part of the next two years in study on the Continent, returning to Oxford for the Easter Term of 1847 to win the Ireland Scholarship, a double first, and a Balliol Fellowship, which was afterwards exchanged for one at Corpus. First rate as a classic, he took an even higher place as a mathematician, and was elected in 1860 to the Savilian Professorship of Geometry and in 1861 a Fellow of the Royal Society. Active also in University business, he was appointed Keeper of the Museum, but in 1881 his health began to fail—the sword was wearing through the scabbard—and he died on Feb. 9th, 1883. Huxley describes him as " One of the ablest men I ever met," which I venture to repeat with the addition, " and one of the most attractive." As a mathematician Gauss had hardly any abler disciple, and his contributions to the Theory of Numbers were specially valuable.

1874. At the Anniversary Meeting on April 27th, General Strachey became Treasurer in place of Professor Flower, and Dr. Debus was elected to fill the vacancy caused by the resignation of General Sir E. Sabine.

Of Dr. Heinrich Debus, who lived and died in 1916 at Cassel, Germany, after his career in England, ending as Professor of Chemistry at the Royal Naval College, Greenwich, it may suffice

[1] The Minute books of the Philosophical Club show signs, in the correction of errors in dates and numbers, of his careful revision while he held the office of Treasurer. A subject index at the end of the first volume (which has been very helpful to myself) was made by him.

to say that he was born in Hesse on July 13th, 1824, educated at Marburg University, was appointed lecturer on chemistry at Queenswood College, Hants., in 1851, and elected F.R.S. in 1861.

1875. On Jan. 28th, in a conversation about the number of Fellows annually elected into the Royal Society, which was begun by Mr. Gassiot expressing his opinion in favour of the existing limitation, Sir W. Grove thought that, as the question was now being considered by a Committee of the Society, it would be inconvenient, until the facts were better known, to pledge the Club to any conclusion, and other members said that the present system had worked well.

At the Anniversary Meeting on April 27th, notice was given that an alteration would be proposed in Rule 4 to change the hour of dinner to 6.30 p.m. on ordinary meetings and 7.0 on anniversaries.

Mr. John Ball and Lord Rosse were elected into the vacancies made by the deaths of Sir C. Lyell and Col. Yorke.

John Ball, the well-known Alpine traveller and botanist, was the son of an Irish judge, born in Dublin on August 20th, 1818, and educated at Oscott and Christ's College, Cambridge, where he was twenty-seventh wrangler. He early showed a love for natural science and the Alps, for at the age of seven the view of that chain from the Jura deeply affected him. After Cambridge he spent four years in Continental travel, not forgetting the Alps and their glaciers, and on his return was called to the Irish Bar. During the famine he served on the Poor-Law Commission, till he entered Parliament in 1852. The loss of his seat, after six years, set him free to study the Alps, and compile, between 1863 and 1868, the three volumes of his excellent *Alpine Guide*. But in 1871 he joined Sir J. D. Hooker in an expedition to the Great Atlas, and in 1882 visited South America, as described in his *Notes of a Naturalist*. Elected F.R.S. in 1868, he made many contributions to botany and geology, dying in London on Oct. 21, 1889.

The Earl of Rosse, who followed his father's steps in astrophysics, and was perhaps even more ingenious as a scientific mechanician, was born at Birr Castle on November 17th, 1840, and, after passing through Trinity College, Dublin, succeeded to the title in 1867, when he devoted much attention to the great nebula in Orion and the radiation of heat from the moon, but also took an important part in general business. He became Chancellor of Dublin University in 1885, was elected F.R.S. in 1867, received honorary degrees and other distinctions, and was created K.P. in 1890, but died, to the great regret of all who knew him, at Birr Castle on Aug. 30th, 1908.

On November 25th, the vacancy caused by the death of Sir C. Wheatstone was filled by the election of Professor Abel.

Sir Frederick Augustus Abel, so well known for his investigations of explosives, was the son of a music master of German descent, born at Woolwich on July 17th, 1827. One of Hofmann's original students, he became chemist to the War Department, and was for many years the chief official authority on explosives, for arms and ammunition were completely transformed during his time; his investigations on gun-cotton, smokeless powder, cordite, the dangers of minute dust in 'fiery' mines, and his researches with Sir Andrew Noble on the chemical changes on firing explosives being all highly valuable. He was elected F.R.S. in 1860, and received a Royal Medal in 1887, with other honours, was a D.C.L. of Oxford and LL.D. of Cambridge, President of the British Association in 1890, was given a C.B. in 1877, knighted in 1883, created K.C.B. in 1891, baronet in 1893, and G.C.V.O. in 1901. Besides being an excellent musician, he was the first secretary to the Imperial Institute, and died at Whitehall Court on Sept. 6th, 1902.

On December 16th, Mr. Ball asked for the opinion of the members present in regard to the expediency of concluding the anniversary dinner of the Royal Society by a soirée at its Rooms, as had been done after taking possession of the new apartments at Burlington House. Dr. Sclater mentioned the advantage of publishing in the daily papers reports of the weekly proceedings of the Royal Society and the President's annual address (as was done by the Geographical), and Mr. Siemens said the system adopted by some societies of printing the discussions on papers was advantageous, because these often contained matter not less interesting than the papers. Conversation ensued on the subjects, but no resolutions were adopted.

1876. At the Anniversary Meeting on April 24th, Mr. F. Galton was elected Treasurer, and a motion, of which notice had been given, for changing the hour of dinner from 6.0 to 6.30 on ordinary days was carried, but not that for fixing it at 7.0 on anniversaries.

A table of yearly attendances from 1866 to 1875 (anniversaries), prepared by the retiring Treasurer (General

Strachey), shows a maximum of 148 and a minimum of 110; the average being 14, the largest 26, and the smallest 7.

The meeting of the British Association at Glasgow led to discussions on October 26th and November 23rd about the subjects brought forward there, some members thinking that, in the Statistical section, the Anthropological sub-section, and the Evening Lectures, the range of these should be restricted. Mr. F. Galton was in favour of empowering the President, instead of the Sectional Committee, to determine what papers should be read, and Dr. Hooker thought that matters would be improved by the appointment of a paid secretary for each committee, but the discontinuance of the Statistical section was evidently viewed with favour, though on the other matters the members present were not at all unanimous.

1877. At the Anniversary Meeting, April 30th, two vacancies were announced, due to the resignation from ill-health of Sir H. James and the absence in America of Professor Sylvester, but the want of a quorum postponed the election till May 31st, when one place only was filled by the election of Professor Burdon-Sanderson.

Sir John Scott Burdon-Sanderson, son of R. Burdon, a former Fellow of Oriel, Oxford, who added the second name on marriage with the only daughter of Sir James Sanderson, was born at Jesmond, Newcastle-on-Tyne, Dec. 21st, 1828. From youth he showed a strong interest in Natural Science, studied medicine at Edinburgh University, and there took the degree of M.D. in 1851. Afterwards going to Paris, he worked at physiology under Claude Bernard, and in 1853 began to practise in London, where his ability in dealing with contagious and infectious diseases was soon recognized. Elected F.R.S. in 1867, he gave up practice three years later, in order to devote himself wholly to scientific research, and twelve months afterwards succeeded first M. Foster and then Sharpey in their chairs of Physiology at University College. In 1882 he became Waynflete Professor of Physiology at Oxford, and in 1895 Regius Professor of Medicine. He received a Royal Medal in 1883, and honorary doctorates from Dublin and Edinburgh, was President of the British Association in 1889, and created a baronet in 1899. In 1903 he resigned his professorship, and died at Oxford, Nov. 23rd, 1905, leaving the reputation of a leader in physiology, especially in exact experiments, and the virtual founder of the Oxford Medical School.

On November 22nd, Professor W. K. Clifford and Dr. Allen Thomson were elected to fill the above-named vacancy and that caused by the death of Mr. Gassiot, an original member.

William Kingdon Clifford, a thinker of great originality, was born at Exeter on May 4th, 1845, and at an early age showed exceptional aptitude for classics and literature as well as for mathematics. Proceeding to Trinity College, Cambridge, he graduated in 1867 as second wrangler, obtaining the second Smith's Prize. Soon after he had been elected to a fellowship, his views on politics and religion were completely changed. In 1871 he left Cambridge to become Professor of Applied Mathematics at University College, London, where he proved to be a most effective lecturer, and was equally at his ease with the most advanced thinkers and with children. Elected F.R.S. in 1874, pulmonary disease showed itself in the spring of 1876, and, after more than one absence in the hope of regaining health, he died in Madeira on March 3rd, 1879, having marked by his suggestive books and papers an epoch in the history of mathematics in England.

Professor Allen Thomson, a physician's son, was born in Edinburgh on April 2nd, 1809, and educated at that University, where he took the M.D. degree in 1830, and at Paris. After holding Professorships in Aberdeen, Edinburgh, and Glasgow, he resigned the last in 1877, when he settled in London. Elected F.R.S. in 1848, he received an honorary LL.D. from Edinburgh and Glasgow, and D.C.L. from Oxford, and was also President of the British Association in 1877. He was regarded as the first of the great biological teachers of the nineteenth century, who made a special study of embryology, and showed a clear critical faculty, an innate love of truth, and was eminently sound, but perhaps almost too cautious. He died in London on March 21st, 1884.

1878. At the Anniversary Meeting on April 29th, two vacancies made by the resignation of Professor W. H. Miller and the death of Dr. Thomas Thomson were filled by the election of Professor Maskelyne and Lord Rayleigh.

Mervyn Herbert Nevil Story Maskelyne, grandson of an Astronomer Royal, was born at Basset Down House, Wiltshire, on September 3rd, 1823, and graduated with Mathematical Honours from Wadham College, Oxford. After studying for the Bar, he gave up law for science, and began lectures on mineralogy at Oxford in 1850, of which he was made Professor in 1856. Next year he was appointed Keeper of Minerals in the British Museum, where he greatly augmented the collection, especially of meteorites, to the history of which, of diamonds, and of other minerals, he made valuable contributions. Elected F.R.S. in 1870, he received the Wollaston Medal of the Geological Society in 1893, and was made an Honorary D.Sc. at Oxford in 1903. In 1879 he succeeded to the Basset Down estate, and next year resigned his post at the British Museum, but retained the Oxford Chair till 1895, sitting in the House of Commons from 1880 to 1892. He died after a prolonged illness at Basset Down on May 20th, 1911.

John William Strutt, third Baron Rayleigh, as now Chancellor of the University of Cambridge, needs only a brief introduction. Born on Nov. 12th, 1842, he was scholar and Fellow of Trinity College, Cambridge, being senior wrangler and first Smith's prizeman in 1865. From 1879 to 1884 he was Professor of Experimental Physics at that University and of Natural Philosophy at the Royal Institution from 1887 to 1905. Elected F.R.S. in 1873, he was a Secretary for eleven years, and its President from 1905 to 1908. He has received the Copley, Royal, and Rumford Medals, several degrees and other distinctions at home and abroad, including the Order of Merit. Perhaps the most notable of his many important contributions to mathematical physics is the discovery of argon in 1894, in collaboration with the late Professor Sir William Ramsay.

1879. At the Anniversary Meeting on April 28th, it was decided to add a clause to Rule IX. to make the proposal of a member valid for five years only, counting from January 1st of the year in which it was made, and another to Rule XII. instructing the Treasurer to remind any member who had not attended a meeting during a year. A new Rule (XIII.) was adopted, which enabled a member of at least twenty years' standing to be transferred, at his written request, to the list of Honorary Supernumerary Members, and defined their position.

As a result of this, Dr. Lloyd and Professor Sharpey were transferred to that list, and these vacancies, together with one caused by the death of Professor Clifford, were filled by the election of Professor Duncan, Sir J. H. Lefroy, and Mr. H. N. Moseley.

Dr. Allen Thomson was elected Treasurer in the place of Mr. Francis Galton, who presented a statement of attendances in the last year of each ten from 1848-9 to 1878-9. The totals were 150, 150, 139, and 120; the maximum number in the first three periods being 22 and in the last one 19. The average attendance had fallen from 16·5 to 13·5.

Professor Peter Martin Duncan, of Scotch ancestry, but born at Twickenham on April 20th, 1821, was educated, partly abroad, partly at King's College, London, from which he graduated as M.B. in 1846. While practising at Colchester he studied natural history and archaeology, besides taking an active part in municipal affairs. Removing to Blackheath in 1860, he was appointed Professor of Geology at King's College in 1870, and then to a similar post at Cooper's Hill. Elected F.R.S. in 1868, he became President of the Geological Society in 1876, and received its Wollaston Medal in 1881. He did a large amount of miscellaneous zoological and geological work, especially on the corals and echinids, and when he died at Gunnersbury on May 28th, 1891, after a prolonged painful illness, left the reputation of a good palaeontologist, an excellent teacher, a genial companion, and a true friend.

Sir John Henry Lefroy, son of the rector of Ashe, Hants., was born on Jan. 28th, 1817, and obtained a commission from Woolwich in the Royal Artillery. From 1840 to 1844 he was engaged on a magnetic survey at St. Helena, from which he was transferred to Toronto and employed for eighteen months on similar work in northern Canada, during which he underwent many hardships but obtained results of great accuracy and value, together with observations of the *Aurora borealis*. After returning to England in 1853, he became confidential adviser on questions of artillery to the Duke of Newcastle, favouring the rifled gun, but was sent to Scutari in the autumn of 1855 to inspect the hospitals. Later on, he was appointed Director-General of Ordnance, resigning the post early in 1870, when he became Major-General and received a C.B. Next year he went to Bermuda as Governor, where he proved to be an excellent administrator, and on retiring in 1877 was created K.C.M.G. From 1880 to 1882 he held the same position in Tasmania, and in the following year published the results of his magnetic work in Canada.[1] He was elected F.R.S. in 1848, and wrote many valuable papers on magnetic and kindred subjects. Late in life he retired from London to Cornwall, where be died near Liskeard on April 11th, 1890, regarded by his many friends as a man of real ability, who was no less gentle than firm, was a sincere Christian, and a most attractive companion.

Professor Henry Nottidge Moseley, son of Canon Moseley, well known for his theory on the motion of glaciers, was born at

[1] In 1884 he revisited that country with the British Association, and the writer remembers him pointing out from a steamer on Lake Huron a place on the shore from which a shot had been fired at him when engaged on his survey nearly forty years previously.

Wandsworth in 1844. From Harrow he went to Exeter College, Oxford, where he obtained a first-class in Natural Science, and afterwards studied abroad. In 1872 he was appointed to the scientific staff on the *Challenger*, where he attended to botany as well as zoology, until the vessel returned in May, 1876, when he was elected to a Fellowship at Exeter College, and began to work out the results of the voyage, and wrote that attractive book, *A Naturalist on the Challenger*. Elected F.R.S. in 1879, he received a Royal Medal in 1887, more especially for his work on the archaic arthropod *Peripatus*, and a visit to North America in 1877 gave him the opportunity of studying the native races of the north-west coast. In 1881 he was elected to the Linacre Professorship of Anatomy at Oxford, and quickly made his mark as a stimulative teacher, but in 1887 overwork began to tell upon his health, and he died on Nov. 10th, 1891.

On Nov. 27th, 1879, the vacancies caused by the deaths of Professor Clerk Maxwell and Dr. T. Thomson were filled by the election of Professor Lister and Professor M. Foster.

Lord Lister, whose work completely revolutionized surgery, was born a member of the Society of Friends at Upton, in Essex, on April 5th, 1827, and went from University College, London, where Sharpey was his teacher, to work under Syme at Edinburgh. Becoming Professor of Surgery at Glasgow, he came to the conclusion that the main difficulty in the healing of a wound came from the putrefaction of the discharges, and on the publication of Pasteur's researches on the generation of micro-organisms, at once applied their principle to surgery, making use of antiseptics and preventives at every stage in the treatment of a patient. He returned to London in 1873 as a Professor at King's College, where his intellectual no less than his personal qualities made him a leader, and few men have done more for the improvement of hospitals. Elected F.R.S. in 1860, as his father had been and his brother became, he received the Royal and the Copley Medals, and was President from 1895 to 1900. Created baron in 1897 and being made O.M. in 1902, he died at his house in London on February 10th, 1912.

Professor Sir Michael Foster was a surgeon's son, born at Huntingdon on March 8th, 1836, and was brought up to his father's profession at University College, London, where he graduated M.B. and M.D. with distinction in 1859. Threatening pulmonary disease drove him to Italy for a time, but with improving health he began to practise at Huntingdon in 1861, then, on gaining reputation as a physiologist, he went back to University College to help Professor Sharpey in practical work, whom he succeeded in 1869. In the following year Trinity College, Cambridge, secured him for that University, where he created a school by his invigorating teaching, and was elected Professor of Physiology in 1883. Becoming F.R.S. in 1872, he was Secretary for twenty-two years, was President of the British Association in 1899, and created K.C.B. in the same year. He represented the University of London in Parliament from 1900 to 1906, resigned his Professorship at Cambridge in 1903, to make botanical experiments in his garden near Great Shelford, and died rather suddenly during a visit to London on Jan. 28th, 1907.

1880. At the Anniversary Meeting on April 26th, the death of Dr. Sharpey, honorary supernumerary member, was announced, and Sir W. Grove was thanked for presenting a new Minute Book to the Club.

On Nov. 25th, Professor Roscoe was elected into the vacancy made by the resignation of Sir W. Armstrong.

Sir Henry Enfield Roscoe, a grandson of the well-known historian, was born in London, Jan. 27th, 1833, and took the degree of B.A. from University College, London, and of Ph.D. at Heidelberg. He was Professor of Chemistry at Manchester from 1857 to 1887, where he gave great impulse to that study and carried out important researches. Elected F.R.S. in 1863, he received a Royal Medal in 1874 for his work on the chemical action of light and the metal vanadium, and was President of the British Association in 1887. He sat in Parliament for a division of Manchester from 1885 to 1895, and, after leaving that city, resided for some years in London and then near Leatherhead, where he died on Dec. 18th, 1915. He was created a knight in 1884 and a P.C. in 1909, besides receiving several other distinctions for his valuable researches in chemistry and his influence as a teacher.

As this was the 300th meeting of the Club, the Treasurer (Dr. Allen Thomson) gave some details of the thirty-three years of its existence. In 1847 and 1855 ten meetings were held, in other years nine, except that in 1871 and in 1873 the meetings in May were dropped, as was that in June, 1872. 114 Fellows of the Royal Society had been or then were members. Of this number 58 were dead. Among the others[1] are 47 ordinary members, besides 2 supernumerary members and 7 who have resigned their membership. Of the 47 original members 7 are living, and of these 4 (Mr. Bowman, Sir P. Egerton, Sir W. Grove, and Sir J. D. Hooker) are still members of the Club; the three who have resigned being Professor

[1] Including Professor Roscoe just elected.

Owen, General Sir E. Sabine, and Mr. E. Solly. In the first third of the Club's period of existence, 18 new members were elected, of whom 6 are actual members, 1 has become a supernumerary, 3 have resigned, and 8 are dead. In the second division of the period 27 new members were elected, of whom 16 are actual members, 1 is a supernumerary, 1 has resigned, and 9 have died. In the third division the new members were 22, of whom 21 are actual members and 1 (Professor Clifford) has died. Of the present members 14 are of more than twenty years' standing, and thus entitled to become supernumerary members under Rule XIII.

After a conversation on the desirability of preparing, and perhaps printing for circulation among the members, a short analysis of the communications, etc., made to the Club, Mr. F. Galton was requested to examine the Minutes and see if that were feasible.[1]

1881. At the Anniversary Meeting on April 25th, the vacancies made by the death of Sir P. Egerton, and the transference to supernumerary membership of Dr. Farre, Dr. Lyon Playfair, and Professor Prestwich, were filled by the election of Professor Dewar, Professor Newton, Captain Noble, and Mr. Tylor.

As Sir James Dewar is actively engaged in research, it is almost needless to recount his many well-earned honours, such as the Rumford and the Davy Medal of the Royal Society, honorary degrees, knighthood (in 1904), and other distinctions. He was born at Kincardine-on-Forth, Sept. 20th, 1842, is Professor of Experimental Philosophy in Cambridge University and Professor of Chemistry at the Royal Institution. The most remarkable of his many discoveries are the results of approaches to the nadir of temperature, in the course of which he has obtained hydrogen in a liquid and in a solid form.

Professor Alfred Newton, so well known as an ornithologist, was born in Geneva on June 11th, 1829, a member of a good Suffolk family, and graduated at Cambridge from Magdalen College in 1853, at which he obtained a travelling fellowship. Though lame from childhood, he studied and collected birds and their eggs in

[1] He announced at the next anniversary that he thought this could not be done satisfactorily, but that he had made an index (copied into the first volume of the Minutes) of the subjects of communications to the Club at the meetings (296) recorded in that volume.

Lapland, Spitzbergen, and other northern regions in successive summers, besides visiting the West Indies. In 1866 he was elected Professor of Zoology at Cambridge, where his geniality and enthusiasm attracted not a few undergraduates to that study. His chief work was a *Dictionary of Birds*, but he wrote many valuable papers, especially on the Dodo (from remains collected by his brother Sir E. Newton in Mauritius) and the Great Auk, whose last haunts he had visited and of which he had six eggs in his splendid collection (bequeathed to the University). He was elected F.R.S. in 1870, and awarded a Royal Medal in 1900, dying in his College rooms on June 7th, 1907.

Sir Andrew Noble, who did so much for the improvement of artillery, was born in Scotland on Sept. 13th, 1831, and obtained a commission from Woolwich, where he made a special study of the science of gunnery. In 1860 he joined the firm of Sir W. Whitworth and Co., ultimately becoming the Chairman of the Company. Elected F.R.S. in 1870, he was awarded a Royal Medal in 1880, and has been the recipient of several other medals, honorary degrees, and foreign orders. He was created C.B. in 1880, K.C.B. in 1893, and a baronet in 1902, and, notwithstanding his many duties, wrote much on scientific questions connected with explosives and artillery. He died at Jesmond Dene, near Newcastle-on-Tyne, on Oct. 22nd, 1915.

Sir Edward Burnet Tylor, the distinguished anthropologist, was born at Camberwell on October 2nd, 1832, his father, a member of the Society of Friends, being chief of a noted firm of brassfounders in Newgate Street, but he gave up business for anthropology at an early age, travelled in Mexico, wrote important books on that journey, the *Early History of Mankind*, *Primitive Culture*, and *Anthropology*, which led to his appointment as Keeper of the University Museum at Oxford in 1883 and its first Professor of Anthropology in 1896. He was elected F.R.S. in 1871, received honorary degrees from St. Andrews, Aberdeen, McGill, and Oxford, and was knighted in 1912. On resigning his chair in 1909 he retired to Wellington, Somerset, where he died on Jan. 2nd, 1917.

1882. At the Anniversary Meeting on April 24th, Sir J. H. Lefroy was elected Treasurer in place of Dr. Allen Thomson and Prof. F. M. Balfour a member of the Club to fill the existing vacancy. Professor Huxley referred in feeling terms to the recent death of Charles Darwin, stating that when the news reached the Royal Society the President (Mr. Spottiswoode) immediately telegraphed to the Dean of Westminster (Dr. Bradley), who happened to be abroad, requesting that the interment should be in Westminster

Abbey, to which the Dean most willingly consented, and the grave was made near that of Isaac Newton. Professor Huxley spoke of the unanimous recognition of Darwin's noble character and of the far-reaching importance of his scientific work by leaders of the various sections of public opinion, among whom were several representatives of the leading schools of orthodox theology.

Professor Francis Maitland Balfour, a younger brother of the Rt. Honble. A. J. Balfour, was born at Edinburgh on November 10th, 1857, and went from Harrow to Trinity College, Cambridge. From an early age he had shown a love of Natural Science, including geology, but, after coming under the inspiration of Professor Michael Foster, was attracted to embryology, obtained a high place in the Natural Science Tripos, and was elected a Fellow of his College. He then followed up the subject, both in Cambridge and at Dr. Dohrn's laboratory in Naples, especially in regard to the elasmobranch fishes, and published in 1880, after some important papers, his *Vertebrate Embryology*, "a work full of new light from beginning to end." Elected F.R.S. in 1878, he received a Royal Medal in 1881. Next spring he was appointed Professor of Animal Morphology at Cambridge, went to the Alps in July, and started from Courmayeur on the 18th to make an attempt with his guide Johann Petrus on the Aiguille Blanche de Peuteret (13,478 feet). On the morning of the 23rd their bodies were found at the foot of the Aiguille. It was "a life too short for friendship not for fame." [1]

On Nov. 9th, Messrs. Willis, through an oversight, had omitted to provide a dinner, so the Committee adjourned, after selecting a candidate for priority of ballot, to fill the vacancy caused by the lamented death of Professor F. M. Balfour, and a quorum was not obtained till Jan. 18th, 1883, when Professor Bonney was elected. He was born at Rugeley on July 27th, 1833, the eldest son of the Rev. Thomas Bonney, and has been entrusted with the interesting task of compiling this volume.

1883. At the Anniversary Meeting on April 30th, Dr. A. Geikie was elected into the vacancy caused by the death of Professor H. J. S. Smith, to which Professor Maskelyne afterwards made a sympathetic reference, reading to the

[1] See *Alpine Journal*, vol. xi. pages 90, 101, 374. A cutting from a newspaper, stating the little that was known about the disaster, is pasted into the Minute Book.

Club an appreciative notice which is inserted in the Minutes, and was known to have been penned by Lord Justice Bowen.

SIR ARCHIBALD GEIKIE, to whom we are indebted for the *Annals of the Royal Society Club*, is so well known and still so vigorous as to require only a very brief mention. He was born in Edinburgh on Dec. 28th, 1835, and educated at that University. Entering the Geological Survey in 1855, he held the Murchison Professorship of Geology from 1871 to 1882, when he became Director-General of the Geological Survey and removed to London. Elected F.R.S. in 1865, he received a Royal Medal in 1896, with the Murchison and Wollaston Medals of the Geological Society. Of that he has been twice President, as well as President of the British Association and of the Royal Society, besides receiving many honorary degrees and other distinctions both British and foreign. He was knighted in 1891, created K.C.B. in 1907, and received the O.M. in 1914. It may be said truly of him that, like some of an earlier generation, he has proved the possibility ot serving two mistresses, science and literature.

On Nov. 22nd, Sir F. Bramwell and Professor G. M. Humphry were elected into the vacancies caused by the withdrawal, from ill-health, of Sir A. Ramsay[1] and the death of Mr. G. A. Spottiswoode, President of the Royal Society.

SIR FREDERICK JOSEPH BRAMWELL was a banker's son, born in London on March 7th, 1818, and trained as a mechanical engineer. At first he paid especial attention to atmospheric railways and road locomotion, but, after beginning business on his own account in 1853, he gradually obtained a large practice in consultative work and as a scientific witness, especially in questions of water-supply, where his imperturbable disposition and ready wit stood him in good stead. An active member of many societies, he became F.R.S. in 1873, and was President of the British Association in 1888, received honorary degrees from Montreal, Durham, Cambridge, and Oxford, was knighted in 1881, and created a baronet in 1889. His busy life ended in London on Nov. 30th, 1903.

SIR GEORGE MURRAY HUMPHRY was a barrister's son, born at Sudbury, in Suffolk, on July 18th, 1820, and educated as a surgeon, becoming a member of the College in 1841. Next year he obtained an appointment at Addenbrooke's Hospital, Cambridge, entered that University, and took the degree of M.D. in 1859. Active in teaching and furthering the interests of Natural Science, he was

[1] Strictly speaking, he was transferred by the Club, in consequence of the state of his health, to the list of honorary supernumerary members.

appointed Professor of Human Anatomy in 1866, which he resigned for the (unpaid) Professorship of Surgery in 1883. He was elected F.R.S. in 1852, was knighted in 1891, and died at his house in Cambridge on Sept. 24th, 1896.

1884. At the Anniversary Meeting on April 28th, Professor Bonney was elected Treasurer in succession to Sir J. H. Lefroy, who called the attention of members to the fact that, when the attendance at the dinners was less than twelve, the Club had to pay Messrs. Willis for the defaulters. This had been done in 1879-80 only for 3, but in 1882-3 for 11, and in 1883-4 for 15, the result being a considerable increase in the expenditure of the Club.

Dr. Warren de la Rue was elected into the vacancy made by the death of Dr. Allen Thomson.

Dr. Warren de la Rue was born in Guernsey on January 15th, 1815, educated in Paris, entered his father's business as a printer in London at an early age, but took a keen interest in chemistry (attending Hofmann's lectures), physics, and mechanism. Elected F.R.S. in 1850, he turned his attention to practical astronomy, and worked at celestial photography, making a special study of the moon in his observatory at Canonbury. His photographs, taken during the total eclipse of the sun on July 18th, 1860, proved the 'red flames' to belong to the sun, from which he proceeded to sun-spots, but later in life reverted to chemistry and investigated electric discharges through gases. He received a Royal Medal in 1864, with other honours, including a D.C.L. from Oxford, ending his busy life on April 19th, 1889.

1885. On Nov. 26th, two vacancies were announced, one from the death of Dr. W. B. Carpenter, the other from Professor A. W. Williamson becoming an honorary supernumerary member, but the want of a quorum prevented these from being filled till Jan. 14th, 1886, when Mr. W. Thiselton-Dyer and Professor J. W. Judd were elected.

Sir William Tanner Thiselton-Dyer was a physician's son, born in Westminster on July 28th, 1843, took his degree from Christ Church, Oxford, and is still continuing his botanical researches at his home near Witcombe, Gloucestershire. He was appointed Assistant-Director of the Royal Botanic Gardens, Kew, in 1875, and succeeded his father-in-law, Sir J. D. Hooker, as Director in 1885, retiring in 1905. Elected F.R.S. in 1880, he has received the Doctor's degree from Oxford, Cambridge, and other Universities, was created C.I.E. and in 1899 K.C.M.G., and has made many valuable contributions to botany.

Professor John Wesley Judd was born at Portsmouth on February 18th, 1840, and educated at the Royal School of Mines. After some service on the Geological Survey, he travelled to study volcanic districts, British and Continental, publishing several important papers, and was appointed Professor of Geology at the Royal School of Mines in 1876, where he served till his retirement in 1905. During this interval he superintended the transference of the School from Jermyn Street to South Kensington, and organized the most complete system of geological instruction in Britain. An excellent chemist and petrologist, we are indebted to him not only for working out the results of the borings in the Nile Delta, but also for dealing with those in the coral reef of Funafuti and the petrology of the eruptive discharges from Krakatoa, and for not a few other books and scientific memoirs. Elected F.R.S. in 1877, he became President of the Geological Society in 1886, received its Wollaston Medal in 1891, the degree of LL.D. from Aberdeen, a C.B. in 1895, and honorary membership of several societies, dying after some months of failing health at Kew on March 3rd, 1916.

As April 26th was Easter Monday, the anniversary was kept on May 3rd, when Mr. D. E. Hughes was elected into the vacancy made by transferring Mr. Busk to the honorary supernumerary members. Some alterations were made in the rules, the principal being the removal of the clause requiring not less than thirty-five members to reside within ten miles of the General Post Office, making twelve members a quorum for election, and changing the Anniversary Meeting from Monday to Thursday.

Professor David Edward Hughes was of Welsh origin, but born in London on May 16th, 1830, and educated in America, showing early talent both in music and experimental science. He invented a type-writing machine for the electric telegraph, and after returning to London in 1877 made great improvements in the telephone and many discoveries in electricity, especially in regard to aerial telegraphy. Elected F.R.S. in 1880, he received a Royal Medal in 1885, and died in London on January 22nd, 1900, "a simple, genial, well-informed man," who, notwithstanding his generosity, had gathered much wealth, which he left for scientific purposes and to hospitals.

1886. On November 25th, the vacancy made by transferring Professor Sylvester to the honorary supernumerary list was filled by the election of Dr. W. T. Blanford.

Dr. William Thomas Blanford, distinguished in geology and zoology, was the son of a carver and gilder, born in London on October 7th, 1832. After receiving part of his education on the Continent, he passed with distinction through the Royal School of Mines, and obtained in 1854 an appointment on the Geological Survey of India, working at first on the Talchir Coalfield, where he detected a boulder bed of glacial origin. The outbreak of the Indian Mutiny seriously endangered his life, but, when it had been quelled, he resumed his surveying work, and after two years in Burma investigated the Deccan Traps. In 1868 he was attached to the Abyssinian expedition, which captured Magdala, the result being large collections and an admirable book, *The Geology and Zoology of Abyssinia*. In 1872 he was attached to the Persian Boundary Commission, and, after an arduous journey to England by the Caspian Sea and Moscow, spent two years at home working out his collection, the results of which were published. After returning to India he took up the survey of Sind, and then, while at the central office in Calcutta, combined with Medlicott in writing the *Manual of the Geology of India*. After another furlough in England, he retired from the Survey in 1882, when he settled in London. Elected F.R.S. in 1874, he received a Royal Medal in 1901, and the Wollaston Medal in 1883 from the Geological Society, of which he was President from 1888 to 1890. During a visit to Canada in 1884 he received from Montreal the degree of LL.D., and was created C.I.E. in 1904. He devoted much time to editing the *Fauna of British India*, to which he contributed the volume on Mammals and two on Birds. In science he combined depth of knowledge with width of view, and, as it was rightly said, "was in word and deed a true gentleman." He died at his house on Campden Hill on June 23rd, 1905.

1887. At the Anniversary Meeting on April 28th, Mr. John Ball was elected Treasurer instead of Professor Bonney, and the vacancy made by transferring Mr. Simon to the honorary supernumerary list was filled by the election of Professor Clifton.

As Professor Robert Bellamy Clifton is happily still living, it may be enough to say that he was born in 1836, was sixth wrangler, second Smith's prizeman, and a Fellow of St. John's College, Cambridge, was Professor of Natural Philosophy at Owens College, Manchester, from 1860 to 1865, when he became Professor of Experimental Philosophy at Oxford, holding that office till 1915, and devoting most of his time to organizing a laboratory and founding a school of Physics in that University. He was elected F.R.S. in 1868.

1888. On Nov. 1st (the meeting having been inadvertently fixed for that day instead of in October), Sir W. Grove called attention to the falling off in attendances, the number announced at the anniversary having been 97, one less than in the previous year, and stated that, unless there was a considerable increase, he should propose next anniversary that the Club be discontinued. The subject was resumed at the meeting of Nov. 22nd, when he said that the objects for which the Club had been founded had been mainly accomplished. The Royal Society had been reformed, and its scientific character raised to a higher level; the other and older Club of its Fellows had also changed its character, and was now chiefly composed of men actively engaged in scientific work. As the members of the Philosophical Club appeared to be losing interest in its meetings, he would ask them to consider at the next meeting whether it could be fused with the Royal Society Club, or, if not, be dissolved.

Captain Abney and Professor G. H. Darwin were elected to the vacancies made by the retirement of Sir J. H. Lefroy and the transference of Prof. Huxley to the list of honorary supernumerary members.

Sir William de Wiveleslie Abney, eldest son of Canon Abney, was born at Derby, July 24th, 1844, and after obtaining a commission in the Royal Engineers, was active in educational work and made a special study of scientific photography. He was elected F.R.S. in 1876, received a Rumford Medal in 1882, is an honorary Doctor of Victoria, Durham, and Dublin Universities, and was created K.C.B. in 1900.

Sir George Howard Darwin, second son of Charles R. Darwin, was born at Down on July 9th, 1845, was second wrangler, second Smith's prizeman, and elected Fellow of Trinity College, Cambridge, in 1868. His first important paper dealt with the effects of geological changes on the earth's axis. Becoming F.R.S. in 1879, he received a Royal Medal in 1884, and was elected in the previous year Plumian Professor of Astronomy at Cambridge, publishing papers on the precession of a viscous spheroid, the former connexion of the moon with the earth, the effect of strains caused in the interior of the latter by the weight of continents, and similar subjects of like importance and difficulty. On his return from South Africa, where he was President of the British Association at the meeting of 1905, he was created K.C.B. In the summer of 1912 his health began to fail, and he died on Dec. 7th, leaving the deserved reputation of an inspiring teacher, an accomplished man, and one remarkable for his " simple, sweet, and open nature."

1889. At the meeting on Nov. 21st, the death of Mr. John Ball, the Treasurer, was announced, and Professor Judd appointed to that office for the remainder of the session. Three new members, Prof. W. G. Adams, Dr. W. Crookes, and Mr. F. du Cane Godman, were elected to the vacancies caused by the deaths of Mr. J. Ball and Dr. Warren de la Rue, and the retirement of Professor Moseley. Also some alterations of the rules, in view of increasing the attendances, were discussed.

Professor William Grylls Adams, brother of Professor John Couch Adams,[1] was born on February 16th, 1836, and took his degree as twelfth wrangler from St. John's College, Cambridge, in 1859, of which he was elected a Fellow in 1865 and F.R.S. in 1872. Appointed in the former year Professor of Natural Philosophy at King's College, London, he held that office till 1905, organizing a physical laboratory and carrying out original work in electricity and terrestrial magnetism, besides editing his brother's scientific papers. Removing in 1906 from London to Broadstone, Dorset, he died there on April 10th, 1915.

Sir William Crookes, though born on June 17th, 1832, is happily still able to carry on his researches into the ultimate constitution of matter, the history of radium, the possibilities of electricity, and the discovery of new elements, besides many valuable practical applications of chemistry, so it may suffice to say that he was elected F.R.S. in 1863, was President from 1913 to 1915, has received its Royal, Copley, and Davy Medals, besides six doctorates and many foreign honours. Knighted in 1897, he received the O.M. in 1910.

Dr. Frederick du Cane Godman, son of Mr. J. Godman of Park Hatch, Godalming, was born in 1834, and is one of the Trustees of the British Museum, so it will suffice to recall his valuable work in zoology, shown more especially in his *Natural History of the Azores*, his *Monograph of the Petrels*, and his contributions to Central American biology. Elected F.R.S. in 1882, he is a D.C.L. of Oxford.

1890. At the Anniversary Meeting on April 24th, an alteration was made in Rule II., the effect being that any scientific foreigner or resident in the Colonies or India,

[1] See page 46.

temporarily visiting this country, or any Fellow of the Royal Society, might be the guest of a member of the Club, except on the anniversary or any special meeting from which strangers are excluded, but that member might not bring the same guest more than once in a session.

As Mr. Buckton and Professor Tyndall had desired to be transferred to the list of honorary supernumerary members, Professor Victor Horsley and Dr. Hugo Müller were elected to the vacancies.

SIR VICTOR ALEXANDER HADEN HORSLEY, son of J. C. Horsley, R.A., was born in Kensington in 1857, and after medical study at University College, became Professor of Clinical Surgery at its Hospital, attaining a high reputation for skill as an operator and for pathological investigations, especially with regard to the thyroid gland. Elected F.R.S. in 1886, he was awarded a Royal Medal in 1894, and received not a few other distinctions. At the outbreak of the present war, he placed himself at the disposal of the Government, and was sent to Mesopotamia, where he fell a victim to the climate on July 16th, 1916.

DR. HUGO MÜLLER was born in Germany in 1834, studied chemistry and mineralogy at Leipzig under Naumann, retaining always his interest in the latter subject, for he did much to establish its classification on the basis of chemical composition. After settling in London, he obtained high repute, was elected F.R.S. in 1866, was an honorary LL.D. of St. Andrews, and D.Sc. of Victoria. After making many valuable contributions to chemistry and mineralogy, he died at Camberley on May 23rd, 1915.

At the meeting on Nov. 27th, the vacancy caused by the transference of Dr. P. L. Sclater to the honorary supernumerary list was filled by the election of Professor A. W. Rücker. It was agreed to accept an invitation of the Royal Society Club to hold a joint meeting early in the coming year.

PRINCIPAL SIR ARTHUR WILLIAM RÜCKER, noted for his services to science and to education, was born on October 23rd, 1848, at Clapham Park, and went to Brasenose College, Oxford, where he obtained a fellowship, after being highly distinguished in mathematics and natural science. Beginning at the Yorkshire College, Leeds, he became in 1886 Professor of Physics at the Royal College of Science, London, from which post he was appointed in 1901 Principal of the University of London. Elected F.R.S. in 1884, be received a Royal Medal in 1891, with honorary doctorates from about six

Universities, for, notwithstanding his onerous official duties, he made very valuable contributions to science, not the least being a magnetic survey of the British Isles for 1886 and 1891, undertaken with Sir T. E. Thorpe. But the strain told upon his health; he resigned office in 1908, retired to Berkshire, and died near Newbury on Nov. 1st, 1915, regretted by all fellow-workers and friends.

1891. On March 12th, the above-named joint dinner with the Royal Society Club was held, 43 being present, including two guests (Professor F. Fuller and Rev. J. H. Gurney). Of the rest, 19 were members of both Clubs; 17 only of the Royal Society Club, and 5 only of the Philosophical Club; the chair being taken by Sir W. Thomson, President of the Royal Society.

At the Anniversary Meeting on April 23rd, it was stated that in the past year the average attendance had been 14 (126 at 9 dinners), an improvement on 12 in the previous year and 10 in 1888-9. The Club decided to dine in future at Limmer's Hotel.

The vacancy caused by the retirement of Professor P. M. Duncan was filled by the election of Sir W. Thomson, President of the Royal Society.

Sir William Thomson, first Baron Kelvin, is still so well remembered that it will suffice to say he was born at Belfast, where his father was a University Professor, on June 26th, 1824, was second wrangler and first Smith's prizeman at Cambridge, a Fellow of Peterhouse, and elected Professor of Natural Philosophy at Glasgow in 1846. From that centre his life's work was done; thither the representatives of Physical Science gathered from far and wide to celebrate his jubilee as Professor in 1896. "Other men, as it was well said, have been as great in some department of Physical Science, no one since Newton has exerted such a masterful influence over the whole domain." He was a rare combination of theoretical insight with practical ability. His conceptions of the work of energy and the nature of matter are still bearing fruit; the successful laying of the first Atlantic cable marks an epoch in history, and the charm of his personality was hardly less marked than the power of his intellect. He was awarded many distinctions in his own and other countries. Elected F.R.S. in 1851, he received the Royal and Copley Medals, was created knight in 1866, G.C.V.O. in 1896, raised to the peerage in 1892, and received the Order of Merit in 1902. Dying on Dec. 17th, 1907, his body was laid in Westminster Abbey near the grave of Newton.

After discussing the relations of the two Clubs, the Treasurer was empowered to propose to the Treasurer of the Royal Society Club the formation of a Committee, to which each Club should appoint five members, three belonging to itself only and two members of both clubs, of which the chairman should be Sir W. Bowman, the oldest member of the Royal Society Club and one of the three survivors of the original forty-seven members of the Philosophical Club. It should consider questions in regard to the two Clubs, such as making the joint dinner annual: partial, or complete fusion: and arranging for a dinner on every evening when there was a meeting of the Royal Society.

On November 26th, the fusion of the two clubs was again discussed, and, though favourably regarded, it was felt that the difference in regard to guests and scientific discussions might present difficulties.

The vacancy made by Professor Flower becoming an honorary supernumerary member was filled by the election of Mr. A. B. Kempe.

Of Sir Alfred Bray Kempe, who is Chancellor of six dioceses and is also Treasurer to the Royal Society, to which he was elected in 1881, it will suffice to say that he was a clergyman's son, born in London on July 6th, 1849, who took his degree from Trinity College, Cambridge, and was called to the Bar in 1873.

1892. The fusion of the two Clubs continued to be discussed at the meetings, and on Feb. 11th Sir W. Bowman gave notice that he should bring forward the following resolution at the Anniversary Meeting: "That the Joint Committee of the Philosophical Club and the Royal Society Club be requested to carry out the scheme, which has been submitted by them, for one year, and that the operation of any rule of the Philosophical Club, which would interfere with the carrying out of the experimental scheme, be suspended during the ensuing session of 1892-3."

The Treasurer (Professor Judd) read an analysis of the dates of meeting and changes in the membership of the Club since its 301st meeting (Nov. 25th, 1880). There had been nine meetings in each year, except in 1882 (October), when, through an oversight, one was not summoned, and in the same month of 1889, because of the recent death of Mr. John Ball, then Treasurer. Since the foundation of the Club in April 1847, 139 Fellows of the Royal Society had been or still were members of it, 81 of whom had died. At present there were 47 ordinary members, 10 honorary supernumerary members, and 1 who had resigned. Of the 47 original members, 4 were living, 3 of them, Sir W. Bowman, Sir W. Grove, and Sir J. D. Hooker, being still on the list, Sir R. Owen having resigned in 1885. In the fourth division of the Club's existence, from 1880 to the present day, 25 new members had been elected, 2 of whom had died. At the present time 12 members of the Club were of more than 20 years' standing. A classified list of the names since the 301st meeting is appended.

At the Anniversary Meeting on April 28th, 1892, the death of Sir W. Bowman was announced, and a vote of sympathy with Lady Bowman and his family was passed. The Treasurer moved the resolution of which the late member had given notice, which was carried by a majority greater than the requisite four-fifths of the twenty-nine members present, with an addition moved by General Strachey, that the rules of the Royal Society Club in regard to admitting to the dinners persons not members of the Club be adopted provisionally by the Philosophical Club.

Dr W. T. Blanford succeeded Professor Judd as Treasurer, and the vacancies caused by the deaths of Sir W. Bowman and Professor Hirst were filled by the election of Professor T. E. Thorpe and Dr. D. Sharp.

Sir T. Edward Thorpe was born near Manchester on Dec. 8th, 1845, and educated at Owens College, Bonn, and Heidelberg. From the Professorship of Chemistry at Leeds, he was appointed to that of the Royal College of Science in London in 1885, afterwards becoming Director of the Government Laboratories, South Kensington. Elected F.R.S. in 1876, he received a Royal Medal in 1889, was made C.B. in 1900 and knight in 1909, is a Ph.D. and honorary doctor of Leeds, Manchester, Dublin, and Glasgow. His contributions to chemical science are many and valuable, including a *Dictionary of Applied Chemistry*.

Dr. David Sharp was born in 1840, and was Curator of the Museum of Zoology at Cambridge till 1909, of which University he is an Hon. M.A. He was elected F.R.S. in 1890, has especially devoted himself to the study of Coleoptera and other insects, publishing important books and papers on these subjects, and now lives at Brockenhurst, Hants.

It was announced at the meeting on Oct. 27th, 1892, that the Royal Society Club had accepted the above-named scheme for joint-dinners, and on Nov. 24th, 1892, the vacancies made by the resignation of Mr. W. Thiselton-Dyer and the transference of Sir W. Grove to the honorary supernumerary list could not be filled for want of a quorum. This was done on December 15th, when only one election was made, that of Mr. W. H. Hudleston.

Mr. Wilfrid Hudleston Hudleston was a doctor's son, born at York on June 2nd, 1820, who changed his surname, originally Simpson, on succeeding to his mother's property. He began ornithology and geology in his school days at Uppingham, graduated from St. John's College, Cambridge, in 1850, and travelled extensively, especially in Northern Europe, besides visiting Algeria, Greece, and Roumania. After studying chemistry, he devoted himself more especially to geology, writing valuable papers, particularly on the Jurassic gastropods, of which he formed a fine collection. Later in life he travelled in North-west India. Elected F.R.S. in 1884, he became President of the Geological Society in 1892, received its Wollaston Medal in 1897, and died suddenly at his country house, West Holme, Dorset, on Jan. 29th, 1909.

1893. At the anniversary on April 27th, the vacancy left at the November meeting was filled by the election of Professor Vines.

Sydney Howard Vines, Professor of Botany in the University of Oxford, was born in London on Dec. 31st, 1849, obtained a first class in the Natural Science Tripos from Christ's College, Cambridge, in 1876, and is a D.Sc. of both that University and London. He has made valuable contributions to botanical literature, was elected F.R.S. in 1885, and to the Oxford Professorship in 1888.

There was a vacancy at the November meeting, but it could not be filled for want of a quorum till the anniversary on April 19th, 1894, when Mr. Francis Darwin was elected, and it was noted that the average attendance during the past year had been 9, the smallest since the foundation of the Club.

Sir Francis Darwin, third son of Charles R. Darwin, was born at Down, Kent, on Aug. 16th, 1848, graduated with high honours in Natural Science from Trinity College, Cambridge, was elected a Fellow of Christ's College, and took the M.B. degree. Then he co-operated with his father in scientific investigation, after whose death he returned to Cambridge, and wrote more than one valuable memoir on his life and work in addition to his own contributions to science. He was elected F.R.S. in 1882, was President of the British Association in 1908, received the medal founded in honour of his father in 1912, and was knighted in 1913.

1895. At the Anniversary Meeting on April 26th, Mr. W. Crookes was elected Treasurer in place of Dr. Blanford, and the vacancies made by the transference of Professor Allman and Dr. Günther to the list of honorary supernumerary members were filled by the election of Mr. Ludwig Mond and Dr. W. J. Russell.

Dr. Ludwig Mond, a merchant's son, was born at Cassel on March 7th, 1839, and educated at Marburg and Heidelberg. After having made more than one discovery of commercial value, such as the recovery of sulphur from waste products, he started the great alkali works at Winnington, where he made other lucrative discoveries, among them an important method for extracting nickel from its ores. He was elected F.R.S. in 1891, was an honorary doctor of Manchester and Oxford, besides Heidelberg and Padua, and died Dec. 11th, 1909. "He was a man of great scientific attainments, of indomitable resource and energy, with a genius for divining the industrial possibilities of discoveries in pure science." His interests were in science, music, art (he formed a fine collection of pictures, especially early Italian), and he unostentatiously devoted no small part of his great wealth to the promotion of science. In its annals his benefactions to the Royal Society and its Catalogue of Scientific Papers, with the founding and endowment of the Mond Laboratory at the Royal Institution, to mention no others, will long keep his memory green.

Dr. William James Russell was connected with America and France, but was son of a banker at Gloucester, born on May 20th, 1830. He began to study chemistry in 1847 at University College, London, then assisted Professor Frankland at Manchester. From 1883 to 1885 he worked at Heidelberg, where he took the Ph.D. degree, and after returning to England investigated gas analysis and cobalt, being ultimately appointed Lecturer on Chemistry at St. Bartholomew's in 1870, which post he held till 1897. He was elected F.R.S. in 1872, having already begun to study absorption spectra, and did much valuable work on impurities in London air and on the effect of light on water-colours. In 1897 he published the results of studies on the photographic effects of uranium salts, of zinc, and of a variety of organic substances. A lover also of flowers, of scenery, and of nature, he had a residence, from 1882, near Chagford, but after fifteen years moved to one at Ringwood, where he died after a short illness on Nov. 12th, 1909.

1896. At the Anniversary Meeting on April 23rd, the average attendance during the year was stated to have been 10·3 as compared with 11 in the previous year, and the vacancy made by the transfer of Sir James Paget to the list of honorary supernumerary members was filled by the election of Dr. Lauder Brunton.

Sir Thomas Lauder Brunton, Consulting Physician to St. Bartholomew's Hospital, and so well known in medical and scientific circles, was born at Hiltonshill in Roxburghshire on March 14th, 1844, but obtained the doctorates of Medicine and of Science in the University of London. He was also an honorary LL.D. of Edinburgh and Aberdeen, and elected F.R.S. in 1874. His scientific writings deal with pharmacology, therapeutics, assimilation, and the circulation, and he also wrote on the relations of the Bible and Science. He was created knight in 1900 and a baronet in 1908, dying on September 16th, 1916.

At the meeting on November 19th, when there was one vacancy, though the Club had lost three of its members—its founder Sir W. Grove, Professor Prestwich, elected in 1860, and Sir G. M. Humphry, who only was one of its ordinary members—a quorum was not obtained till the anniversary on April 8th, 1897, when Professor Tilden was elected. In the interval the Club had lost Professor Sylvester, but his death did not add to the vacancies.

As Sir William Augustus Tilden, though he has retired from professorial work, is still vigorous, it will suffice to say that he was born in London on Aug. 15th, 1842, became D.Sc. of its University, and, after being Professor of Chemistry at Mason's College, Birmingham, was elected in 1894 to the same position in the Royal College of Science, London, from which he retired in 1909. He has made many valuable contributions to chemical science and its history, is an honorary doctor of Dublin, Manchester, and Birmingham, was elected F.R.S. in 1880, and has received the Davy Medal.

1897. At the meeting of Oct. 25th, the Chairman gave as a toast, " Long Life and Prosperity to the Philosophical

Club," as this was its jubilee. The sands, however, of its separate life were in reality running low.

The November meeting (on the 18th) failed to attract a quorum, and one was not obtained till January 20th, 1898, when Professor Meldola was elected into the vacancy made by the resignation of Mr. D. Sharp.

PROFESSOR RAPHAEL MELDOLA was a member of a Jewish family, born in London on July 19th, 1849, and trained at the Royal School of Mines, who became Professor in the Finsbury Technical College and then of Organic Chemistry in the University of London. He had charge of the Eclipse Expedition to the Nicobar Islands, made many scientific discoveries in regard to coal-tar dyes, wrote much on these and similar chemical subjects, including photography, on entomology, and the Essex earthquake of 1884. Elected F.R.S. in 1886, he was awarded the Davy Medal in 1913, and was an honorary doctor of St. Andrews and Oxford, and ended his busy life on Nov. 16th, 1915.

1898. At the Anniversary Meeting on April 28th, Professor W. G. Adams became Treasurer in the place of Sir W. Crookes, and Mr. Thornycroft was elected into the vacancy made by Sir R. Strachey becoming an honorary supernumerary member.

SIR JOHN ISAAC THORNYCROFT, naval architect and engineer, was born at Rome in 1843, his father and mother both being sculptors. In the important shipbuilding works which he founded at Chiswick, he has introduced many improvements in naval architecture and engineering, especially in obtaining high speed, and is still engaged in adding to the efficiency of the British Navy. He was elected F.R.S. in 1893, and knighted in 1902.

On November 17th, the transference of Mr. Francis Galton to the honorary supernumerary members made a vacancy, which was filled by the election of Professor J. J. Thomson.

SIR JOSEPH JOHN THOMSON, the recently appointed Master of Trinity College, Cambridge, was born near Manchester on Dec. 18th, 1856, and graduated in 1880 from that College as second wrangler and second Smith's prizeman. He was elected to a fellowship in the same year, and Professor of Experimental Physics in 1884. His success as a teacher and his researches into electricity, magnetism, and the ultimate nature of matter, have made his name so famous that it need only be said that he was elected F.R.S. in 1884, and became its President in 1915, after having received the Copley, Royal, and Hughes Medals, besides several honorary doctorates and distinctions, including a Nobel Prize. He was President of the British Association in 1909, was created knight in 1908, and has received the Order of Merit.

1899. The Treasurer reported at the Anniversary Meeting on April 27th, that the total number of attendances, including guests, during the past year had fallen from 106 to 98: and the vacancy made by the resignation of Professor Vines was filled by the election of Professor Weldon.

Walter Frank Raphael Weldon, son of Walter Weldon, a chemist of note, was born at Highgate on March 15th, 1860, and, after studying medicine at University College and King's College, London, went to St. John's College, Cambridge, won distinction in Natural Science, and obtained a fellowship. After research at Naples and a visit to the Bahamas, he worked vigorously at the Marine Biological Laboratory at Plymouth, and was elected in 1890 F.R.S. and Professor of Zoology at University College, London. In his researches he adopted, in co-operation with his colleague Professor Karl Pearson, the exact statistical methods of Francis Galton, applying these to variations in two species of shrimps, and they may be regarded as the founders of Biometrics. His election in 1899 to the Linacre Professorship of Comparative Anatomy at Oxford in no way lightened his labours, which proved to be too arduous for a constitution never robust, and an attack of influenza, while on an Easter holiday, developed on his return to London into acute pneumonia, which proved fatal on April 13th, 1906.

A quorum was not present at the November meeting or until the anniversary on April 5th, 1900, when Dr. Larmor, Professor Langley, and Mr. J. J. H. Teall were elected to fill the vacancies made by the resignation of Sir G. Darwin, and the deaths of Sir E. Frankland and Professor D. E. Hughes.

Sir Joseph Larmor was born at Magheragall, Antrim, on July 11th, 1857, and came from Queen's College, Belfast, to St. John's College, Cambridge, where he was senior wrangler, first Smith's prizeman, and Fellow in 1880. After some educational work in Ireland, he returned to Cambridge, and was elected in 1903 to the Lucasian Professorship, the chair of Newton and Stokes. He became F.R.S. in 1892 and received a Royal Medal in 1915. He has published many memoirs on mathematical physics, and the title of one, *Aether and Matter*, will suffice to indicate the general line of his researches. He was created knight in 1909, and has represented his University in Parliament since 1911.

PROFESSOR JOHN NEWPORT LANGLEY, born November 10th, 1852, was a scholar of St. John's College, Cambridge, who, after obtaining a first class in the Natural Science Tripos of 1874, was elected a Fellow of Trinity, and succeeded Sir Michael Foster as Professor of Physiology in 1903. Becoming F.R.S. in 1883, he was awarded a Royal Medal in 1892, and has received several other distinctions on account of his valuable contributions to physiology.

SIR JETHRO JUSTINIAN HARRIS TEALL was born at Northleach, Gloucestershire, on January 5th, 1849, graduated with distinction in geology from St. John's College, Cambridge, at which he obtained a fellowship, and, after publishing an important work on British Petrography, became Petrologist to the Geological Survey, and ultimately its Director, from which position he retired in 1913. Elected F.R.S. in 1890, he is a Cambridge Sc.D., besides honorary doctorates, has been President of the Geological Society, has received its Bigsby and Wollaston Medals, and was created knight in 1916.

1900. On October 25th, at a meeting attended by twenty-five members, the Treasurer informed the Club that a motion in favour of the amalgamation of the two Clubs had been passed by the Royal Society Club on June 28th. A similar resolution was now carried with one adverse vote, and a committee appointed to give it effect.

1901. At the Anniversary Meeting on April 25th, the number of members present being twenty-two, the Treasurer reported that there had been 97 attendances at the eight meetings in the past year as against 100 in the previous one. The draft rules for the amalgamated Clubs were read and passed after slight emendations.

These rules have been printed by Sir A. Geikie in the *Annals of the Royal Society Club*,[1] so it will suffice to indicate their main differences from the original rules of the Philosophical Club, the more distinctive of which have been already given.[2] The combined Club is to consist of sixty-six ordinary members, all of whom must be Fellows of the Royal Society, with the following *ex officio* members : the President, the Treasurer, the two Secretaries and the Foreign Secretary, and the Astronomer Royal ; the President of the Royal Society on joining the Club becomes its President. The Anniversary Meeting is to be held on the Thursday of the week in

[1] Pages 479-81. [2] See page 2.

which the Royal Society meetings close, and at this three Treasurers are to be elected. Each member may introduce one visitor, the President not being thus limited.

The last (486th) meeting of the Philosophical Club, at which fourteen members were present with one guest, was held on June 13th, 1901.

Thus ends the history of the Philosophical Club as a separate body. For several years the attendance of its members had conspicuously fallen off, notwithstanding efforts to increase it by modifications of the rules. Its Minutes also indicate that communications on matters of scientific interest had become less frequent. But the Club had accomplished its object. This, as its Minutes more than once declare, was inciting the Council of the Royal Society to more energetic action in the cause of science and its Fellows to take a keener interest in Natural Knowledge. That had been done. The Royal Society has now for years past exercised an influence, continuously widening and strengthening, on the progress of science ; it has become, as all know who have had any official connection with it, more and more the channel of communication between the Government and the leading men in the different fields of scientific work in our country, thus securing for the former the best advice on questions which require special knowledge. As this advice is privately communicated, it can be accepted by representatives of a Government without loss of official dignity, while the Society incurs no danger of being fettered by red tape or exposed to the ignorant criticism of the professional politician. The advantage to the nation of this informal connection has been more than ever obvious during the last four years.

The falling off in the attendance at the dinners and in the frequency of communications on matters of scientific interest, which were their special feature, are both largely due to a change of habits. People now generally reside at a greater distance from the centre of London than in former days, and though communication has been facilitated, struggling for a place in an over-full motor-bus or becoming a strapholder in a crowded train is not a tempting termination to a pleasant dinner. The meetings also of the Royal Society are now held in the afternoon, so that at their close Fellows, who have attended them, are more apt to go home. The strain of life also, if I may trust my own experiences, has become greater since the middle of the last century, and the interests of those who work in the fields of science have been to some extent narrowed, as remarked in the Preface, by increasing specialization. But the Philosophical Club, as I trust these Annals will prove, did good service in the furtherance of science.

SECTION II

COMMUNICATIONS TO THE PHILOSOPHICAL CLUB

As has been already said, the members present at the dinners of the Philosophical Club were invited by the Chairman to make communications to the Club on any subject of special scientific interest, and the Treasurer was instructed to record these in the Minutes. Thus the latter range over a wide field, and commemorate many of the most important advances that have been made in science during the fifty four years of the Club's separate existence. They include such subjects as the discovery of new chemical elements, spectrum analysis, advances in electricity, botanical and zoological exploration, deep-sea soundings, borings in the Nile delta and in the Funafuti atoll, the eruption of Krakatoa, the physics and history of glaciers, the nature of *Eozoon Canadense*, and the recognition of palaeolithic implements. The variety and disconnected character of the subjects made a continuous narrative so extremely difficult that I decided to place the abstracts of them in chronological order and in separate paragraphs. Obviously this method of treatment is the less attractive, but after rather careful consideration and some trial I have found it the most practicable one—at any rate for myself.

The study of these Minutes has impressed upon me more strongly than ever how marvellously great the progress in discovery has been during the above-named period, or, at any rate, during the last seventy years of the nineteenth century. When I was born, the application of steam to locomotives had only just got beyond the experimental stage; [1] large areas of Africa were still blank on our maps, while the fauna and flora of several other parts of the world were very imperfectly known, and the annals of even the greater nations, prior to some four and twenty centuries ago, were largely blended with legend. Since the Club was founded history has been carried back into a past far more remote than was on record in our books. The monuments in the Mesopotamian and adjacent regions have been unearthed [2] and the languages of their builders deciphered and interpreted; the relics of Minoan ages have proved the existence of a great pre-Hellenic civilization; the mists have almost vanished from the early history of Egypt, and kings been shown to have reigned before the once semi-mythical Menes. The application of the microscope to the study of rocks has done wonders for petrology. Evolution, from a conjecture, has been recognized as a process of the highest and far-reaching importance,[3] and researches in Chemical Physics have revolutionized our conceptions of matter, ether, and energy. In one or other of these great advances, the men who joined in the conversations at the table of the Philosophical Club took an active part. It is much to have lived through such a wonderful epoch!

But these records also show, if I may venture to say it, that such great gains are not without some loss. The men of science of that earlier time had wider interests and more varied knowledge than is possible, as a rule, for their successors. At the present day students of science are in danger of being fettered by the multiplicity of details, often comparatively unimportant, and being over-burdened by the 'literature of the subject,' now a hundredfold greater

[1] The Liverpool and Manchester railway was opened September 15th, 1830.

[2] Strictly speaking, digging had begun before the Club was founded, but it was in the same decade.

[3] The *Origin of Species* was published in the autumn of 1859.

than it was in those early days. Though we can walk in sunlight, where our grandfathers had to grope, yet its brightness has sometimes revealed so much that we find it difficult to 'see the wood for the trees.' Over-specialization compels many a man to contract his outlook and to limit his field of work, so that he suffers, often consciously and regretfully, from an atrophy of his sympathies. Science, in fact, to use Huxley's simile,[1] is now in danger of being smothered, like Tarpeia at the gate of the Capitoline fortress, by the gifts which are being heaped upon her, though bestowed by those who truly loved her, and meant, not to requite her faithlessness, but to reward her fidelity.

1847. At the second meeting of the Club (May 6th) the members (including Sir J. Herschel and General Sabine), discussed the question of the Centigrade scale for thermometers. Though they did not pass any resolution, the Club seemed favourable to the decimal system, though its introduction into England was felt to be difficult in practice, because of the numerous tables calculated on the Fahrenheit scale, and the more frequent use of 'minus degrees' appeared to be a real objection to the Centigrade graduation. On this account, it was suggested that a new graduation with the lowest degree of natural cold as its zero would be preferable, but that at any rate the authors of papers would do well, when referring to temperature, to insert both scales.

Mr. Wheatstone, at the third meeting of the Club (June 3rd), produced a "collection of curious letters from Franklin, Priestley, and others relating to the early history of the Royal Society." One, written by the first-named to 'Mr. John Canton of Spital Square, Bishopsgate Street,' about a proposal to award the Copley Medal to Priestley, is copied.[2]

[1] Address on retiring from the Presidency of the Royal Society.

[2] Joseph Priestley (1733-1804), Benjamin Franklin (1706-1790). The latter began his researches in electricity in 1746, which led to his election as F.R.S. in 1753 and the award of the Copley Medal. Four years later, an important political mission brought him to England, where he remained for five years. That medal was received by J. Canton, also a distinguished electrician, in 1751 and 1764.

It is undated, but as Franklin was in England from 1764 to 1775, and Priestley received that medal in 1772, it must have been written either in or just before that year. It states that the Council of the Royal Society had doubted whether they could receive a paper in which Priestley gave an account of experiments already published, and which had been directly communicated to them by Canton instead of being referred to them by the Society. They had therefore decided to consult the Founders' will and reconsider the matter at the next meeting of the Council, when, if the one permitted and the other approved, the medal would be awarded to Dr. Priestley. Thus, as Canton writes, "The business ended for that time, and how it will conclude at last seems an uncertainty, for I think some persons are busy in an opposition to the measure. But I hope it will end in favour of merit, in which case I think our Friend cannot miss it."

The Club then resolved that "Mr. R. Brown, Mr. Forbes, Dr. Royle, and Mr. Wheatstone, be requested to use their best endeavours to procure MS. letters relating to the Royal Society to be submitted to the Philosophical Club."

Afterwards Dr. Royle exhibited specimens of tea which had been grown in the Himalayas, and gave an account of the introduction of that shrub from China, stating that he and Dr. Falconer, the one writing in England, the other in India, after considering such information as could be obtained about the climate and characteristics of China, had recommended Garhwal, with two other provinces,[1] as most suitable for tea cultivation, and nurseries had been established in 1843, with the sanction of the Indian government. From these the India House had already received specimens of both black and green tea, thus settling in a great measure the long-disputed question whether one or two species of the tea plant were employed in making the two different coloured teas. "The first and as yet one of the best specimens of black tea was manufactured while Dr. Falconer

[1] The names are not clearly written in the Minutes.

(President of the Club on that evening) was superintendent of the tea nurseries." [1]

Whether English naturalists should make use of the French system of linear measurement was discussed at the fourth meeting (June 17th), since the 'line' now employed by them was not small enough for all purposes, and was regarded by some as a tenth of an inch, by others as a twelfth. The adoption of the former value was proposed, but it was felt that even then the inch was not the decimal part of a foot, and neither of these corresponded with a Continental unit. The French metrical system had this recommendation, that it was equally favourable to large or small measurements. A change to that received strong support, though the difficulties it would involve were admitted, and the real question felt to be whether these were outweighed by the advantages. It was ultimately resolved that Mr. Owen, who had introduced the subject, should be requested to bring it up at the forthcoming meeting of the British Association at Oxford.

Mr. Grove mentioned on October 28th a phenomenon which he had observed but had not found noticed in any treatise on Optics. A small object, if held very close to the eye, is not visible, but, if a convex lens or compound microscope be placed on its further side, it can then be seen magnified with a tolerably clear definition. This was confirmed by Dr. Miller,[2] who attributed the result to the parallelism of the rays of light which had passed through the lens, though he also was unable to recollect any mention of the fact in print. Mr. Grove said he thought it might have useful applications, such as detecting defects in lenses.

1848. Sir Snow Harris enquired at the ninth meeting of the Club (Feb. 24th) what evidence there was of the earth

[1] According to the *Dictionary of National Biography*, Dr. Falconer superintended the first cultivation of Indian tea in 1834, while Keeper of the Botanic Garden at Sahàranpur, and in that year the plant was discovered growing wild in Upper Assam and cultivated in 1835 near Luckimpur, to the north of the Brahmaputra.

[2] Both W. A. Miller and W. H. Miller were present at the dinner, but the latter is much more likely to have made the remark.

having once been liquid and of its interior being still in this condition, and invited Mr. Hopkins to express his own views. He replied that he thought the subject was not yet ripe for discussion, but that it would be much advanced if Sir H. de la Beche would undertake some experiments on the results of pressure. The latter expressed himself willing to do this, if the requisite funds were provided and friends would co-operate.

During the fourteenth meeting (Oct. 26th) a letter, written by Dr. Hooker from a station in the Himalayas, was read to the Club, in which he said :[1] "Kinchinjunga, the mountain opposite us, is now found to be the highest in the world, 28,178 feet, as measured by the Surveyor-General, who has just announced the result."[2] After referring to the heights obtained for some other peaks and his admiration for the way in which the surveyors' work had been done, the writer continues, "There is not a shadow of doubt that the snow-line is much higher in Thibet than on the south slope of the Himalayas. In Upper Assam (27½°) we have permanent snow at 15,000 feet, but have about 16,000 feet in Kimaweena, (and) 17,000 to 18,000 feet in upper valley of Sutlej ; 36° N. it is 20,000 feet. Is not this defying latitude ? Precipitation and evaporation are the important elements. There is no precipitation in Thibet, precipitation and no evaporation in Upper Assam. The south pole over again ! "

Conversation then turned on the sea-serpent, which according to the newspapers had been seen on Aug. 6th, 1848, by Capt. M'Quhae of the *Daedalus* frigate.[3] Mr. Bell said it had been thought the animal might have been a gigantic land snake, some of which are known to exceed 30 feet in length ; speaking for himself, he recognized the difficulty

[1] The letter was probably written from Darjeeling, where Dr. Hooker arrived on April 16th, 1848, leaving it for the Kinchinjunga district on October 27th.

[2] In *Round Kangchenjunga* (the spelling exhibits variation) D. W. Freshfield gives the elevation as 28,156 feet, stating that it is the third in height of the measured mountains of the globe, yielding place to Mount Everest, 29,002 feet, and to ' K. 2,' which is 28,250 feet.

[3] His letter was dated Oct. 7th, 1848. The creature was seen in the S. Atlantic, lat. 24° 44′ S. and long. 9° 20′ E.

which was presented by the distance from land. Sir Charles Lyell remarked that, when visiting America in 1845, he had heard of an appearance of the sea-serpent, and Mr. Dawson,[1] at his request, had collected the evidence of several witnesses.[2] In the same year an unusual monster, according to a published account, had terrified some Norwegian fishermen. These stories accorded so well with Pontoppidan's[3] account of the sea-serpent that it and they must refer to the same creature as that which visited the coast of New England between the years 1815 and 1825, chasing shoals of herring and mackerel into the harbours of New England and sometimes coming very near to the beach. A good view was obtained of it from the shore, its length being estimated as from 60 to 90 feet, and its appearance described. It raised its head occasionally several feet out of the water, had a mane, swam very rapidly, and when shot at dived and re-appeared at a long distance.[4] He thought the same creature had terrified the crews of fishing boats in the Hebrides in 1808, which was afterwards cast ashore on the Island of Stronsa (Orkneys), and the damaged skeleton was said to have measured 60 feet. The head was sent to Dr. Barclay in Edinburgh, but after his death it unfortunately disappeared. The College of Surgeons possessed some of the vertebrae, which, however, were said to belong to some kind of shark.

[1] Afterwards Sir W. Dawson.

[2] One group had seen a snake-like animal in August, 1845, at Merigomish in the Gulf of St. Lawrence, swimming, nearly aground, within 200 feet of the beach, and estimated its length as 100 feet. It was slender in proportion to its length. A similar creature had frightened fishermen in that gulf in the course of the summer, and in October, 1844, had swum slowly past Arisaig, near the east end of Nova Scotia. An observer, who said he was within 40 yards of it, estimated its length as 60 feet. In February, 1846, a snake-like animal was seen from the deck of a steamer off the coast of Virginia. Lyell also mentions an earlier occurrence in August, 1817, and for several successive years. In the harbour of Gloucester, Mass., some observers were only 10 yards from it, and one even fired a shot at its head; on which it dived and rose about 100 yards away. Its estimated length was 80 to 90 feet.

[3] Born 1698, died 1764. The account was published in 1750.

[4] See *Second Visit to the United States*, ch. viii. vol. i. pages 131-157. 1849.

Mr. Bell expressed doubts whether any shark could correspond with the description of the sea-serpent, but Sir C. Lyell, while admitting the difficulty, suggested a way of overcoming it, and said that the teeth of a shark (*Carcharodon megalodon*) found in the Crag of Norfolk and Suffolk were sometimes very large.[1]

The subject was resumed at the 15th meeting (Nov. 23rd), when Mr. Owen criticized the evidence in favour of the existence of a sea-serpent, and particularly of that said to have occurred in the Hebrides. The two vertebrae from this, in the Museum of the College of Surgeons, belonged to the Basking Shark (*Selache maxima*).[2] He showed how readily false impressions might be produced, and quoted an extract [3] from the private log of Lieutenant Edgar Drummond, which he regarded as more trustworthy than Captain M'Quhae's, for it was written down the same day, and the other one reproduced from memory some two months afterwards. Lieutenant Drummond stated that the head, with the back fin, was the only part visible to him, the one being long, pointed, and flattened at the top, perhaps 10 feet in length, the upper jaw projecting considerably. The fin, visible occasionally, "was perhaps 20 feet in rear of the head. The creature pursued a steady and undeviating course, keeping its head horizontal with the water, and in rather a raised position, disappearing occasionally beneath a wave for a very brief interval. . . . It was going at the rate of perhaps from 12 to 14 miles an hour, and when nearest was perhaps 100 yards distant. . . . It was visible to the naked eye for five minutes and with a glass for perhaps fifteen more. The weather was dark and squally at the time, with some sea running." Professor Owen remarked

[1] They may measure 5 inches along the margin with a basal width of 4 inches. (Nicholson and Lydekker, *Palæontology*, page 945.)

[2] The Basking Shark of the Atlantic (*Cetorhinus maximus*), which grows to over 30 feet in length, and that of the Pacific and Indian Oceans (*Rhinodon typicus*), which can exceed 45 feet, have, however, small teeth. The living species of *Carcharodon* (now named *C. Rondeletii*) attains to 40 feet.

[3] Printed in the *Cornwall Gazette*.

that no serpent has a fin, either dorsal or caudal, and the only known marine animal from 20 to 30 feet in length which could swim at from 12 to 14 miles an hour was *Phoca proboscidea*. This, by the action of its low-set pectoral paddles, could raise at pleasure its head and the forepart of its body above water. He doubted the existence of a 'mane,' for the Lieutenant had not observed this. Both the form and the colour of the part visible agreed with the above-named seal, and nothing else but the large terminal fin would be seen, and that only occasionally. So he thought the supposed sea-serpent was a large species of that seal. A letter from Sir C. Lyell was afterwards read, stating that, since the last meeting, he had seen the vertebrae from Stronsa, which had belonged, as Prof. Owen had said, to *Squalus maximus*. Possibly, as the latter had suggested, we might account for the length, 60 feet, by supposing two specimens to have been washed ashore and their bones arranged as a single skeleton.[1] But such a shark is not likely to have frightened fishermen, nor did its aspect agree with those seen in Norway and in the St. Lawrence in 1845, and so often prior to that in the United States northern seas, so he was not satisfied that the sea-serpent of the north, though doubtless neither ophidian nor reptilian, could have been a well-known kind of shark only 30 or 35 feet long.[2]

1849. At the 19th meeting (March 27th) Colonel Sykes read a letter from Dr. Buist, of Bombay, stating that as the meteorological observations indicated such a general uniformity (the barometer in 1843 standing at 29·824 inches, in 1844 at 29·801 inches, in 1845 at 29·815 inches, and in 1846 at 29·816 inches, the curves, daily, weekly, and hourly being often coincident), he doubted whether, though it would be well to continue observing, it was worth while publishing anything more than the anomalies of the weather. Colonel Sabine, however, thought it would not

[1] This seems a rather improbable hypothesis.

[2] A good recent summary of the Sea Serpent question is given by H. N. Hutchison, *Extinct Monsters*, etc. (1910), page 315.

be prudent to discontinue either making or printing the observations.

Mr. Grove afterwards asked for the reason why currents of air, when they issue from tubes on flat surfaces, instead of blowing these away, rather attracted and drew them closer. Mr. Wheatstone replied that rather complex explanations of this had been given, which, however, amounted to supposing that the fugitive particles of air produced a vacuum, and then the surrounding air kept the surfaces together. Mr. Grove replied that he had, of late, been inclined to take that view, by observing that when matter was moving in any direction than that in which gravity acted, its weight was diminished. In the above-named experiments the surfaces would remain equally mobile in any direction when all was tranquil, but when the air between them was in rapid motion transverse to the direction in which gravity acted, they would be kept by this at a certain distance.

At the 20th (anniversary) meeting (April 30th), Mr. Wheatstone read a letter from Dr. Hooker, who wrote from Darjeeling to say that he had just returned from a three months' journey among the snows of Eastern Nepal and Sikkim, in the course of which he had reached in mid-winter a height of from 13,000 to 14,000 feet on a mountain 28,000 feet high.[1] The weather had been remarkably fine, he had brought back safe his two portable barometers, had kept 'a tolerable meteorological register with many hundred observations,' and corresponding observations had been made for him at Darjeeling. He had visited four snowy passes on spurs from Kinchinjunga, and had camped for three days on its southern face in the snow, which, however,

[1] On this adventurous expedition, described in chapters ix. to xv. of the *Himalayan Journals*, Dr. Hooker travelled on the western and southern side of Kinchinjunga, encamped at elevations of 13,000 feet, and ascended to heights, or crossed passes, from 16,000 to 17,000 feet above the sea. The occasion mentioned seems to have been early in January, 1849, at some cattle huts called Jongri, 13,140 feet, to the north-west of Mon Lepcha, near the Rathung river. Strictly speaking, it is on the southern flank of Kabru (24,015 feet) rather than Kinchinjunga, but the two peaks are connected by a ridge every part of which is above 22,000 feet.

drove him down by falling deeper and deeper. The upper part of that mountain, above 20,000 feet, is a great outburst of granite which "protrudes in veins at 12,000 feet, and above this carries up the mica-schist and gneiss in enormous masses to 18,000 and even 20,000 feet, baked and distorted in the most extraordinary manner."

Afterwards Mr. Forbes read a letter from Mr. McAndrew, then examining the sea bordering the Spanish coast, in which he stated that in the Bay of Vigo, the continuity of the Lusitanian fauna, north and south of it, was interrupted by an assemblage of littoral forms of the British type, among them being a number of *Fusus contrarius* so common in the (Red) Crag. Mr. Forbes pointed out the bearing of this fact on the land continuity, which he had supposed once existed between South-west Ireland and North-west Spain.[1]

Information about recent observations of scientific interest on the Continent was invited at the 21st meeting (May 24th), when Mr. De la Rive (guest) stated that M. Plücker had proved by experiment that when a mass of bismuth of any shape was fused and then cooled between the poles of a powerful electromagnet, it afterwards would resume that position in regard to those poles; thus indicating a property of the metal, unless (as was just possible) it contained iron, the particles of which would produce this result by arranging themselves along that axial line. He had also been informed by M. Plücker that the absolute weight of certain liquids increased under the influence of magnetism without any change of their density. Du Bois-Reymond[2] had shown that if any one held in each hand a metal tube communicating with the terminals of a galvanometer this was deflected, if one arm were held out, the other remaining bent; but when the converse was done, the galvanometer was deflected in the opposite direction, the positive electricity passing from the outstretched hand through the galvanometer to the curved hand.

[1] See *Memoirs Geological Survey*, vol. i. pages 336-403.

[2] Well known for his researches in electricity and psychology. Born at Berlin in 1818; died there in 1896.

Dr. Marcet (guest) stated that, according to M. Bernard,[1] a considerable quantity of sugar existed in the liver, and was also present in the heart, the secretion of which ceased immediately when the pneumogastric nerve was cut. M. Bernard had also found the pancreatic juice to have a chemical action on fatty matters, causing their assimilation and conversion into parts of the chyle, so that the one was necessary for the healthy formation of the other. In rabbits the secretion between the biliary and pancreatic ducts was found to differ much (as described) from the chyle. These experiments, he thought, might have an important bearing on certain forms of disease. Mr. Bowman mentioned another discovery of M. Bernard, that an animal after injury to its brain passed urine loaded with sugar, and Mr. Bell said that green food, taken from the stomach of a rat and pressed out of a silk bag, became milky when treated with bile.

During the 22nd meeting (June 21st), Sir Philip Egerton read a letter from Professor Agassiz[2] announcing his discovery that the heterocercal tail of a young *Lepidosteus* exhibits the same form as that of *Dipterus* or *Diplopterus* in the Old Red Sandstone. He had also obtained from Lake Superior a new genus intermediate between the Salmonoid and Percoid fishes, and thus illustrative of forms occurring in the Cretaceous Period. Besides this, Tertiary forms are met with, and he remarks, "It is one of the extraordinary features of this continent that there are so many types of ancient families still living here."

Sir R. Murchison then communicated a letter from M. Barrande,[3] of Prague, who wrote that he had succeeded in

[1] Claude Bernard (1813-1878), the noted French physiologist, who began to make his mark about 1841 and gave up a Professorship at the Sorbonne in 1868 for one at the Jardin des Plantes. His first important work was on the function of the pancreas gland, and his second on the glycogenic function of the liver. To these researches Dr. Marcet doubtless referred.

[2] J. L. R. Agassiz (1807-1873), born at Motier, Canton Friborg, Switzer land, and, after graduating in medicine at Munich, made his mark as a naturalist and became a Professor at Neuchatel. From 1836 to 1844 he devoted much time to studying the glaciers of the Alps.

[3] Joachim Barrande (1799-1884). Born at Sauges in France, he followed Charles X. into exile, and became tutor to the Comte de Chambord. Settling at Prague, he devoted himself to the study of the Palaeozoic fossils of

tracing *Sao hirsuta* from its embryonic condition of a simple disc-like body through twenty stages to a fully formed trilobite—an important discovery, for it not only illustrated the life-history of that crustacean, but also reduced the number of so-called species; for, in a recently published work on Bohemian trilobites, M. Corda had made ten genera and eighteen species out of a part only of these stages in the development of *Sao hirsuta*.

Professor E. Forbes said that, as a lady had found on trial, sea-water could be kept in a healthy condition for animal life by pouring part of it backwards and forwards through the air.

Dr. Royle then read a letter from Dr. Hooker referring to Arrian's account of plants found by Alexander's army in the deserts of the Gadrosi.[1] These are (1) trees, abundant and reaching a large size, which exude a gum like myrrh—the googal balsam tree; (2) the salt-marsh trees with thick laurel-like leaves and fragrant white flowers; this suits *Aegiceras magnum*; (3) one with a thorny stem and acrid juice, *Euphorbia narcifolia*. These three cannot be mistaken, and are found within twenty miles of Karrachee.[2] The odoriferous herb (*ναρδου ῥιζα*) is the only plant difficult to identify, for there are two or three herbaceous plants on the rocks in Scinde called wild nard. He thought the 'root of nard' collected by the Phoenicians must have been that of the reed-like grass generally named *Calamus aromaticus*, found in dry hot parts of India, the distilled oil of which is commonly called oil of spikenard.[3]

Bohemia, of which he formed an unrivalled collection, described in his *Système Silurien de la Bohême*, 22 volumes of which had been published before his death. (See *Geol. Mag.* 1883, p. 528.)

[1] See Arrian, *History of Alexander's Expedition*, book vi. ch. xxii. He makes the statement on the authority of Aristobulus. The army was returning.

[2] Dr. Hooker did not personally visit this part of North-western India, but probably obtained the information about its flora either at the Botanic Gardens of Calcutta or from Dr. Thomson, with whom he spent about nine months in exploring the Khasia mountains.

[3] Arrian states that they gathered good store of the roots, and that the plants, when trodden under foot, perfumed the air.

At the 23rd meeting (Oct. 25th), Dr. Playfair gave a short account of an accident in the sewers at Westminster, and Mr. Rennie referred to the drainage system of St. Petersburg, which he had recently examined, and gave his reasons for preferring the plan of taking the sewage of London into the Thames to any other method.

To an enquiry about Sir J. Franklin's expedition, Mr. Goodsir replied that the explorer's brother doubted whether the rumour that the Esquimaux had fallen in with its members could be trusted, for none of them possessed a knife of a peculiar shape, which had been taken for giving away, so as to be an indirect means of tracing the expedition.

A letter written from Swansea and read at the 24th meeting of the Club (Nov. 22nd) described a remarkable meteor of a bright red colour which was seen from near that town on the evening of Nov. 2nd.

Afterwards Sir J. Richardson [1] gave some account of his expedition in search of Sir J. Franklin, mentioning, in addition to what had been published in the newspapers, some peculiar limestone hills which occur shortly after leaving the Mackenzie River. About 300 miles west of the latter were clays of an Upper Tertiary age, which ignited spontaneously.

Colonel Sykes mentioned a curious instance of variation of rain-fall in India, for, from May to September, no less than 338·38 inches of rain had fallen at the Convalescent Station at Mahabaleshwar, on the Western Ghat, while at Paunchgunny, close by, it had been only 58 inches.

Professor Owen gave an account of the illness, and death on Nov. 20th, of the Rhinoceros at the Zoological Gardens, and described its anatomy. Of this comparatively little had been known, and the accounts published were all written by Fellows of the Royal Society, and appeared in the

[1] Sir J. Richardson (1787-1865) was surgeon and naturalist to Franklin's polar expedition in 1819-21, and was with him in his second expedition to the mouth of the Mackenzie River, 1825, parting from him in the following year and exploring the coast to the Coppermine River, afterwards visiting the Great Slave Lake. He conducted a search expedition for Franklin in 1847, and returned to England without success on Nov. 6th, 1849. His 'Journal' of the expedition was published in 1851. (See page 25.)

Philosophical Transactions, namely one by Dr. James Parsons in 1743, a second by Mr. W. Bell in 1793 on a two-horned Rhinoceros, dissected at Bencoolen, and a third by Mr. H. L. Thomas in 1801.[1]

The members present at the 25th meeting (Dec. 20th) discussed a recent report of the Commissioners appointed to enquire into the application of iron to railway structures. Mr. Rennie reported that experiments, conducted by and for them, had shown that a load traversing a bar produced a greater deflection than if it were placed on the middle part, and that as the velocity of the traversing weight increased, so did the deflection; that corresponding with a rate of thirty miles an hour being more than double of the amount produced by a 'dead weight.' The greatest deflections also were not in the middle but towards the extremity of the bar most remote from the point of access, a result which had not been anticipated by the Commissioners, but had been predicted by Professor Airy, the Astronomer Royal.

1850. At the 26th meeting (Jan. 24th), Dr. Hooker's imprisonment in Sikkim was mentioned, and Lord Dalhousie was said to have taken steps to secure his release.[2]

Sir J. Richardson gave an account of rich deposits of native copper in the neighbourhood of Lake Superior,[3]

[1] *Phil. Trans.* xlii. p. 523; *id.* 1793, part i. p. 3; *id.* 1801, p. 145.

[2] Dr. Hooker was then travelling with Dr. Campbell, the superintendent of Darjiling, which was purchased about 1840 from the Rajah of Sikkim. The story, a rather complicated one, is told in chapters xxv. and xxvi. of the *Himalayan Journals*. They were arrested on Nov. 7th, 1849, at their camp when returning from an attempt to travel in Thibet, and were detained till Dec. 24th. The motive was the hope of extracting from Dr. Campbell, who was at first violently assaulted, a treaty favourable to the ambitious designs of the Rajah's chief minister. Accidental circumstances prolonged their captivity, which ended when the chief offender found that Lord Dalhousie was not to be trifled with, but for a time their lives were evidently in danger.

[3] The metal occurs "in 'trappean' rocks and their associated conglomerates (ascribed by Whitney to the Lower Silurian Period) in Michigan on the southern shore of Lake Superior. . . . Masses of nearly pure copper, weighing over 400 tons, have been met with. . . . The bulk of the produce is, however, obtained by stamping and washing rock containing from ¾ to 4 per cent. of copper." J. A. Phillips and H. Bauerman, *Elements of Metallurgy* (1887), page 399. (They are late Precambrian in age.)

saying that hitherto the difficulty of separating it from the mass had much impeded a profitable development of the metal.

Colonel Sykes, at the 27th meeting (Feb. 28th), drew attention to two sources of grave error in observations with wet-bulb thermometers. These were (1) a possible lowering of temperature by the proximity of a dry-bulb thermometer; (2) in calm air its own vapour, by forming an enclosing shell, might make readings fallacious; (3) if that shell is removed by a current of air, the velocity of the latter affects the temperature of the bulb; (4) it is also affected by radiation from surrounding objects; (5) the dew-point determined by Apjohn's formula, appears to be too high with small depressions of the wet-bulb thermometer, but much too low with considerable depressions. The last matter he discussed in some detail.

A letter from Dr. Layard,[1] read at the 28th meeting (March 28th), announced the discovery of some new sculptures in Assyria. Attention was called to the importance of securing daguerrotypes of all figures too heavy to be moved, and this led to a discussion on photographic questions.

The 29th (anniversary) meeting fell on April 29th, when Mr. Spence referred to the exhibition of two flies at the Zoological Society, apparently identical with a species described by Bruce, the bite of which drove cattle mad, and which seemed to have a resemblance to the Hornfly.[2]

The subject of photography was resumed, and Lord Rosse remarked that Ronconi was reported to have daguerrotyped some of the nebulae, but he doubted whether the light of a nebula would suffice to produce a daguerrotype that would be of any use, and whether an equatorial could yet be

[1] Afterwards Sir A. H. Layard, G.C.B. (1817-94). He was then, viz. from October, 1849, till some time in 1851, working at either Kayunjik or Nebi-Yunus, having begun excavations at Nimrud in 1845 and sent to England, in the following year, the large man-headed winged bull and lion, which are now, with other important pieces of sculpture, obtained in this (see *Nineveh and its Remains*) and the later expedition, preserved in the British Museum.

[2] *Haematobia serrata*, a pest to cattle in Abyssinia.

constructed with such an extremely accurate movement as is now frequently required. He described practical difficulties which had arisen on making drawings of nebulae, and thought photography might be applied to them, if sufficiently sensitive plates could be made. To an enquiry about the measurement of γ-Virginis, Lord Rosse replied that he had not worked at double stars with his telescope, for the nebulae occupied the observer's whole time.

When Sir R. Murchison raised the question of lunar volcanoes, Lord Rosse replied that he had observed several features, corroborating the idea that the moon's surface wholly consisted of them. These were such as, holes in the apices of the conical mounds in the centres of the basins, material on the plains resembling ejected débris, streams like consolidated lava, in some of which light could be seen through an arch over a fissure, and the white lines consisting of precipitated snow-like matter. As the conditions on the moon—diminution of gravity, absence of wind, etc.—differed from those on the earth, the character of the surface could not be identical. He regarded, however, with some scepticism the statement that an actual eruption had been observed, though the number of craters appeared to multiply with the improvement of telescopes, for nearly twice as many could be seen on any part of the moon's surface with the six-feet reflector as with the three-feet one. To a remark that the volcanoes of the moon appeared to have been active where its surface was in a viscous condition, Colonel Sykes replied that he had received by the last mail an account of the discovery of mud volcanoes at Materam in India.

At the 30th meeting (May 23rd) Mr. Galloway made some remarks about daguerrotyping astronomical objects, and Mr. Grove spoke of the differences in the aspects of some of the mountains on the moon, according as they were more or less illuminated. After this Dr. Royle gave the results of investigating the action of physical agents on plants. In cotton the length and fineness of the fibre are more dependent on the continuous presence of a moderate degree of moisture in the air than on any other cause. This, he thought, accounts for cotton being chiefly cultivated near the coast, or, at any rate, in districts where vapour-laden winds are prevalent. In Egypt or in the great river valleys of Central India, irrigation might produce the same effect.

At the 31st meeting (June —[1]), Mr. Grove again referred to the illumination of the mountains of the moon, stating that one of them, in four days, might change in aspect from a bright to a dark spot, after which Dr. Royle read a letter from Dr. Jameson announcing the discovery in the Punjab of an extension of the Salt Range to the north-east; another from Mr. Adam referring to a collection of Punjab birds which he was forming, and a third from Mr. Fortune[2] stating that he had despatched to India from the coast of China tea plants and seeds, and that upwards of 2000 of the former had arrived in safety.

The 32nd meeting (Oct. 24) was signalized by Sir C. Lyell's announcement that a stuffed specimen of *Dinornis*, hitherto known only from skeletons, had been found among a collection of birds recently received from New South Wales. This corresponded very nearly with the form inferred from the bones.[3] He also stated that another mammalian jaw had been obtained from the Stonesfield slate.[4]

Colonel Sabine gave an account of Regnault's hygrometer

[1] Day of month omitted in Minute.

[2] Robert Fortune (1813-1880) visited China for the Horticultural Society in 1842, and for the East India Company in 1848; also Formosa and Japan in 1853; he introduced several well-known plants into England, was active in promoting the culture of tea in India, and published accounts of his journeys.

[3] There is some mistake here. The specimen in any case must have originally come from New Zealand, for the moa has not been found in Australia. The moa also has not been seen by any European, though it probably has not been long extinct. Can the apteryx be the foundation of the story?

[4] It is difficult to identify this specimen. Owen, *Fossil Mammals of the Oolite Formations* (Palaeont. Soc. 1870), p. 12, enumerates three specimens of *Amphitherium Prevostii*, one of *A. Broderipii* and one of *Phascolotherium*, as described by him in or before 1846. A fourth, *Stereognathus ooliticus*, also described by him, was noticed in 1854 (British Association). Possibly this may be the above-mentioned specimen, though it had been found some years earlier.

and his method and apparatus for making thermometers, which was followed by a letter from Mr. Welch to Mr. Gassiot describing in detail the system followed at Kew Observatory in electrical and meteorological observations.

At the 33rd meeting (Nov. 21st) Colonel Sabine said he had received from Dr. Wolfgang Haecker, of Nuremberg, a horse-shoe magnet, weighing 35 grains, capable of supporting, if certain precautions were taken, 4785 grains (135 times its own weight). Mr. Gassiot remarked that the same maker had sent one to him, weighing 40 grains, which had held up a total weight of 4599 grains (115 times its own weight).

At the 34th meeting (Dec. —[1]) Colonel Sabine said that a magnet, weighing 36 grains, had now been received from Dr. Haecker, which supported 5280 grains, or 146 times its own weight.

Mr. Grove drew attention to an effect produced on the retina by rubbing the eye before looking through a lens, placed at one end of a tube, when striae, crossing one another, make their appearance. For instance, if a convex lens of one-inch focal length be thus placed in a tube six inches in length, and the light of a candle, placed one foot from the other end, be viewed through a pin-hole in it, after the eye has been slightly pressed by the finger, these striae are visible, accompanied occasionally by black spots, which he attributed to the derangement of small vessels and secretions in the eye, which were thus rendered visible.

1851. On Jan. 30th, the 35th meeting, Mr. Grove exhibited specimens from Dr. Schönbein,[2] of Basle, illustrating the effects of insolated oxygen on such chemical substances as sulphide of antimony, of arsenic, and of lead, but which were not produced by oxygen, kept in the dark.

Professor E. Forbes read a letter from M. Puggaard, of Copenhagen, on the geology of the Island of Moen.[3] He

[1] Figure omitted.

[2] Christ. Fried. Schönbein, born at Wurtemberg, 1799, died at Baden Baden 1868, appointed Prof. of Chemistry at Basle 1828, who did some important work, especially in organic chemistry.

[3] Described by him in *Moens Geologie* (1874).

had come to the conclusion that there both the chalk and the Pleistocene Tertiaries were affected by disturbances, which had occurred between the deposition of the Glacial or Pleistocene drift and the last boulder period.[1]

Colonel Sykes gave an account of a number of mud craters, small and large, extending for 25 miles along the coast of Lus, to the N.W. of Cutch and the mouth of the Indus.[2] They emit gas (the nature of it undescribed) together with mud.

At the 36th meeting (Feb. 27th) Dr. Faraday said, in reference to Mr. Grove's communication at the previous meeting, that Professor Schönbein writing to him on Dec. 28th, 1850, mentioned his discovery that oil of turpentine and essence of lemon, if exposed for some time to the joint action of pure oxygen (or atmospheric air) and light, can become 'most energetic oxydizing agents,' changing the colour of indigo solutions, and turning with the utmost facility the metallic sulphides into sulphates. Experiments which he had made fully confirmed Professor Schönbein's conclusions.

Dr. Lyon Playfair remarked that artists would give a large price for turpentine which had been long exposed to sunlight in half-empty bottles, because it possessed peculiar properties in dissolving cobalt.

Mr. Gassiot described at the 37th meeting (March 27th) an apparatus, recently obtained by the Kew Observatory, for graduating with great accuracy thermometer and barometer tubes, after which Sir R. Murchison spoke of a new war-steamer on the wave principle, the outcome of some experiments undertaken for the British Association, and built for the King of Prussia. It was 550 tons burden, and had engines of 160 horse-power, making, on the average,

[1] See Lyell, *Antiquity of Man*, ch. xvii., for a fuller account. In the *Quart. Jour. Geol. Soc.* vol. lv. (1899), pages 305-311, reasons are given by myself and Canon E. Hill why we were unable to accept the above-named explanation, or that which attributed the disturbance to the thrust of an ice-sheet.

[2] See Lyell, *Principles of Geology*, for a fuller account (ed. 11, vol. ii. pages 76-7).

$15\frac{2}{3}$ statute miles an hour. It could carry and fire efficiently. as had been proved by experiments which he quoted, a heavier armament than any other vessel of the same size in the British Navy. As a sister ship had already proved its competency in heavy weather, naval officers had considered such vessels to fulfil all the requisites of a good sea-boat.

At the 39th meeting (May 22nd) Professor Bond of Harvard Observatory, and M. Metelet were present as guests. The former spoke of the progress made in applying the daguerrotype to astronomical purposes. Attempts made at Boston to photograph the sun had been failures, notwithstanding every precaution, because of the intensity of the light, but the Cambridge telescope of 22 feet focus and 15 inches aperture had succeeded well with the moon. Records of the double star Castor and of Jupiter with its belts and satellites had also been obtained.

Afterwards M. Metelet described the method of tracing atmospheric waves by comparing times of the actual and expected barometric minima at different stations. The atmospheric oscillations appear to proceed from the north, and travel more readily over the sea: large tracts of land, and particularly mountain chains, such as the Urals, presenting a barrier to them. In the progress of these waves the oscillating air appears to set up two currents, the upper one proceeding from north to south, and the under in the reverse direction. The lines of vegetation seem to have some relation to these waves, but that has not yet been accurately established. Colonel Sabine remarked that observations in America would be most valuable, because of the peculiar physical character of that continent.

Professor Plantamour, a guest at the 40th meeting (June 19th), mentioned that barometric observations made at Geneva and at the Convent on the Great St. Bernard,[1] showed that temperature produced differences, which might amount to 120 feet, between the observed and the calculated

[1] He published an elaborate essay on them in 1860 (*Mem. de la Soc. de Physique et d'Histoire Naturelle de Genève*, t. xv.).

heights. When asked what allowances were made for local causes, such as the presence of clouds, he replied that exact comparisons had not yet been made, but that observations, taken at the Convent nine times daily by competent scientific men, promised to be of considerable value.

Mr. Grove said that he had found by experiment the advantage of resinous compounds as a substitute for flint glass to secure achromatism in telescope lenses. The best ingredient was a cement formed by nearly colourless resin and castor oil, the refractive and dispersive powers of which could be altered within certain limits, and which was sufficiently pliant and tenacious to yield to the expansion of the glass by temperature. Among other promising experiments, he had very satisfactorily corrected a bad lens by using this composition. That was done some months ago, but he mentioned the matter, because he had read in a Catalogue of the Exhibition[1] that a telescope there had a solid material, the composition of which was kept secret, instead of flint glass. M. Plantamour said that oxide of zinc had been substituted for oxide of lead in flint glass, and that glass so made was less liable to corrosion by exposure to the atmosphere.

Mr. Horner referred to investigations in the Nile Valley, undertaken to ascertain the rate at which alluvium had accumulated, by ascertaining its thickness around monuments, the date of which was known, and thus to connect historical and geological time. It was intended to begin at the Obelisk of Heliopolis, the age of which was known.[2]

At the 41st meeting (Oct. 30th) Captain Skogman, of the Swedish Navy, who was a guest, announced that the measurement of an arc of the meridian was about to be repeated in his country, and observations were then being taken to ascertain whether the Baltic and the Polar seas differed in level.

To the 42nd meeting (Nov. 27th) Mr. Bell gave an account

[1] The well-known one opened May 1st, 1851.

[2] See Lyell, *Antiquity of Man*, ch. iii. (especially pages 40, 41, ed. 4), and *Principles of Geology*, vol. i. pages 430-434, ed. 11.

of the boa constrictor at the Zoological Gardens, which had recently swallowed a blanket, stating that instances were on record where this snake in darting at its prey had seized other things, and had been apparently unconscious of its mistake.

The occasional fall of fishes during showers of rain in India was discussed on Dec. 18th. Colonel Sykes thought the spawn was caught up by a whirlwind, but Dr. Hooker held that it was the fish themselves, for the whirlwinds, during the monsoon season, are frequently very powerful. All the members who had been in India agreed that such falls really occurred.[1]

Dr. Royle, in reply to an enquiry, said that tea was now grown on more than 2000 acres from Kumaon westwards on the lower slopes of the Himalayas.[2]

Mr. Porter spoke of a cloth, the invention of Klaussen, and made half of sheep's wool half of flax, some of which he was then wearing.

Dr. Hooker said that a museum was then in process of construction at Kew to be devoted to foreign products, and the conversation turned on a project for removing the Crystal Palace, or part of it, to Kew, and for appropriating the surplus fund to a school of design, a thing much needed. Colonel Sykes asked him why plants in India, though the ground was waterless and cracked by heat, burst suddenly into flower. Dr. Hooker thought it due to the sudden access of heat to water lying at some distance below the surface.

1852. Dr. Playfair, at the 44th meeting (Jan. 29th), stated that, eighty years ago, Lady Moira had proposed the plan of making cloth, mentioned at the last meeting, and was presented with a medal at Manchester, but the effort had failed owing to the fiscal regulations of that day.

[1] "Showers of fish and frogs are by no means uncommon, especially in India." In one which occurred in 1839, the fish, all of one kind, were about three inches long. See Ferrel, *A Popular Treatise on the Winds* (1890), page 414, and pages 381 to 393, for instances of the lifting power of tornadoes.

[2] In 1908 it amounted in India proper to over 531,000 acres, *Encycl. Brit.* (India).

At the 48th meeting (May 27th) Dr. Marcet communicated some recent researches by Dr. Bernard, which showed that section of a sympathetic nerve increased animal heat on the corresponding side. On that also where the nerve was divided, the heat was more or less persistent, and was less affected by alterations of external temperature. Thus, if the general temperature was raised, that of the side, where the nerve was whole, was raised more than on the side where it was divided, and if the general temperature was lowered, the lowering was greater in the former case than in the latter to a larger extent than had happened in the first instance. This effect, as yet, had not been explained.

He also mentioned some curious instances, observed at New Orleans, of increase of temperature in the human body after death. These appeared to proceed, in some cases, from a lingering vitality in the organism after apparent death, in others to the contrary—the death and putrefaction of portions of the organism, prior to that of the individual.

He further stated that at Geneva, during this spring, N.E. winds had lasted consecutively for 90 days.

Dr. Du Bois-Reymond's electrophysical experiment (21st meeting) was again mentioned. A discussion took place, but without any confident expression of opinion, on the question, whether the deflection of the galvanometer, on contracting the muscles of one arm, arose from the proper muscular action or from increased secretion in the incurved finger or other secondary actions.

Colonel Sykes at the 49th meeting (June 24th) referred to the importance of using balloons for meteorological observations, now that the management of them was in proper hands and better understood. Mr. Green,[1] he added, who was about to give up making ascents for the amusement of the public, was willing to aid in the advancement of science. Lord Wrottesley said that the Council

[1] Charles Green (1785-1870) made 528 ascents between 1821 and 1852, when he ceased to be a professional aeronaut. In the former years he made the first ascent with carburetted hydrogen gas, and in 1836 travelled through the air from Vauxhall to Weilburg in Nassau.

of the Royal Society had considered a proposal of this kind fifteen years ago, but had been deterred from acting on it by the serious practical difficulties which then presented themselves.

The familiar fact that the barometer falls before rain and rises after it was then discussed, and the intention expressed, which, however, was not fulfilled, of resuming the subject at the next meeting.

Dr. Carpenter stated that the bars of the Menai Bridge,[1] after having been some time in place, had been found to have become highly magnetic and also brittle. Mr. Grove thought that the former effect was probably due to their vertical position and constant agitation, in lines approximately parallel to those of terrestrial magnetism. He did not regard the brittleness as a necessary consequence of the magnetism, though it also was probably a result of the continual vibratory disturbance. It had been shown by experiment that the elasticity of metals was affected by electric action and magnetization.

1853. At the 58th meeting (June 18th) Dr. Miller[2] gave some account of the standard instruments, lately prepared at Kew; weights had been made from 1 pound avoirdupois to 0·01 of a grain. For the heavier—from 100 to 7000 grains—gun-metal, thickly electro-gilt, had been used, and platinum for those less than 100 grains. A standard yard had been laid down upon a flat-rolled brass scale between gold pins. These standards had been used in constructing, for meteorological purposes, two barometer tubes of one inch internal diameter. He added some details of the operation of boiling the mercury in these unusually large tubes.

[1] The Suspension Bridge, opened in 1825, must be meant, though the Britannia Tubular Bridge was completed in 1850.

[2] This must have been Prof. W. A. Miller, for in the course of his remarks he mentioned Prof. W. H. Miller, of Cambridge, who was an active member of the committee, appointed in 1843 to reconstruct the standards of weight and measurement destroyed by the burning of the Houses of Parliament in 1834. The work was completed by 1854, when the standards of weight, length, and capacity were authorized (18 and 19 Vict. ch. 72).

A letter from Sir J. Richardson, read at the 59th meeting (Oct. 27th), stated that he had been informed by Lieut. Cresswell that on Baring Island,[1] trunks of pines, that must be drift-wood, occur frequently in a gravel or mud which forms a mound of considerable size at least 200 feet above the present sea-level. All over the Arctic Islands shells are found belonging to species still living in the seas, thus indicating a rise of land to that extent in times, geologically speaking, very recent.[2] Lieut. Cresswell had also mentioned that, in the same region, considerable quantities of silicified wood were embedded in a limestone.[3]

Sir C. Lyell mentioned that Dr. Lea, of Philadelphia (who was present as a guest), had been the first to discover a bone of a saurian (of which a jaw had been found since he left that city) in a rock wherein only footprints had previously been observed. It was not yet certain whether the formation was Triassic or somewhat later, but this probably was the oldest remnant of a large reptile which, as yet, had been discovered.[4]

Colonel Sabine showed the Club a bottle made of green glass, which was egg-shaped, the neck having been broken off. It was one of several found on the coast of Siberia rather east of Nova Zembla, where two great currents meet. One of them had been closed by a stopper. Both the Russian government and our own had endeavoured, but without success, to ascertain where these bottles were made. They were not in use in the country where they had been found, and none like them had been supplied to Sir J. Franklin or other Arctic travellers.

Sir R. Murchison said that General Haug was planning an expedition to explore the north-eastern part of Australia in the hope of discovering a passage by the Victoria and Albert Rivers to the Gulf of Carpentaria.

[1] Now called Baring Land, the southern part of Banks Land, about lat. 71°-72°.

[2] For other instances see *Manual for the Arctic Expedition*, 1875, pages 538-540.

[3] See same *Manual*, page 538.

[4] Perhaps it was that afterwards named Clepsysaurus and from the Trias.

At the 60th meeting (Nov. 24th) Colonel Sabine said that a Norwegian at Lloyds had identified the bottle exhibited at the last meeting as one of those used by fishermen of his country as floats for nets.

He also gave some account of the magnetic action of the moon, as observed at the earth's surface. This reached a maximum when the planet was on the upper and lower meridian and a minimum when halfway between these positions—results bearing on the question whether the moon was idiomagnetic or magnetic by induction.

Mr. Bowman explained how the eye adapted itself to distance, showing that the images reflected from or near the anterior part of the crystalline lens advance, when the eye is used to view near objects, while those formed on the posterior surface remain stationary, showing an increase in convexity of the anterior surface of the crystalline lens for near objects. When the eye was submitted to galvanism the image examined by a microscope changed its position, so as to show an increased convexity, which after a time became permanent.

At the 61st meeting, on Dec. 22nd, Mr. Rennie gave an account of the steam engine of M. du Trimblet, which he had seen on a recent visit to France. This uses ether in addition to water, the principle being that the condensed vapour of water, which has done its work in one cylinder, is used as a source of heat to vaporize ether in a second cylinder, and thus gives additional power by utilizing the heat of the water, which hitherto had been wasted. He had seen the engine applied to propel a boat, and had formed the opinion that it used about half the ordinary amount of fuel. The ether wasted cost only about one franc per hour in an engine of 45 horse-power, and the boat had performed twelve voyages of 800 miles each. The principal objection that occurred to him was the danger of explosion or combustion from the vapour of the ether.

1854. At the 63rd meeting (Feb. 23rd) Mr. Horner read a letter from Sir C. Lyell, written from Madeira, giving an account of the geology of that island, with enthusiastic praise of its scenery.[1]

Sir R. Murchison announced the discovery of true coal at Heraklea on the Asiatic coast of the Black Sea, the first to be found in the Russian dominions.[2]

At the 65th meeting (April 24th) a letter was read from Captain Spratt, who had been called away from the Aegean to join the Black Sea fleet, giving a short account of the coal mentioned at the last meeting. Its quality was excellent, equal to the best Newcastle, and certainly it was shown by fossils to be anything but modern (as had been asserted). Dr. Playfair, who had examined specimens, said the coal, at the edge of the field, changed to a kind of anthracite.

Professor Owen exhibited the skull of a species of *Felis* which had been found at a depth of 70 feet near Buenos Aires. It resembled a tiger, but the upper jaw had two large canine teeth, the corresponding canines in the lower jaw being small. So far as known, it represented an extinct species.

Lord Rosse, at the 66th meeting (May 25th), spoke of his experience (with Dr. Wood) in the application of photography to astronomical purposes. This convinced him that results of practical value would not be obtained till the collodion could be made more sensitive. He also described an apparatus for moving the plate, and a new process for polishing the surface of mirrors used in large reflecting telescopes.

Dr. Carpenter said that, as he had found, photographs, taken in a microscope with a $\frac{1}{12}$-inch objective, revealed,

[1] Sir C. Lyell went to Madeira early in January, 1854, and after a stay of about three weeks passed on to Teneriffe, Palma, and the Grand Canary. The letter, dated January only, is printed in *Life, Letters, and Journals of Sir C. Lyell*, vol. ii. pages 191-3. But on comparing with this the manuscript copy in the Minute Book, I find several differences. Some words in it are incorrectly written, others are left blank as illegible to the copyist. Two or three clauses, with merely personal details, and one long section, giving a description of the succession of rocks in the island, with a diagram, are omitted. But probably this last was done, because, even in 1881, the account would be less interesting than it was in 1854. In the printed copy, however, on page 192, "rents" should be "vents."

[2] But Heraklea is on the northern coast of Asia Minor in the province of Kastamuni, and thus Turkish.

when examined with a hand lens, more than could be seen by the unaided eye. He went on to speak of the binocular microscope,[1] saying that a defect in the original instrument had now been overcome by Nachet, a French optician. With the latter he had examined Polycystinae from Barbados, using a ½-inch objective, with admirable results.

According to Colonel Sykes, Mr. Bonelli, superintendent of the electric telegraph at (?) Sidmouth, had devised a plan for replacing the card process in the Jacquard loom by a telegraphic apparatus which, he maintained, would reduce the cost of working that loom by two-fifths.

Oct. 26th. 68th meeting. Mr. Wheatstone described a 'difference engine,'[2] invented by M. Schwarz, then on view at Bermondsey, and exhibited tables calculated and printed by it.

Mr. Rennie suggested a plan for closing the southern channel of the Bay of Cronstadt (not more than 8 feet deep) by sinking ships across it, which would cause it to be silted up.

At the 69th meeting (Nov. 23rd) Colonel Sykes read a letter from the Messrs. Schlagintweit, dated 'off Alexandria,' and giving the general results of their examination of the temperature and density of the water in the Mediterranean, which they had taken several times daily. Their observations showed that, in proceeding eastwards, the specific gravity increased.[3] A discussion followed on the methods of bringing water from great depths, and on some recent analyses of such water.

Sir Proby Cautley gave an account of the difficulties encountered in the construction of the Ganges Canal, lately

[1] It was devised in 1851 by Professor J. L. Riddell, of New Orleans, and constructed in the following year. See *The Microscope and its Revelations*, by W. B. Carpenter (Ed. Dallinger, page 97).

[2] The elaborate calculating machine, at which C. Babbage worked from 1822 to 1842, was given up in the latter year. One which was a greater practical success, and is still used, was produced by M. Thomas, of Colmar, about 1850.

[3] The temperatures of the western part of the Mediterranean are noticed, after more systematic soundings, in Wyville Thomson, *Depths of the Sea*, ch. vii., and that of the Ocean in his *Voyage of the Challenger* (*the Atlantic*), and in certain of the special Reports of that expedition.

completed.[1] The chief were: bad building materials, bad foundations (sand and alluvial mud), and the impetuous torrents, due to the proximity of mountains. He described how these—especially the second and third—had been overcome; the former by constructing either vertical cylinders of brick or blocks of the same material, perforated with similar cylinders, which were allowed to settle down, till they came to rest in the sand. In this way whole piers and abutments of bridges were constructed. The latter difficulty—the large and rapid torrents—was overcome by carrying them either under or over the canals.

Colonel Portlock, in reply to a question, gave some account of the siege of Sebastopol, which, he said, presented exceptional difficulties, because of the rocky nature of the ground. Still, notwithstanding these, the progress by blasting had been wonderful, and the final result was not doubtful.[2]

Dr. Hooker exhibited some fine specimens of fossil leaves of dicotyledons, apparently trees, brought by Captain Beechey's expedition from Disco Island (Greenland). These were peculiarly interesting as coming from a region within the Arctic circle, now occupied by a very different vegetation. They occurred in a shale, overlying thick beds of coal, and probably belonged to the Tertiary era.[3]

Mr. Grove informed the Club that he had seen a medal of the new metal aluminium, considerably larger than half a crown. Its colour was good, its outline sharp, and its

[1] He had superintended that work in 1843-5 and 1848-54, being created K.C.B. in the last-named year.

[2] The siege of the southern side, on which the defences had been hurriedly prepared by General Todleben, began late in September, 1854. After the capture of the Malakoff and Redan on September 8th, 1855, that side of the city was evacuated by the Russians.

[3] Since the above date, many specimens have been collected and brought to Europe. Heer in *Flora Fossilis Arctica*, 1868-73, described 137 species. These include many kinds of trees, thirty of them conifers; also beeches, oaks, and magnolias. He considered them to be Miocene in age. See A. Geikie, *Text Book of Geology*, page 1271. A similar flora (with lignite) was found by Captain Feilden at Discovery Bay, Grinnel Land, lat. 81° 45′ N., in 1876. Heer, *Quart. Jour. Geol. Soc.* 1878, page 66.

specific gravity between 2 and 2·5.[1] The metal was remarkable for strength and lightness combined, and had been produced by the sodium process.

1855. At the 72nd meeting (Feb. 22nd) Dr. Playfair described a method for the preservation of vegetables which had been invented by Verdel. They were compressed and dried, after supersaturated steam had been blown through them, but they recover their form and colour after being slowly boiled.

Mr. Rennie described a method of preserving meat, raw or cooked, by extracting from 50 to 60 per cent. of the water and then immersing it in gelatine prepared from the bones of the animal. Large quantities of both the vegetables and the meat had been ordered by the Government for use by the army in the Crimea.

Mr. Gassiot exhibited a dinner fork, covered with silicon, which had been deposited by the galvanic process. Mr. Grove suggested that aluminium might be used for voltaic purposes, since it is highly electro-positive and not attacked by nitric acid.

Dr. Playfair mentioned that calcium had the colour of gold, and if it had a different allotropic state might replace that metal for electrotyping processes.

Dr. Bence Jones read extracts from a letter by Du Bois-Reymond, dated Feb. 4th, 1855, mentioning that, in Wöhler's Laboratory,[2] leucine had been prepared from inorganic elements, together with some of the higher members of the homologous series of fatty acids. Also that artificial tallow was about to be made to replace the Russian.

Dr. Miller announced that alcohol had been made from olefiant gas. Mr. Wheatstone remarked that this had been

[1] Probably this was from aluminium prepared by M. Sainte-Claire Deville, whose first researches were published in 1854. See for the history of the metal up to 1887, J. A. Phillips, *Elements of Metallurgy*, s.v. Aluminium. Even then the author writes, "Up to the present time aluminium has not found the extensive application for which its properties would appear to fit it." He states that its specific gravity varies from 2·56 after fusion to 2·67 after hammering.

[2] Friedrich Wöhler (1800-1882) began a new era in the branch of organic chemistry by the artificial production of urea in 1828.

discovered by Faraday many years ago, and the result had now been obtained by more than one process.

At the 73rd meeting (March 22nd) Admiral Smyth read a letter just received from Captain R. P. King with the news that some remains of Leichardt's party had been found.[1]

Dr. Miller mentioned a proposal to fire guns by using Ruhmkorff's coil. The method was equally applicable to various submarine purposes, and no difficulty was apprehended.

Dr. Bence Jones read a letter from Professor Du Bois-Reymond stating that the cellulose, which Virchow asserted to be present in the brain, had proved to be one of the compounds of cholesterin, which presents the same reaction as cellulose, " so this time we get off with the fright of being closely allied to the cabbage."

Attention was drawn at the 74th meeting (April 30th) to a statement made in the House of Commons that a paper manufactory was to be established at Woolwich, because the cartridge-cases, made by a manufacturer at Aberdeen, in which pulp was used instead of paper to prevent the overlapping of the latter (which interfered with the accuracy of firing), could not be packed with sufficient closeness to travel with safety and economy.

At the 75th meeting (May 10th) Sir John Richardson mentioned that the hostility of the Loucheux Indians to the Eskimo occupying the country about the mouths of the Mackenzie River was diminishing in consequence, it was believed, of the visits of the boats and ships of the expedition to those shores.

He also mentioned that six or seven years ago the shoulder-bone and tooth of a mastodon had been found on a spit by the Swan river, to the west of Lake Winnipeg, at a height of 800 feet above the sea, in lat. 52°. The spot had recently again been visited. In lat. 62°, to the north-west, at an elevation of 1800 feet, a skeleton of a mammoth had

[1] F. W. L. Leichardt (born in Prussia in 1813) went to New South Wales in 1841, crossed the Australian continent from east to north in 1844-5; started to cross it from east to west in 1848, and was never heard of again.

been found some years ago in excellent preservation. This, however, had been unfortunately lost in a lake, with the exception of a tibia, which was now in the Haslar Museum.

Mr. Grove, at the 76th meeting (May 24th), spoke of some observations of Saturn's rings published in the *Atti della Reale Accademia dei Lincei*, made with a telescope of 14 feet focal length and a 9-inch object glass, which showed the dark portions of both the main rings to be, not shadows, but interspaces between successively lighter rings.[1]

Mr. Huxley mentioned some observations by Professor Kölliker in regard to the action of solutions on spermatozoa and cilia. When these were weak their movements were stopped, but not killed, for they recommenced when the solution was strengthened. They were stopped by water, but renewed by the addition of sugar, gum, and neutral salts. They were prolonged by caustic alkalies, but killed by acids.

Colonel Sykes had received letters from the Schlagintweits, announcing their return to Calcutta and the safety of their instruments.

Mr. Horner stated that seventy-two pits had been sunk across the Nile valley, through desert sand, to a depth of 7 feet above the level of the Mediterranean. In the excavation near the statue of Rameses at Memphis, pieces of brick, tile, and pottery had been found 48 feet below the surface, and thus 40 feet below the pedestal of the statue, which is 78 feet above the Mediterranean, and was erected, according to Lepsius, about 3200 years ago.[2]

At the 78th meeting of the Club (Oct. 25th) Prof. Faraday was reported to have announced at the Royal Institution that nickel, when heated, gained in magnetic power.

Dr. Hofmann stated that experiments undertaken by

[1] This must refer to the two outer rings, though the third—the faint inmost one—was discovered in 1850.

[2] The first set of pits was in the latitude of Heliopolis, where the valley is 16 miles wide. The other is one of a set across the valley, where its width is 5 miles (Lyell, *Antiq. Man*, ch. iii.).

himself and his guest, M. Cahours,[1] showed ammonia (NH_3) and phosphuretted hydrogen (PH_3) to have a great analogy. As in compounds of the former, each equivalent of hydrogen may be replaced by ethyl, methyl, and amyl, so, in the latter, the same can be done, thus forming new and highly basic substances in every way corresponding with the hydrogen compounds.

M. Cahours, in reply to an enquiry from Admiral Smyth about the cost of manufacturing aluminium, specimens of which had attracted so much notice at the Paris Exhibition, said that some totally different method of manufacture must be devised, before it could be produced cheaply, so that at present it was regarded as a curiosity, which had only a theoretical interest.

Colonel Sabine gave an account [2] of a remarkable tornado which had occurred on April 30th, 1852, near New Harmony, in Indiana, U.S. The breadth of the whirling air-column appears to have been about a mile, and at nine or ten miles on either side the air was calm enough to allow of ordinary agricultural work, but in the track of the tornado, trees, many of them 15 feet in circumference, were overthrown, frequently being twisted half round before this happened. Its axis moved at the rate of about 60 miles an hour, first N. 30° E. for 50 miles, and then a little N. of E. for 200 miles further, the change of direction corresponding with an angle in the Ohio valley, to which its course was roughly parallel. The sky was described by persons in the neighbourhood as a cloud, with vivid blue, green and red light on its lower part. At 3 p.m., in a place four miles on one side of the axis, the thermometer stood at 80° and the barometer at 29·09 inches. At 4 p.m. the first flash of lightning occurred, which was followed by a heavy, driving hailstorm; the stones sometimes measuring 8 inches in circumference and weighing four ounces. At that time the thermometer

[1] Probably Professor A. A. T. Cahours, a distinguished French chemist, elected Professor of Chemistry in the École Polytechnique at Paris, who was born Oct. 2nd, 1813, and died March 17th, 1891.

[2] It had been published in *Smithsonian Contributions*, vol. vii. article 2.

had fallen 2° and the barometer risen 0·08 inch. The latter maintained this rise, while the tornado passed over, but afterwards, by 5.45 p.m., it had fallen by the same amount. The thermometer continued to fall during the passage. Mr. Chappelsmith, who gives the account, considers the phenomena to be consistent with the rotatory theory, but indicative of an ascending column of air in the axis of the tornado, with an influx of air towards it from the sides.

At the 79th meeting (Nov. 22nd) Colonel Sykes stated that gutta-percha [1] had been discovered in the Peninsula of India.

Mr. Grove gave an account of a visit to the family of M. Séguin, the inventor of wire-bridges and tubular boilers, who has a large estate in the Côte d'Or, and related how his great-uncle Montgolfier had discovered the balloon which bears his name. He had been airing his wife's gowns, and observed them to become inflated and tending to rise when filled with heated air. On her return she found her husband sending up little paper balloons, and thus originating his invention. He then referred to experiments of M. Séguin on the conversion of motion into heat, which formed the subject of a discussion.

At the 85th meeting (May 22nd, 1856) Dr. Playfair described an improved method of nature-printing, due to a student at Marlborough House. The object is dabbed with lithographic ink, transferred to the stone, and then worked upon by acid. By this means the 'velvety' texture of the leaves is perfectly retained. The impression may also be transferred to copper and etched in the usual manner.

Colonel James explained how greatly photography had expedited the production of maps at the Ordnance Survey. By employing it, the 25-inch map was reduced to the 6-inch scale with perfect accuracy.

[1] Dr. W. Montgomerie, of the Indian Medical Service, introduced it to England for practical purposes in 1843, the Malacca Peninsula and Malay Archipelago being the chief source of this juice of one or more species of *Isonandra*, and by 1860 the quantity imported exceeded 16,000 cwt., but it is now much greater

Mr. Gassiot informed the Club that Ruhmkorff had obtained a secondary spark 2½ inches long from his induction apparatus.

At the 86th meeting (June 19th) Dr. Hooker read a letter from Colonel James referring to the Ordnance Survey maps, and exhibited some specimens of them.

Dr. Bence Jones read a communication from Professors Müller [1] and Kölliker,[2] stating that, if the nerve of a rheoscopic frog were spread over the beating heart (removed from the body) of another frog, a secondary contraction of the former attended every systole of the latter. The experiment succeeds only with one frog out of two or three, but in such case the secondary contractions will go on for ¾ hour or more. But the most remarkable thing is that the secondary contraction of the rheoscopic frog a little precedes the primary contraction of the heart itself.

At the 87th meeting (Oct. 16th) Mr. Rennie described a new and economical method of making steel, devised by Captain Uchatius, of the Vienna Arsenal; exhibiting a box of cutlery manufactured in that city from Styrian iron, and bars made, on Oct. 10th, at his own works, from Indian cast-iron and common English cast-iron, Herr Karl Leng, partner of Captain Uchatius, operating on each occasion. The effect of this new process would diminish by about one-half the expense of making steel, and would produce in a few hours a result which usually required three weeks, and sometimes double that time. It consisted in running a certain amount of melted iron into a crucible of water. This converted it into shot-like particles. Of these 24 pounds were mixed with 6 pounds of crushed ore, and with half that amount (as was said) of manganese peroxide. After the addition of a little fire-clay the whole was melted

[1] Johannes Müller (1801-1858), born at Coblenz, Professor of Anatomy and Physiology at Bonn 1826, and at Berlin 1833, regarded as almost the founder of modern Physiology.

[2] Albert von Kölliker (1817-1905), born at Zurich, where he became Professor, and was then appointed to the Chair of Anatomy at Würzburg in 1847. Distinguished especially for his work on microscopic anatomy and on the development of the embryo.

down. The bar, produced from this, was then hammered, and proved to be excellent steel. "The importance of this process for reducing the cost of steel in the manufacture of tires, axles, piston-rods, boiler-plates, and other important machinery can hardly be estimated."

On Nov. 13th, the 88th meeting, Mr. Grove described the recent occultation of Jupiter by the moon, as he saw it through quite a small telescope (magnifying about 43 times). As the planet approached the moon, it seemed to project towards the disc of the latter, and this gave way to an apparent flattening of both bodies, producing a definite line between them, as Jupiter skimmed the edge of the moon for 10° or 15°. If the observation could be trusted, this might be due to the moon's atmosphere or perhaps to its disc being only partially illuminated. The light of Jupiter was not so bright as that of the moon, and looked more blue.

Colonel Sykes communicated the results of some excavations made by Mr. Augustus Bellasis on the site of an Indian city, about 80 miles to the north-east of Hyderabad, which had been destroyed by an earthquake in the eighth century. These showed the arts to have been well advanced. The people could blow and cut glass, could make china like Stafford ware, could put glazes on clay and trace designs upon hard stones without incision. Masses of steel, cast in crucibles, with charcoal attached, were met with, and a house containing a lapidary's tools. The town was about three miles in circumference, and its destruction, as skeletons were found in the houses, must have been sudden.

Professor Tyndall exhibited an apparatus invented by M. Matteuchi for determining the power of crystalline bodies to conduct electricity in different directions. This was formed mainly of bars of bismuth, about 2 inches in length and 2 lines in width, of which the cleavage planes were sometimes parallel with, sometimes perpendicular to, their length, and the differential galvanometer showed the rate at which each set conducted electricity or heat.

He also, with Prof. Huxley, gave an account of investigations which they had undertaken to ascertain the relation between the veined structure in glacier ice and rock cleavage.[1] The results, in their opinion, threw considerable light on the theory of glacier motion.

At the 89th meeting (Dec. 11th) Professor Huxley invited attention to Professor Von Siebold's recently published work, *Parthenogenesis bei Schmetterlingen und Bienen*, in which he brought forward strong evidence to show that the females of certain *Pychidae* and of *Bombyx mori* produce fertile ova without previous fecundation, and with the former the process may be repeated for several generations. With the bees, not only can the unimpregnated Queen-bee lay fertile eggs, but she also appears to fertilize, after impregnation, only those ova which are laid in neuter or female cells, those laid in drone cells remaining unfertilized.

Professor Tyndall drew attention to the fact that the green colour of many of the Swiss rivers and lakes had not yet been explained.[2]

1857. At the 90th meeting (Jan. 18th) Sir C. Lyell reported that, at his suggestion, Mr. Beckles[3] had opened a quarry in the Purbeck Beds in search of fossil mammals and had already discovered about thirteen species.[4]

On Feb. 5th, the 91st meeting, Professor Tyndall described some more observations on the physical structure of ice. Agassiz, he said, had noticed that bubbles made a peculiar noise when escaping from the surface of thawing glacier ice,

[1] Professor Tyndall did not yet feel satisfied that he could demonstrate this veined structure to be, like cleavage in rocks, the effect of pressure as the ice was forced through a narrow part of a valley. That happened in 1858. See *Glaciers of the Alps*, part ii. sect. 27 (1860).

[2] In his *Glaciers of the Alps*, part ii. sect. 7 (1860), he suggests that the greenness and the blueness may be due to the presence of mud of increasing fineness in the water. He afterwards worked out this idea, which is now generally accepted.

[3] Samuel H. Beckles wrote some papers on footprints and fossils from the Wealden, became F.G.S. in 1854 and F.R.S. in 1859. He died in August, 1890.

[4] Sir C. Lyell gives a full account of these and subsequent discoveries in his *Elements of Geology*, pages 379-384 (6th ed.). In *Mesozoic Mammalia* (Palaeontographical Society, vol. xxiv.) Professor Owen describes and figures (with others) Mr. Beckles' specimens, which he assigns to eleven genera and about twice as many species.

attributing this to the escape of air enclosed in cavities and acted on by heat that had passed through the ice. He (the speaker) had compressed a quantity of snow into ice like that of a glacier, and then by heating it obtained the results observed by Agassiz.[1] Such ice also showed a veined structure at right angles to the pressure, and this structure was sometimes exaggerated into a true cleavage.

Dr. Carpenter gave the results of his studies of the green grains in 'Greensands,' which he had found in rocks as far back as Silurian, and which proved to be casts of foraminifera made by a greenish, siliceous material. He gave particulars of the cast of a curious *Orbitolite*, the calcareous part of which had disappeared, as is well shown in Ehrenberg's figures.[2]

Sir R. Murchison observed that the Greensands were a good example of the value of Palaeontology, for it had proved those near St. Petersburg to belong to the Silurian Period, which Brongniart had supposed to be Tertiary.

At the 94th meeting (May 14th) Dr. Barth [3] was a guest, and gave an account of Timbuctoo. The people are such strict Mohammedans as to forbid the use of tobacco. To that creed they had not long been converts, for it was forced upon them by the Fulahs, a warlike race of Arabs, which had subdued a great part of Central Africa. The natives are not true negroes, their hair is not woolly, and they show an affinity, like the Madagascar people, to the Malays. They are intelligent, but speak an unwritten dialect, Arabic being the learned language, in which histories exist, of both Timbuctoo and Bornou, that go back to the fifteenth century. They are giving way to the Tuaregs, who exact

[1] See *Glaciers of the Alps*, part ii. sect. 5 (1860), and *Hours of Exercise in the Alps* (1873), pages 362-8.

[2] See W. B. Carpenter, *The Microscope and its Revelations* (Dallinger's Ed.), page 827, note.

[3] Heinrich Barth (1821-1865), a German, 'One of the greatest modern scientific travellers,' began his journeys in countries near the Eastern Mediterranean in 1845. In 1850 he started from Tripoli and explored thence to Adamáwa in the south and from Bagirmi in the east to Timbuctoo in the west, returning to Europe in 1856. His great work, *Travels and Discoveries in Central Africa*, was published 1857-8.

tribute from them. The town Timbuctoo has a resident population of above 13,000 persons, and a shifting one of about 10,000.

At the 95th meeting (June 11th) General Sabine read a letter from the Archduke Maximilian of Austria, thanking English men of science for the interest they had taken in the preparation of the exploring expedition of the *Novara.* All the instruments, which had been prepared and verified in England, had been safely received, and the vessel had reached Gibraltar, which was to be its basal station for magnetic observation on the voyage to the Cape of Good Hope.[1]

Mr. Grove, at the 97th meeting (Nov. 19th) said that, during the past autumn, he had discovered the skin of a newly captured trout to have photographic properties. When leaves, or other objects, were pressed upon the skin, on either side of the upper part, they left a very perfect outline, which was negative in character, the darkest portions being those more exposed to the light. No such impressions appeared on the under surface. Professor Huxley thought that the effect might be due to contraction of the chromatophores (sacculae containing colour) upon the surface of the fish. Dr. Carpenter and Dr. Sharpey thought the suggestion worth following up, but said that chromatophores had not yet been actually found in the trout's skin.

Professor Tyndall described an ascent of Mont Blanc made during last autumn,[2] when he and his companions had felt extreme prostration during the last part, having to halt after each fifteen steps. He called attention to the blue tint seen in a hole made by thrusting an alpenstock into the snow.

At the 98th meeting (Dec. 17th) Mr. Horner gave further particulars about the borings in the Nile Valley. Fragments of coarse pottery had been found at a depth of 45 feet. Taking as a basis for calculation the statue of Rameses II.

[1] The expedition returned in 1859 after about three years' voyage, and the results were published 1862-77.

[2] An account of it is given in *Glaciers of the Alps*, part i. sect. 11.

(1394 B.C.) near Memphis and about one-third of a mile from the river, the rate of accumulation would be about 3½ inches per century, but this, as he explained, could not be regarded as very precise.

Professor Du Bois-Reymond described in a letter to Dr. Bence Jones his studies of three specimens of *Silurus electricus*[1] from the coast of Africa. From the largest, 9 inches long, he obtained 15 to 20 shocks on alternate days. The smallest, about 4 inches long, died; the middle one, as it became sickly, he killed. Only a single nerve, easily laid bare, went to each electric organ.

1858. To the 99th meeting (Jan. 21st) Dr. Sharpey described Dr. Livingstone's plans for a journey in Africa. He intended to establish a settlement on the high land near the junction of the Kafue and the Zambesi rivers, some distance below the Falls, to test the suitability of this region for cultivating cereals, and to study the tsetse fly, with the possibility of exterminating it.[2]

In regard to this fly Mr. Grove suggested experiments which might be advantageous, mentioning its singular aversion to human excrement. Mr. Spence advised comparing it with the *zuni* fly described by Bruce in Abyssinia.

Dr. Sharpey wished that some fly-fisher would investigate the temperature of living trout, as he believed it to be higher than that of water.

General Sabine informed the Club that Dr. Hochstetter of the *Novara* had written to him from the Cape of Good Hope. The vessel was to proceed thence to the Nicobar Islands.

At the 100th meeting (Feb. 18th) Sir Snow Harris exhibited and described a modification of Lind's wind gauge.

[1] The electric catfish, now called *Malapterurus* and separated from *Silurus*, belongs to Tropical Africa; that inhabiting the Nile grows to about 4 feet in length.

[2] He started March 10th, 1858. He was rewarded by the discovery of Lakes Shirwa and Nyassa, the northern shores of which he explored, but met with many disappointments and trials, including the death of his wife. He returned to London July 23rd, 1864 (see *Zambesi and its Tributaries*, 1865).

General Sabine said that Sir C. Lyell had heard from Mr. Mallet,[1] who wrote from Naples, where he was engaged in investigating the effect of the recent earthquake in Southern Italy. He had not found any change in the level of the Temple of Serapis, but the Posilippo tunnel, near Naples, showed several new cracks, and was in a tottering condition. He was shortly going on to Calabria.

Mr. Grove mentioned that the object-glass in an old Dollond 6-inch telescope had been sensibly improved by inserting a metallic ring about one-eighth of an inch from the glass.

At the 101st meeting (March 18th), Sir Charles Lyell communicated two letters written by Mr. Mallet from Naples, after his return from Calabria. There he had suffered much from the cold, and in crossing Mount Vultur he had to force his way through a sudden fall of snow 5 feet in depth. In order to trace the effect of the earthquake in a northerly direction, he intended to return home by way of Rome.

Sir C. Lyell also called attention to a possible cause of inaccuracy in estimating the height of the Temple of Serapis, namely, the action of the wind in raising the sea above its ordinary level, and so damming back the water of the hot spring. The staple to which a bronze ring had been attached, below the level of the water, was an important point in measuring the elevation of the floor.

The Geographical Society, according to Sir R. Murchison, had given a favourable reception to a proposal made by "a gentleman of the name of Baker," [2] who had had considerable experience of travel in tropical climates and explored parts of Ceylon. This was to land at Algoa Bay

[1] The results were published in his book, *The Neapolitan Earthquake of 1857*.

[2] Samuel White Baker (1821-1893), knighted 1866. He must have changed his plans, for he explored the Nile tributaries of Abyssinia 1861-2, and then, after a stay at Khartoum, went up the White Nile to Gondokoro, where in February, 1863, he met Speke and Grant on their return from the Victoria Nyanza. Proceeding southwards he reached Lake Albert Nyanza and returned to Khartoum in May, 1865.

and explore the part of Africa between the Zambesi and Port Natal. He hoped to have the company of Captain Palliser,[1] and would be glad if men of science would suggest matter deserving investigation.

On April 20th, the 102nd meeting, Dr. Gassiot exhibited a photograph of spots on the sun, taken at Kew with the photoheliograph on March 15th last, which showed that the principal difficulties in manipulation had been surmounted.

Professor Tyndall stated that he had found by experiments that the readiness with which liquids assume a spheroidal condition depends on their power of absorbing radiant heat, and this, when of low intensity, is readily arrested in those into the composition of which hydrogen enters.

Dr. Hooker said that Dr. Livingstone, writing from Sierra Leone, had stated that Lieut. Glover, in his journey after the wreck of the *Dayspring*, had recovered some of Mungo Park's[2] manuscripts, written on stray leaves of a table of logarithms.

On May 20th, the 103rd meeting, M. Brown-Séquard[3] (guest of Dr. Bence Jones) described the results of his experiments in transfusion of blood on dogs and rabbits *in articulo mortis*, to which they had been brought by injuries to the intestines and peritoneum. When apparently at the last gasp, with the heart barely beating, blood was transfused from other animals. This produced instantaneous effect—restoration

[1] Perhaps W. R. G. Palliser, commander in the Royal Navy, who, in 1854, distinguished himself in expeditions against Chinese pirates.

[2] Mungo Park (1771-1806) explored the Upper Niger from 1795 to 1799. He undertook, under Government auspices, a second expedition in 1805, and was killed, with all his men, on his journey down that river, at Boussa (Northern Nigeria) in a conflict with the natives, but the particulars of his fate were not ascertained till 1812.

[3] C. E. Brown-Séquard, born at Port-Louis, Mauritius, on April 8th, 1817, had an American for father and a French woman for mother. He graduated in medicine in Paris, and for a time practised in London. Then he held Professorships in the United States and in Paris, to which he finally returned as Professor of Experimental Medicine at the Collège de France, where he died on April 2nd, 1894. He was highly distinguished as a physiologist, who was a daring experimenter, and made most valuable contributions to science.

of breathing, the heart's action, consciousness, and volition. In some cases these lasted for several, and in one case for 11¼ hours.

Mr. Busk enquired whether salt and water of the same density as the blood would have produced similar effects, for transfusion of this mixture in cholera cases had prolonged life, even for sixteen hours.

Dr. Sharpey said the injection of salt and water had never effected a permanent cure; febrile symptoms had generally supervened and carried off the patient. He had tried, in cases of asphyxia, to restore animation by transfusion, but without success.

Dr. Falconer gave some particulars about the bone caves in Devonshire, towards the excavation of which the Royal Society had granted £100. They had the same general character as those explored by Buckland twenty-five years ago, but which had been since then much neglected. One group of ossiferous fissures in the limestone, containing bones of animals no longer living in Britain, was on the slope of Windmill Hill, near Brixham.[1] It had been purchased some time back, apparently as a speculation, by a dyer, who was asking too high a price for liberty to excavate it. The other cave, Kent's Hole, near Torquay, had been known since 1615. Here excavations were undertaken by the Rev. J. MacEnery, who died in 1843, after working on them for some twenty years. His collections were unfortunately dispersed, and his manuscripts bought for wastepaper by a tailor. In some of these caves the contents apparently belonged to two widely separated epochs: the lower to the Pliocene, the upper to the Glacial. A cave in Gower, which contained bones of an African rhinoceros, proved marked changes of level, for it was now many feet above the sea, and yet contained sea-shells. As regards the presence of the

[1] For the history of the excavation of the Brixham Caves and Kent's Hole, see *Memoir of William Pengelly* (1897), pages 296-314, under whose indefatigable supervision the work was effected. MacEnery's manuscript, at first supposed to have perished, was happily recovered and was printed, also by Pengelly's care, in the *Transactions of the Devonshire Association*, vol iii. pages 196-482.

rhinoceros, M. Lartet,[1] a French geologist, had suggested, in explanation of a similar mixture of southern and northern animals, that the former, at a time of greater cold, had reached Spain, where their remains occurred in the upper gravels, and had migrated as far north as the Rhine.

At the meeting on June 17th, the 104th, Dr. Falconer, invited by the chairman (Mr. Horner), continued the subject of the Devonshire caves, stating that the owner of the Windmill Hill cave had now agreed to more reasonable terms, and Miss Burdett Coutts had given £50 towards the expense of excavation.

A memorial to the Chancellor of the Exchequer in favour of retaining the Natural History Collections at the British Museum was read, and was signed by the majority of the members present (eighteen in all).

At the 105th meeting (Oct. 28th) Sir C. Lyell gave an account of his late visits to Vesuvius[2] and Etna. On the former, during September, he had been able, as the steam and irrespirable gases escaped by the great crater, while the lava was discharged from two flattened dome-shaped cones at its base, to approach within a few feet of the spot from which the lava was issuing. It was white-hot at the moment of its escape, moving at the pace of a fast-flowing river; in a few yards it changed to a red heat, and then quickly became encrusted with black scoria, and this, as the upper part was the first to solidify, took the shape of loops of rope, with down-pointing curves. Afterwards he spent five weeks

[1] Edouard Lartet (1801-1871), the distinguished French palaeontologist, who, after valuable studies of the Upper Miocene vertebrata in the South of France, and those of the Pliocene Age from Pikermi in Greece, devoted himself to exploring the ossiferous caverns in the limestone region of the southern Provinces, publishing his first paper in 1860, and then co-operating in Perigord with our late countryman, Henry Christy. The results were published in *Reliquiae Aquitanicae*, commencing in 1865. They are now given in most of the larger text-books of Geology and Anthropology.

[2] A severe and protracted eruption of Vesuvius began on May 21st, when lava issued from seven new mouths on the north and north-west sides of the cone, one great stream flowing towards and on either side of the Hermitage. A branch of it, which is crossed by the ordinary road up the mountain, is a very good example of the 'corded' type of lava, black and vitreous. See *Life, Letters, and Journal*, vol. ii. pages 291-293.

on Etna.[1] There he had seen several compact lava streams inclined at angles of from 20° to 40°; that of 1688, which is 5 feet thick, being as compact as 'Scotch trap.' In some places it lay at an angle of 48°, but its thickness here was only 2½ feet. At one part of the mountain horizontal lava beds rested on others which were highly inclined; thus indicating two centres of eruption, as it was at Teneriffe. Nine-tenths of the fossils, collected from sedimentary beds under Etna, belonged to existing species; so the volcano had been built up in later Tertiary times.[2]

Professor Tyndall described his examination of the veined structure in Alpine glaciers, to compare it with the slaty cleavage of rocks. He had found the former cutting the stratification of the snow at all angles up to 90°.

Dr. Falconer recurred to the excavations in the Devon caves. The one carried inwards in a horizontal direction above the stalagmite floor of the cavern had come upon reindeer antlers in good preservation. About 2½ feet vertically below them, after breaking through this floor, several specimens of what were known to antiquarians as flint knives were found in good preservation. Then came a 'bed of ochry loam' about 11 feet thick, and then a gravel, flint knives being found in both, and in the loam bones of rhinoceros and hyaena belonging to the Glacial Period.

Mr. Wheatstone then exhibited some specimens of paper, pierced for transmitting messages by a form of printing-telegraph which he had invented. It could produce about 320 symbols or letters a minute.

At the 106th meeting (Nov. 25th) General Portlock gave an account of the trials of Armstrong's guns at Shoeburyness. One, with a nine-pounder bore, but a rifled barrel, had thrown an oblong 18 pounds shot, with an error of only 20 feet in 7000 yards. A 12-pound shot from a 6-pounder gun had

[1] *Op. cit.* vol. ii. pages 303-311.

[2] See *Principles of Geology*, vol. ii. page 6 (ed. 11) for a more precise statement, and chapter xxvi. for a general discussion of the structure of Etna and its two eruptive centres.

pierced through 6 feet of solid oak at a distance of 400 yards, and gone 200 yards on the other side.

At the next meeting, the 107th, on Dec. 16th, he resumed the subject of these Armstrong guns. They are breech-loaders, the rifled barrel being of steel, which is bound round with a spiral band of welded wrought iron, the weight being somewhat greater than that of a brass gun of similar calibre. He also described the shell, which is built up of segments, united by lead and enclosed in an envelope of the same, to secure its fitting closely to the rifling of the barrel. Guns of three sizes have been made—one, a six-pounder, throwing a twelve-pound shot; another a nine-pounder, throwing an eighteen-pound shot, and the third a sixteen or eighteen-pounder, throwing a thirty-two-pound shot. The first sent a twelve-pound shot, which at 600 yards penetrated eighteen inches into a brick wall, and then exploded, doing it great injury. One hundred rounds, 98 of which passed through a target 9-foot square, were fired from the same gun in as many minutes, and after that it showed no signs of injury. The eighteen-pounder threw a thirty-two-pound shot 9600 yards, with a deflection of 20 feet. Sir R. Murchison remarked that bringing into the Navy these guns, on the breech-loading principle, would mean that only eight men instead of thirteen would be required for working each of them.

1859. Mr. Horner called attention, at the 108th meeting (Jan. 27th), to the remarkable contrast between the recent winter temperatures in England and the United States. In the one the weather had been very mild; in the other, at 6 a.m., the thermometer had been down to $-32°$ F. at Keene, New Hampton, to $-38°$ at White River Junction, and to $-40°$ at St. Johnsbury. In Halifax it registered $0°$ at 8 a.m.; in New York, $-16\frac{1}{2}°$ at 3 a.m., and in East Boston, $-18°$.

In a conversation which followed, arising from an announcement of the success of a subscription, initiated at a previous meeting, in aid of an artist whose drawings of microscopic objects had been very useful to workers in science, the idea of a Royal Society Relief Fund was discussed, and strongly supported.[1]

To those present at the 109th meeting (Feb. 24th) Mr. Wheatstone exhibited the results of experiments made by M. N. de St. Victor with nitrate of ammonia and permanganate of potash in order to produce a specially sensitive paper. Copies of engravings were taken in about fifteen minutes by using the former salt, while the blue impressions resulting from the latter required an hour for their completion. Another experiment was to wash over a paper with tartaric acid, expose it to sunlight for two minutes, then roll it up loosely and enclose it in a dark metallic case, where it was left for six minutes. At the end of that time, the case was opened, a few drops of water thrown in, the whole warmed, and the case inverted over a sheet of photographic paper, above which was placed the original to be copied. In a few minutes a negative transfer was effected, developed, and fixed in the usual manner. Mr. Busk mentioned an experiment, made about twelve years ago, in which paper was washed in the dark, first with nitrate of silver, next with tartaric acid, and then placed between the closed leaves of an old printed book for twelve hours. After being removed in the dark, it gave, on exposure to sunlight, a copy of the printed page. A copper-plate engraving, however, did not admit of this kind of transfer.

At the 110th meeting (March 24th) Dr. Bence Jones read a letter from Professor Du Bois-Reymond. His experiments had shown that, if the sciatic nerve were divided on one side of a rabbit, and the animal then killed by strychnine, the muscle in the paralysed limb had an alkaline reaction, and that in the tetanized part an acid one. The result was unfailing in rabbits, but not always so in dogs. One of his pupils had proved the indirect irritability of muscular fibre by showing that, after the destruction of the nerve, hydro-

[1] The idea was further discussed at the next meeting, and the Treasurer requested to write to each member of the Club to ascertain his opinion on the subject (the Minutes contain a copy of the letter). The fund was established in the course of the year; see page 52.

chloric acid, diluted to one-tenth per cent., caused the muscle to contract, and ammonia produced the same result, even when more diluted.

Mr. Paget mentioned a case of a patient whose tendon Achilles had been divided. The thermometer in the ward stood at 65° F.; on the surface of the foot and in the wound itself only at 70°. He thought this due to the sluggish movement of the circulating fluid.

Sir B. Brodie said that, in the case of dogs, where life was prolonged by artificial respiration, the circulation might continue till the temperature throughout the body had fallen to about 70° F.

It was mentioned at the 112th meeting (May 26th) that Dr. Falconer had discovered flint implements among the bones of preglacial animals in the cave of Maccagnono; on which Professor Huxley observed that the absence of stratification in the deposit reduced the value of its evidence in regard to the extreme antiquity of the human race, while Mr. Grove thought the non-occurrence of human bones to be singular.

At the next meeting (113th) Dr. Falconer was present, and gave a description of the cave.[1] Charcoal and rude flint implements occurred beneath stalagmite in a breccia containing bones of *Elephas antiquus*, the hyaena, a large bear, a *Felis* (probably *F. spelaea*), and numerous bones of the *Hippopotamus*. "The vast number" of the last shows that "the physical condition of the country must have been greatly different, at no very distant geological period, from what obtains now"; yet, since then, the top of the material filling the cave had been cemented to the roof by stalagmite, after which the greater part of its contents had been cleared out.

Dr. Perthes[2] (a guest) said he had discovered among some

[1] The Minute corresponds in all important respects with the account given in Lubbock's *Prehistoric Times*, pages 260-262.

[2] This is probably one of the noted publishers at Gotha. He might be a son of F. C. Perthes (born in 1772 at Rudolstadt), who, after establishing himself at Gotha, became noted as a publisher of historical and patriotic

neglected manuscripts a poem describing the invasion of England by William the Conqueror; also a maritime history of Genoa, commencing in 1099, and continued by authority of the Senate; the last entry being by John Doria, who gives an account of two ships sent round Africa to the East Indies. They never returned, and the last surviving descendant of their crews was found by the Portuguese who were coasting Africa prior to the departure of Columbus (1492).

At the 114th meeting (Oct. 27th) Professor Tyndall gave some results of his work in the Alps during the past summer. In the previous one he had placed a minimum thermometer on the rocks close to the summit of the Finsteraarhorn (14,025 feet), by which, according to another observer this year, a temperature of $-32°$ or $-34°$ (Cent.) had been registered. Professor Frankland and he had attached six thermometers to as many strong posts at intervals from the bottom to the top of Mont Blanc. They had spent a night in a tent on the summit, whence the colour effects of the sky and the mountains in the early morning were remarkably fine. Candles of the same size were burnt there and at Chamonix for definite periods. There was no appreciable difference in the rate of consumption, but that at the top gave a very feeble light, and the blue of the flame extended one-eighth of an inch above the tip of the wick.

Sir C. Lyell described his examination of the gravels above the Somme valley near Amiens, whence he had obtained sixty-five flint hatchets, and proved the correctness of Professor Prestwich's accounts. Though the evidence was not yet complete, he had little doubt that the Siberian mammoth and the tichorhine rhinoceros were contemporaneous with the makers of the hatchets. Commenting on the absence of human bones from these deposits, he remarked that not a single human skeleton had been found

works, dying there May 18th, 1843; or a grandson of his uncle, S. G. J. Perthes (1749-1816), who devoted himself, with his sons, to publishing important geographical works, such as *Petermann's Mitteilungen.* From the nature of the communication the latter seems more likely.

on the bed of the Lake of Haarlem, which had now been dried, drained, and cultivated, though it had been navigated for hundreds of years and the scene of a great battle between the Dutch and the Spaniards.

Nov. 24th. Dr. Hofman mentioned that, in lecture experiments, he had found sparks from the Ruhmkorff coil useful in the decomposition of gases, for instance with ammonia, marsh-gas, and carbonic acid. In particular cases he had observed two stages of decomposition. Professor W. A. Miller said that, in his own lectures, he had used this coil for similar purposes.

On Dec. 22nd (116th meeting) Sir R. Murchison said that Dr. Livingstone had found that his intended exploration required a steamer, especially fitted for river navigation, and had applied for one to the Government.[1] It had been granted, and would leave this country in April or May. Captain Speke, he went on to say, proposed to descend the lake which he had recently discovered,[2] and to follow the river issuing from it, which he believed to be the White Nile. Mr. Petherick, consul at Tetuan, was to ascend the Nile and meet him. Government had granted £2500 towards the expense of the expedition.[3]

Colonel Smythe,[4] Director of the St. Helena Observatory, sent word of his mission to the Fiji Islands, asking for suggestions as to matters demanding investigation. Dr. Hooker was asked if he could be accompanied by a botanist from Kew.

[1] He had left on March 10th, 1858. Though the steamer was unfitted for its purpose, he explored, notwithstanding many difficulties and trials, the northern bank of Lake Nyassa, returning to the east coast of Africa, whence an adventurous voyage took him to Bombay.

[2] On July 30th, 1858.

[3] Speke, with his companion, Captain Grant, left England April 27th, 1860. The story of the expedition, which, notwithstanding grave difficulties, placed the matter beyond reasonable doubt, is told in his book, *Journal of the Discovery of the Source of the Nile* (1863).

[4] William James Smythe (1816-1887), R.A., who saw service in Kaffir War, India, etc., was sent to these islands in 1859 to report upon their cession to England. He advised against it, on the conditions then proposed, and they did not become British till 1874.

1860. At the next meeting (117th), on Jan. 26th, Dr. Hooker announced that Dr. Seeman,[1] who had accompanied Captain Kellett on the *Herald*, had been allowed by Government to go with Colonel Smythe.

Lord Wrottesley announced that at a meeting of the Trustees of the British Museum, the proposal to separate the collections had been carried by one vote.

Feb. 23rd, 118th meeting. Professor Tyndall thought that Professor James Thomson was wrong in attributing the regelation of ice to pressure, for, as he had calculated the height of the column of ice above the Montanvert to be over 4000 feet, that, if it acted vertically downwards, would only lower the melting point there by 0.9° C., while its observed temperature was −5° C., and yet the ice was yielding more rapidly in the centre than at the sides in the proportion of 2 to 1. Professor Faraday said that his experiments on regelation proved that two pieces of ice which were in contact under water at a single point, would freeze together; but he had not observed this property in the case of any other solid—wax, spermaceti, and some of the metals having failed to show it. He thought it might be restricted to bodies which expand in becoming solid.

March 22nd, 119th meeting. Professor Brown-Séquard, who was a guest, gave an account of his recent enquiries into the existence of special nerve fibres. He had found that some animals, particularly the frog, when the entire posterior root of the spinal nerve has been divided, slowly learned the power of directing the movement of the limb, which could also be observed, though to a much smaller extent, in the mammalia. He had also endeavoured to ascertain if any decussation existed in the fibres of the spinal cord, and had found on making a vertical incision in it on one side of the medial line that the limbs on both sides were more or less paralysed.

[1] Berthold Carl Seeman (1825-1871), born at Hanover, studied at Kew. Naturalist to the *Herald* on its voyage on west coast of America and in Arctic Seas, 1847-51; accompanied Colonel Smythe 1860; made valuable contributions to Botany.

Professor Huxley said that investigation by M. Ducaze Duthiers of the fluid from the *Murex*,[1] which produced the Tyrian dye, was at first colourless, but when exposed to the sun's rays, it became, first, bright yellow, then blue, and finally red. The same investigator had taken a photographic negative from one of Ostade's pictures, and a positive from this (which he exhibited) showed the red colour.

April 23rd, 120th meeting (anniversary). Mr. Busk described his visit to Amiens and Abbeville to study the gravels. The more they were examined, the more perplexing became the evidence as to their age, but he had no doubt that the flint implements were the work of man, were of great antiquity, and were much older than the deposits in the bed of the Somme valley. He described the stone coffins of Charlemagne's age, which were found in the beds over the gravels. In these were human bones with teeth in good preservation.

Sir H. James exhibited some specimens of photozincography, and gave a description of the process.

On May 24th, Sir R. Murchison resumed the discussion on the implementiferous gravels, calling attention to the fact that the worked flints occurred in the lower part of these, and were unworn, while the pebbles were rolled, and suggesting that the latter might be long anterior to the former, and have been transported to the place where the manufacture had been carried on, and the two mixed up. As an illustration of this Professor W. H. Miller said that, in the Venetian Alps near Cortina, he had seen beds of gravel not less than forty feet in thickness, beneath which, as he was informed, a village had been found. There had been time enough for its inhabitants to escape, but not to remove their goods, so that the works of man would occur under the gravel, but no human bones. Some members of the Club doubted

[1] This, according to Canon Tristram (*Land of Israel*, 1865, page 51), was *M. brandaris*, at any rate at Tyre, though according to some authorities *M. trunculus* was the more usual source, but he says the masses of broken shells, which must have been used to obtain the dye, consist almost entirely of the first species.

whether the implements could be the work of man, because they are found over so large an area near Amiens and Abbeville and under similar circumstances elsewhere.

Dr. Falconer stated that, after he had left Italy, Baron Francesco had explored a new ossiferous cave, Ben Fratello, near Aquadolce, which contained, together with the bones of large herbivora such as he (the speaker) had found, those of several carnivora, the identification of which might, he hoped, be helpful in determining the age of these deposits.

June 21st, 122nd meeting. Colonel Sir H. James said he had learnt that the process of photozincography had been independently invented by Mr. Taylor, a member of the Australian Geological Survey.

A letter from M. de Verneuil [1] was read, giving reasons against the proposed division of the collection in the British Museum, and showing how space could be gained by a rearrangement. Professor Huxley stated that, in giving evidence before the Parliamentary Committee, he had dwelt strongly on this point.

Professor Frankland exhibited a new chemical compound, which he had recently obtained. It consisted of boron and ethyle, the latter standing in the same relation to the former as the oxygen in boracic acid, and might be named borethyle. Its composition was—boron 10 per cent., carbon 75, and hydrogen 15. It ignites spontaneously on coming in contact with air, and burns with a green flame.

Oct. 25th, 123rd meeting. Dr. Daubeny said that he had repeated M. Pouchet's experiments on solutions which had been subjected to high temperatures and accessible only to air that had passed through a red-hot tube. In these also low forms of vegetation had appeared.

Professor W. A. Miller described the success of Bunsen

[1] Philippe-Eduard Poulletier de Verneuil (1805-1873), born and died in Paris, devoted his time and fortune to the study of Geology and Palaeontology. He travelled extensively from the Ural Mountains to the United States of America, studying more especially the Palaeozoic rocks in these regions and in the intermediate countries of Europe, including Spain and Great Britain.

and Kirchoff[1] in detecting minute amounts of metallic bases by the lines which they produce in the spectrum, each metal revealing itself by a special line or lines. Of these and of the instrument he gave a description. For purposes of qualitative analysis, as was shown by examples, this method exceeds in delicacy any other in existence.

Professor Loomis,[2] a guest, gave an account of American expeditions to observe the recent solar eclipse. In that to Labrador, though the state of the weather prevented the taking of photographs, the contacts were seen, and an observer, separated from the rest, saw the red flames with the naked eye. The expedition to Vancouver Island had no photographic apparatus, but obtained good observations of the contacts. He also mentioned that during the aurora of Sept. 2nd, 1859, which extended all over the United States, the electric influence on the telegraph wires was so strong that for about an hour messages were transmitted from Boston to Portland (fully 100 miles) and back, by its agency alone. The direction of the current also was constantly changing. On another line, messages were transmitted from Philadelphia to Pittsburg (about 300 miles), though with less steadiness than in the other case. The auroral current was frequently strong enough to overpower the ordinary battery.

Nov. 22nd, 124th meeting. Dr. Hooker, writing to Professor Huxley from Beirut, announced his discovery of moraines in the Lebanon, perhaps also in the Anti-Lebanon. In the former range the heads of the valleys

[1] Robert Wilhelm Bunsen (1811-1900), born at Göttingen, was successively Professor of Chemistry at Marburg, Breslau, and Heidelberg. Of his many discoveries, among them the invention of the magnesium light, the greatest was spectrum analysis, in conjunction with Gustav Robert Kirchoff (1824-87), born at Königsberg, who became Professor of Physics at Berlin in 1874 and was also notable for his researches in electricity, optics, and the mechanical theory of heat. The Davy Medal was awarded to them jointly in 1877, the Copley to Bunsen in 1860, and the Rumford to Kirchoff in 1862.

[2] Elias Loomis was born in Connecticut on Aug. 7th, 1811, graduated at Yale, won distinction in Physical Mathematics, did much research, and wrote largely on subjects more or less connected with astronomy, returning ultimately to Yale as Professor of that subject. He died Aug. 15th, 1889.

are broad, open, and shallow, surrounded by bare rounded heights of broken rock, without precipices or peaks, though the summits in one part rose above the average height of the range (about 6000 feet) to fully 9000 feet. The bottoms of the valleys become, lower down, narrow and terraced. Above 5000 feet they are very barren, below this level brushwood is abundant. No glaciers or permanent snow-fields now exist, and there is little water in the higher parts, for that from the melted snow (of which much falls till about May) disappears down conical depressions from five to twenty feet in depth. Moraines only occur in the broad flat heads of the valleys, at from 6000 to 7000 feet. But these are quite typical, rising abruptly from flat-floored valleys in long continuous masses of débris, and the cedars (now about 400 in number) occupy five or six of them in close contiguity. None of the trees seemed less than forty years old (for drought kills all the seedlings); the more aged may perhaps have lived 500 years.[1]

Colonel Sykes drew attention to the gale of Oct. 2nd. In the morning the barometer stood about 30 inches; it fell 1.1 inch before 9 p.m., and began to rise before midnight. The wind, which had been strong all day, then increased to a hurricane, which lasted till 9 a.m. on the 3rd, by which time the barometer had returned to 30 inches.

Dec. 20th, 125th meeting. Dr. Carpenter gave an outline of the results obtained by Dr. Wallich,[2] who had accompanied, as naturalist, Captain Sir Leopold M'Clintock in H.M.S. *Bulldog* on her sounding expedition (in view of laying a sub-Atlantic telegraph) to Iceland, Greenland, and Newfoundland. Former deep-sea soundings had proved the tests of *Globigerina* to be abundant on the sea-bottom at more than 1000 fathoms depth, but it was uncertain whether the animals habitually lived so far beneath the

[1] For an account of these and other surviving groups of cedars in the Lebanon, see H. B. Tristram, *Land of Israel*, pages 623-632.

[2] George Charles Wallich (1815-1899), M.D. Edinburgh, after service as an army surgeon in India, returned to England. The results of the above-mentioned voyage were published in his important work, *The North Atlantic Sea-bed* (1862).

surface. Now several specimens of *Ophicoma* had been brought up from 1260 fathoms between Cape Farewell and Rockall, in the stomachs of which *Globigerina* were abundant. Small tubes also, formed of the shells of this foraminifer, and probably once tenanted by an annelid, were brought up from 1913 fathoms; living serpulae with spirorbis from 680 fathoms, and free annelids, with amphipod crustacea, from 445 fathoms, so that the enormous pressure at great depths seems not to have any destructive effect on such delicate organisms.[1]

Sir R. Murchison stated that Mr. M'Douall Stuart, with two men and thirteen horses, had recently made a journey from Adelaide for 1300 miles to the north. He had turned back in lat. 18° 47′ S. and long. 134° E., being prevented from reaching the north coast only by the hostility of the natives. Instead of the arid salt desert, which he had expected, he had found a succession of oases, providing sufficient water and vegetation to maintain transit between the southern and northern part of the Australian continent.

1861. Jan. 24th, 126th meeting. Sir R. Murchison said he had that morning heard of an expedition undertaken by Mr. M'Douall Stuart, prior to that mentioned on the last occasion, for which the citizens of Adelaide had provided the funds, and during which he had discovered in the interior an immense lake,[2] which extended northward beyond the range of telescopes, its southern margin being 29° S. lat. and 139° E. long. The water was extremely salt, though springs of fresh water, often copious, were abundant in its near neighbourhood. Mr. Stuart had now started, with a considerably stronger party, on a fresh expedition into the interior.[3]

Dr. Hooker, in exhibiting a branch of a new species of *Araucaria*, which had been found growing to a height of

[1] The story of the distribution of life in the deeper parts of the Ocean, prior to the voyage of the *Challenger* (Dec. 1872-May, 1876), is told by Professor C. Wyville Thomson in *The Depths of the Sea*, 1873.

[2] Probably Lake Eyre, though 137° would be nearer its longitude.

[3] The one which reached a point west of Chambers Bay in 1862.

from 160 to 180 feet, on an island off New Caledonia, commented on the extremely local distribution of these trees over the islands of the southern Pacific, which had now furnished six species.

Feb. 21st, 127th meeting. Mr. Darwin gave an account of his experiments with *Drosera* (sun-dew), a species of which was abundant on a common near Down, and described how it entrapped flies and held them till they died in a cage of its hairs, which afterwards returned to their normal position. He had ascertained that non-nitrogenous materials did not set these in motion, but that a very small amount of nitrate or carbonate of ammonia caused one of the hairs to emit its secretion, and a portion of flesh or even of ordinary hair had the same effect.[1]

Mr. Prestwich mentioned that six flint implements, resembling those from Abbeville, had been found by Mr. T. Leech between Herne Bay and Reculver at the foot of a cliff consisting of Lower Tertiary beds, capped with gravel. Mammalian remains of the same period as those in the Somme valley had occurred previously at no great distance.[2]

March 21st, 128th meeting. Mr. Prestwich stated that, since the last meeting, he and Mr. John Evans had visited Herne Bay, and each of them had found, on the shore at the foot of the cliff, a flint implement of the Abbeville type. Next day he found an implement at the foot of Swale Cliff near Whitstable.

April 29th, 129th meeting (anniversary). Dr. Carpenter exhibited a specimen of a large Polyzoon, much resembling in its mode of growth the *Eschara foliacea* of our own seas. It had been detached from a ship which was one of the expeditionary force sent to China, and had been anchored for about six months at the mouth of the Peiho. Its size, as its growth might reasonably be limited to that interval,

[1] He began work on this subject in the summer of 1860, and continued it intermittently till 1875, when he published the results in his book, *Insectivorous Plants.*

[2] For a full description see J. Evans, *Ancient Stone Implements* (1897), pages 613-7, where five of them are figured.

was an indication of the rate at which this occurred. Mr. Busk remarked on its resemblance to the *Biflustra* of the East Anglian Coralline Crag.

Professor Miller referred to Schroeder's experiments on fermentation, which led to the conclusion that, if all living germs are strictly excluded, this cannot take place, even when the liquid is one easily susceptible of that change.

Mr. Gassiot described his experiments on the heating of electrodes. He had noticed, twenty-two years ago, that the positive pole became hot, the negative one remaining cool. This Mr. Grove had attributed to the oxidation of the metal employed in the electrodes. But he had found that, with an induction coil and thin wires for the electrodes, the negative pole was the hotter, and that this held good whether the discharge was passed through air or through a vacuum. When he used a powerful Grove battery and solid brass balls as electrodes, the negative ball became heated, and this ball, with an intermittent discharge from the battery, first exhibits a white glow round it, and soon becomes red-hot. But on substituting a continuous discharge the negative ball suddenly cools, and the positive one becomes red-hot. He thought the resistance offered to the passage of the electric current was the most ready explanation of these phenomena.

Dr. Bence Jones said that, as Professor Brücke had informed him, his experiments showed that pepsin does not act as a ferment, but forms definite chemical compounds with alimentary substances.

Oct. 31st, 132nd meeting. Mr. Gassiot exhibited photographs of the recent solar eclipse taken in Biscay by Señor Novara with the Madrid equatorial.

Dr. Hooker read a communication from the Rev. M. J. Berkeley [1] about a human skull, found in the drift at Nottingham, together with bones of the elk, 18 feet below the surface of the ground.

[1] Miles Joseph Berkeley (1803-1889), F.R.S., Hon. Fellow of Christ's College, Cambridge, and ultimately Rector of Sibbertoft, Northamptonshire, was author of *Introduction to Cryptogamic Botany* and other works on *Fungi*.

Professor Tyndall communicated some observations on lunar radiation, made with a thermoelectric apparatus, on a bright clear night when a faint haze, indicative of precipitated vapour in the atmosphere, surrounded the moon. On the cone being turned towards the moon, the pile indicated a radiation of cold, which he accounted for by supposing that the obstruction to terrestrial radiation, due to the mist, had been removed when this had been dispersed by the moon's rays.

Professor Huxley described the [Neanderthal [1]] skull, a cast of which he had recently examined. The brain cavity is only about two-thirds of that in a fully developed man, being intermediate between it and the chimpanzee. The supraorbital ridges are of enormous size, and the fragments of humerus and tibia found with the skull are human in proportion, but are very thick and have strong ridges.[2]

Sir C. Lyell said that the age of the formation, in which the skull was found, is uncertain, and gave an account of the discovery by M. Lartet of human bones with those of extinct animals, including *Ursus spelaeus*, and with flint implements in a sepulchral vault in the south of France.

Nov. 28th, 133rd meeting. Mr. Grove said that recently, in observing the planet Saturn, the ring of which was then invisible, he had noticed two bands across its disk, which he thought might be explained as follows. The plane of the ring now passes through the earth, but not through the sun, which accordingly shines on one surface of the ring, so the bands result from the passage of the solar light to the disk of Saturn, through the space between the outer and inner ring, and that between the latter and the planet.

Mr. Paget mentioned a case, where, during a convulsive paroxysm, a patient had swallowed a set of artificial teeth, which had lodged in the throat below the root of the tongue.

[1] In the manuscript of the Minutes a blank occurs where the name should be, but I have no doubt he was referring to the discovery in this cave.

[2] See Huxley's *Man's Place in Nature*, pages 128-143 (1863). They are more fully described and assigned to the Mousterian age (rather later than that of the St. Acheul race) by W. J. Sollas, *Ancient Hunters*, chapter vi.

This produced a difficulty of swallowing, which threatened inanition, and the cause of it was not detected for three months, the patient having referred the sense of obstruction to a lower position, about the level of the cricoid cartilage.

Mr. Busk reported that Professor Frankland had found *Acari* swallowed *nux vomica* with impunity, and had shown that the minute pellets, voided by them, consisted of clear, highly-refracting particles, almost entirely soluble in alcohol. These, he suggested, might consist of strychnine and the immunity be due to its not being absorbed by their alimentary canal. This alkaloid also was not poisonous to cockroaches.

Dec. 12th, 134th meeting. Sir H. James informed the members that photography was now largely employed for transmitting to officers accurate representations of all articles of military equipment; a foot rule, to give scale, being always included. He also said that it was proposed to obtain by photozincography facsimiles of the noted Limancas archives. These require absolute accuracy in reproduction, for they mostly consist of despatches in cypher, from documents in very bad Latin. Progress, he reported, was being made with the reproduction of *Domesday Book,*[1] but the county of Kent was at present omitted, since Mr. Lakin had already published in facsimile a portion of that county. The reproduction of the Shakespeare folios of 1620 had been suspended, owing to failure of funds. He also mentioned the completion, in all its details, of the Trigonometrical Survey of the British Islands, commenced in 1783. An arrangement was now in progress to connect it with the Survey of Belgium; this, with the Prussian one, and it with the Russian. The completion of that work will give an exact measurement of an arc of parallel from the west of Ireland to the Ural Mountains. In order to link up Britain with Belgium, part of France had to be crossed. For this the French Government had afforded every facility to our officers, and its own Survey staff had

[1] The first instalment, the part relating to Cornwall, was published before the end of 1861.

gone over their work. A comparison of the results thus obtained led him to conclude that the great theodolite, made by Ramsden in 1783 (which is still in working order and used on this Survey), was a more accurate instrument than the French repeating circle.

Dr. Carpenter exhibited photographs by Dr. Haidinger of dissections of the nervous system, and Mr. Paget mentioned that Dr. W. Budd [1] had successfully photographed many pathological specimens. He suggested that the Royal College of Surgeons would do a great service to science by having photographs taken of many important specimens in the Pathological Museum.

1862. Feb. 27th, 136th meeting. Colonel Sykes communicated a description of a black rain, which fell on Jan. 14th at Slains and along the whole eastern coast of Aberdeenshire. According to the minister, Mr. James Rust, the morning, about 8.30, was clear; then the sky darkened, threatening rain. About an hour later, "a large, dense, black, smoky-looking cloud came driving over the sea from the S.S.E., and discharged a shower of rain with drops like ink, which blackened all the water collected in cisterns from the roofs of houses, and dirtied clothes put out to bleach so effectively that warm water was needed to wash out the spots." Mr. Rust suggested the dust might be due to a recent eruption of Vesuvius.[2] Sir R. Murchison said that though it was not impossible for dust from Vesuvius to travel as far as Aberdeen, he thought the peculiar blackness of the cloud indicated a smoky origin. That recent eruption had differed from those in past centuries, in that for some miles near Vesuvius the land had risen about 3 feet.

March 27th, 137th meeting. Colonel Sykes referred to the black rain mentioned at the last meeting, and said that he had made enquiries which had satisfied him of the trustworthiness of the narrator. Professor Tyndall stated

[1] William Budd (1811-1880), M.D. Edinburgh, who practised for many years in Bristol, was the author of numerous medical papers, especially on zymotic diseases.

[2] A rather severe eruption had occurred, Dec. 8th-10th, 1861.

that his own experiments made him doubtful whether a sufficient quantity of soot could have been distributed through the atmosphere to produce the blackness described.

Colonel Sykes then gave an account of a balloon ascent, made under the auspices of the Meteorological Committee of the British Association. But as the balloon unfortunately was not of the stipulated capacity and very leaky, it had only risen to the height of a mile and a half, and its final descent had been rather dangerously rapid. Professor Tyndall suggested the erection, at an elevation of 14,000 feet, of a permanent hut for scientific observations,[1] such as determining whether the solar spectrum is of the same length as at lower positions, whether as many obscure rays are present in it, and whether its red end is longer.

May 22nd, 139th meeting. Professor Dove,[2] of Berlin, described a new method of photometry. When micro-photographs of inscriptions are viewed through a microscope, they appear, with transmitted light, black on a white ground, but with reflected light, white on a black ground. By using both kinds of light, and due graduation, the one can be made indistinguishable from the other, and if the lights to be compared are adjusted, so that the one is transmitted and the other reflected, their relative intensity can be estimated from the amount of movement required by the microscope. In a similar way the illuminating power of different coloured lights can be compared.

Professor Wurtz,[3] of Paris, gave an account of the method of reconverting aldehyde into alcohol by digesting it with an amalgam of sodium.

[1] That has now been done. Besides the Gniffetti Hut, at 11,877 feet, there are now the Regina Margherita Hut at 14,961 feet, both on the Italian side of Monte Rosa (see Angelo Mosso, *Life of Man on the High Alps* (Translation 1898)), and the Vallot Observatory at 14,320 feet on Mont Blanc, besides that erected on the summit by M. Janssen (now removed).

[2] Heinrich Wilhelm Dove (1803-1876), Professor of Natural Philosophy at Berlin for many years, made important investigations in optics and electricity, and did much to establish meteorology on a scientific basis.

[3] Charles Adolphe Wurtz (1817-1884), born at Strasburg, resident in Paris from 1844, an eminent chemist and author of several works, two of which, *The Atomic Theory* and *Modern Chemistry*, have been translated into English.

June 19th, 140th meeting. Sir R. Murchison stated that a rich bed of graphite had been discovered on the banks of the Lower Tunguska River, one of the principal tributaries of the Yenesei in Siberia. It must, however, be transported to the mouth of the latter river, and then by sea to Russia, before the discovery would be of any commercial value. Hitherto no ship had succeeded in making the sea journey, but the discoverer of the deposit, M. Sideroff, attributed this to their commanders having always taken the Kara Strait, to the south of the two great islands of Novaya Zemlya, or the Matyushin Shar between them, both leading into the Kara Sea, which is always full of ice. But he believed that the route to the north of Barents Land would prove practicable, and had offered a reward to the first vessel that should be successful.

Oct. 31st, 141st meeting. Mr. Gassiot mentioned recent experiments with his large water-battery of 3400 cells. At first he had simply repaired the loss by evaporation. Encouraged by the results, he had recharged the whole set with salt and water, and improved the insulation by mounting each jar on rails of shellac, when the current was sent through the exhausted tubes as distinctly as with the Ruhmkorff coil. In a perfect vacuum neither discharge nor heating of either electrode occurred till heat was applied to the fused potash, but as the temperature of that was raised, a cloud of vapour was formed, the negative electrode became heated, and a continuous action carried off a large quantity of platinum. With one tube, a distinct singing sound was produced, when the discharge took place.

Nov. 27th, 142nd meeting. Sir H. James stated that photozincography, which hitherto had been restricted to subjects expressed by definite lines (such as maps, manuscripts, etc.), had now been applied to reproduce ordinary photographs, where tints had to be rendered, with good results, as the specimens, which he exhibited, demonstrated.

Dr. Hooker described that strange African plant, the Welwitschia, of which additional specimens had recently reached him.[1] These had fully confirmed his original view of its structure. The two great fleshy leaf-like bodies are persistent cotyledons, never changed, though in some cases they may be a century old. He gave additional particulars of its structure, stating that the embryogeny combines in a remarkable way that of the gymnosperms and the angiosperms, and the fructification consists of cones, female and hermaphrodite, the ovules in the latter being abortive.

Dec. 11th, 143rd meeting. Dr. Daubeny exhibited some fibrous balls, picked up on the Mediterranean coast near Villa Franca,[2] which apparently were formed from the leaves of *Posidonia maritima*, a plant allied to *Zostera marina*.

1863. Jan. 29th, 144th meeting. Sir R. Murchison said that three ladies had fitted out a steamer at Khartum, and, after ascending the river Sobat for some distance, had continued up the White Nile till they were obliged to turn back, owing to the shallowness of the water, rather south of Gondokoro and about 4° north of the equator. No news had reached them of Mr. Petherick, who had set off for that place to meet Captains Speke and Grant, except a rumour that, owing to unfavourable weather, he had sent his boats back to Khartum and proceeded on foot, and it was apprehended that he had been killed.

March 24th, 146th meeting. Dr. Bence Jones read an extract from the Minutes of the Board of Managers of the Royal Institution, dated March 1st, 1813, in which Sir Humphry Davy reports having engaged a young man named Michael Faraday,[3] "whose habits seem good, his disposition active and cheerful, and his manner intelligent." His duties were to assist Professors and Lecturers, both before and during their discourses, to prepare instruments and illustra-

[1] *Welwitschia mirabilis* is described by Dr. Hooker in the *Linn. Soc. Trans.* vol. xxiv. (part i. 1863). A short account is given in *Encyc. Brit.* vol. xxix. page 192 (11th ed.).

[2] Now Villefranche, a few miles to the east of Nice.

[3] He succeeded Davy in the Chair of Chemistry at the Royal Institution in 1827, and was at the above date a member of the Club, having been elected May 6th, 1847.

tions, and to clean and keep in order the same. His predecessor, it is recorded, was dismissed for striking an official who had rebuked him for neglect of duty.

April 27th, 147th meeting (anniversary). Dr. Carpenter[1] described a new binocular microscope, made by Messrs. Nachet, which he had examined in Paris. The reflecting prism of this sent to the right eye the pencil which should have been transmitted to the left one, and *vice versa*, the result being to produce a very complete pseudoscopic conversion and give a more correct notion of solid form than could otherwise be obtained. He expected it would be valuable in testing the strength of our previous mental associations, by the different degrees in which our notions of different objects resist the converting process.

He also said that he had seen, during his visit, a lamp for burning the vapour of American petroleum. A piece of sponge, soaked in this, was enclosed in a metal vessel, and atmospheric air, in passing over it, took up so much of the vapour that, on issuing from a metal tube, it burnt like an ordinary gas light, the charge lasting for about nine hours.

Mr. Gassiot gave an account of a spectroscope with nine prisms, made under his direction by Spencer Browning. It had been too recently finished to enable him to make a prolonged use of it, but it had, for example, distinctly separated the thallium line from the barium one, which previously had been regarded as coincident.

May 28th, 148th meeting. Dr. Falconer communicated an account of a recent conference in France concerning the human jaw found in the drift at Moulin Quignon.[2] On hearing of the discovery, he had gone in April to Abbeville and had examined the pit and some flint implements, said to have been found in the same beds, together with one or

[1] He afterwards discussed the question of pseudoscopy in his *Mental Physiology*, §§ 168-170. See also his *Microscope and its Revelations* (ed. W. H. Dallinger, pages 92-97).

[2] The following account is condensed from a minute (apparently copied from a document) which occupies six and a half pages of the *Minute Book* (folio). The authenticity of the jaw was for some time a ' burning question,' but it is now generally repudiated.

two separate human molar teeth. The shape of the jaw was peculiar, and both it and some of the pebbles in the drift had a black coating. At first he inclined to regarding the two as contemporaneous, but, after his return to England, on closer study of the flint implements, some purchased by himself and others obtained by Messrs. Evans, Prestwich, and Brady, he had been suspicious of the authenticity of both. He at once communicated his doubts, through M. Lartet, to M. de Quatrefages, who had already expressed his belief in the jaw to the French Academy. A meeting of representative savants of England and France was then arranged, so he, with Dr. Carpenter, Mr. Busk, and Mr. Prestwich, went on May 9th to Paris. The points for special discussion were (1) the genuineness of the flint implements, (2) the authenticity of the jaw and teeth, said to have been found in the lowest bed of gravel. Dr. Falconer, after mentioning the characters generally indicating a forgery,[1] said that the conference frequently referred to both genuine and fabricated specimens, and its French members inclined to the view that between these no adequate distinction could be maintained. Next came the examination of the jaw, the separate tooth (which M. Boucher des Perthes had given to Dr. Falconer) being withdrawn from the controversy. A strongly adherent layer of a black material, mixed with sand, which M. Delafosse pronounced natural, covered the jaw, but an examination of one end revealed lines suggestive of brush marks. The bone, when sawn across, was moderately firm, not very friable, having the ordinary odour, with the cortical layer a pale buff colour and the diplöe of a darker tint. The section passed through a fang of the remaining tooth, and showed it to be in the same condition as the loose one already mentioned. In short, the jaw is in a state indicative of considerable antiquity, like one from an old cemetery, but not such as should characterize a bone from a drift of so remote an age. The conference then adjourned to Abbeville, where they engaged workmen

[1] As these are now familiar to archaeologists, it is needless to repeat them.

to lay bare a vertical face of gravel, about 15 or 16 feet from the surface to the chalk, and some distance back from the old one. In the course of the day five flint implements were found "under the very eyes of the members," the genuineness of which seemed beyond suspicion. Four of them were of a form which at Paris had been supposed to indicate forgery. They had, however, been found where the drift showed signs of disturbance, and a pipe in the middle, reaching down to the chalk, was occupied by a material rather different from the usual stratified gravel, which suggested the possibility that the jaw might have been subsequently introduced. Several members of the conference, including Messrs. Milne Edwards and de Quatrefages, expressed no opinion as to the geological age of the bone, though regarding it as contemporaneous with the gravel. Dr. Falconer and Mr. Busk thought that if the latter were really of the same age as the Somme valley deposits, the bone had too recent an aspect to belong to it. Mr. Prestwich remarked that he had known the Moulin Quignon gravel for several years, and that, prior to the discovery of the jaw, very few *hâches* had been found, and these of the oldest and rudest types. Those since obtained were of a different type and more modern in aspect. That these were not stained, while the surrounding pebbles were so, was a difficulty which, however, was diminished by his having got an uncoloured flint from the *couche noire.* At first he had doubted the genuineness of jaw and *hâches*, but he now thought it possible that if the latter were so, the former might be the same.

June 11th, 149th meeting. Mr. Lubbock described the circumstances under which human skeletons had been found in 1862 at Mesnières, near Abbeville, as ascertained by himself, Mr. Prestwich, and Mr. Evans. The lower jaw of one of them presented a striking resemblance to that from Moulin Quignon.

Oct. 29th, 150th meeting. Professor Ramsay said that during the past summer members of the Geological Survey had discovered and mapped terminal moraines in the south of Scotland. They apparently belonged to the latest part of the Glacial Period, and were associated with a gradual rise of the land. No such moraines, or ice scratches, or other signs of glacial action, had been found in the Peak of Derbyshire, though abundant evidence of the former presence of ice had been met with in the adjacent region.

Dr. Frankland remarked that he had observed glacial striation in Craven (Yorkshire), and some remarks were made about rocks on the islets around Spitzbergen being scored by floating icebergs.

Dr. Hooker exhibited photographs of drawings by Dr. Hector, made in the South Island of New Zealand, at comparatively low levels above the sea, which showed the effect of glacial action and much resembled similar phenomena in the Himalayas. Glaciers still existed in New Zealand at about [2400] feet [1] above the sea.

He also showed a Japanese botanical work, with well-executed outline illustrations of the plants. He thought this was the first instance of an original work on natural history in the East.

Mr. Busk said that a large cavern had been discovered in the Rock of Gibraltar during the excavation of a tank, and had been traced to a depth of above 100 yards. In its uppermost part works of art and bones of men had been found associated with those of numerous animals. Others lay beneath a stalagmite floor, among which were a hyaena, leopard, deer, and two species of rhinoceros (both probably extinct). The fauna was African in character, and he, with Dr. Falconer, was now engaged in working it out.

Nov. 26th, 151st meeting. Colonel Sykes commented on a recent balloon ascent by Mr. Glaisher.[2] At a height of 22,000 feet it passed through a dry cloud, having a temperature of 18° F., the air in which was not saturated;

[1] The manuscript omits the figure. On the eastern side of the New Zealand Alps the end of the Tasman Glacier is about 2350 feet; on the western one the Fox Glacier comes down to about 700 feet.

[2] He was accompanied by Mr. Coxwell (on September 5th, 1862). They reached 29,000 feet, at which elevation the latter was just able to open the valve, Mr. Glaisher having already become insensible.

on emerging from it he observed numerous dark clouds. A mile lower down rain fell on the balloon, and below this, it passed through rain, snow, and ice spicules, and the temperature had risen to 33° F. Professor Stokes thought that the dry cloud probably consisted of spicules of ice.

Dec. 17th, 152nd meeting. Professor Frankland stated that recent examination of the lunar surface led him to suppose that the moon also had undergone a glacial epoch, and that several of its valleys, rills, and streaks are due to former ice action. In some cases the moraines would be on a gigantic scale, and he gave two examples, one, in the great streak running from the base of Tycho under the S.E. wall of Bullialdus, lower down in which is a pair of curved ridges with their convex sides towards the north; the other, in a great valley running past the eastern edge of Rheita. The moon is supposed to be without an atmosphere, but as it must have cooled much more quickly than the earth, its internal structure would be very cavernous, and seamed with communicating fissures. If then it contracted only to the same amount as granite, a fall of 100° C. would produce cellular space amounting to nearly 14 million cubic miles, which would suffice to engulf an ocean, proportionate in volume to that on the earth.

1864. Jan. 28th, 153rd meeting. Sir R. Murchison referred to reports about the Zambesi mission and the rumoured death of Dr. Livingstone, expressing the hope that the latter was not true, though there was some reason to believe he had been wounded in the foot.

He also said M. de Verneuil had informed him that the hook several inches long and rather like an anchor, which had been found in sawing up a block of marble from the Ardennes, was only part of the bony covering of a Cephalaspis.

Feb. 25th, 154th meeting. Sir H. James said that a deviation of the plumb-line had been observed at Cowhythe near Portsoy, the cause of which was now being investigated.

May 26th, 157th meeting. Dr. Hooker exhibited photographs of fossil ferns from the coal formation of Otago, sent by Dr. Hector, one being a species of *Glossopteris*.

Mr. Lubbock described a visit, recently made with M. Lartet, Mr. Christy, and Mr. J. Evans, to some caves in the department of the Dordogne. They contained flint implements of the roughest type, with very numerous articles of reindeer horn—harpoons, needles, etc.—very neatly made and finished, besides figures of animals, such as the horse and the reindeer.[1]

June 16th, 158th meeting. Mr. Gassiot exhibited some examples of colour photography, but they were fugitive in character and could be exhibited only in diffused light, so that the result was not considered to be satisfactory.

Mr. Paget gave an account of a patient in the hospital, one of whose kidneys had been exposed by a wound in the lumbar region, so that it could be observed. Its natural colour appeared to be pale, like that of blotting paper.

Dr. Hooker read a letter from Mr. Haast[2] about some New Zealand glaciers. The west coast, he said, for the last fifty miles south of the Totara River[3] is formed by enormous moraines, Cliffy Head, Bad Head, Albert Head being only terminal moraines of former glaciers. The largest glacier, equal in size to the Tasman, descends to within 500 feet of the sea-level and eight miles from it. But on both sides of this glacier, luxuriant forests are growing, with areca pines and tree-ferns. Mr. Haast had also found in

[1] The working out of these caves, some of the more noted being in the limestone cliffs by the river Vezère, was continued for some years by Lartet and Christy, and the results embodied in *Reliquiae Aquitanicae* (1865-75). Notices of them will be found in almost any book dealing with ancient man, and the time when this race existed is called (from one of the caves) the Magdalenian epoch. It is later than that of Mousterian (Neanderthal) man. The climate was colder than now, the reindeer being abundant in that part of France.

[2] Afterwards Sir J. F. Julius von Haast (1824-1887), distinguished as a geologist and explorer of New Zealand; discovering coal and gold fields south-west of Nelson, making the first expedition (in 1862) into the Tasman district, Professor of Geology in New Zealand University, and author of works on the geology of those islands.

[3] The Totara River enters the sea on the west coast a little north of that from the Franz Josef Glacier (which descends to 692 feet above sea-level and fourteen miles from the sea). The Fox Glacier comes down to 670 feet and within 10 miles of the beach. Perhaps this was the one mentioned. See A. P Harper, *Pioneer Work in Alps of New Zealand*, page 8.

some old moraines, cut through by mountain torrents, "great quantities of moa bones."

Oct. 27th, 159th meeting. Dr. Hooker exhibited a copy of an inscription from a large bell, found by a missionary in crossing the North Island of New Zealand, the characters of which, as some thought, resembled Malayan.

Mr. Busk gave an account of his recent visit, with Dr. Falconer, to the Rock of Gibraltar in order to examine the cave and fissures on Windmill Hill, from which Captain Brome, Governor of the Military Prison, had obtained and forwarded to England during the last year a number of human and other bones. The fissure appears to commence about 400 feet above sea-level, where the highest part of the rock joins Windmill Flat, and the dip of the strata changes from a steep western one to a low eastern one. The Flat is an old sea bottom, its surface being formed of water-worn rock, and the fissures, as they contain no marine remains, must be later in date than the elevation of it. Captain Brome traced it to a vertical depth of more than 200 feet, but the animal remains are mostly restricted to the first 80 or 90 feet, the fallen blocks and subsequent stalagmite having apparently blocked it. Among the animal remains were a bear, *hyena brunnea*, two species of *ibex* (neither of which had been identified), and *cervus elaphus*; the last two genera being very abundant.

Professor Tyndall mentioned his experiments on obscure thermal rays, to the existence of which in the solar spectrum Sir W. Herschel had first called attention. By using rock-salt lenses he had compared the visible spectrum of the gas flame with the invisible one of hydrogen, and had ascertained that the obscure thermal rays in both lay beyond the red rays of the spectrum. He had also proved [1] iodine to be remarkably transparent to these ultra-red undulations, and that a solution of this in carbon sulphide, though wholly opaque to the luminous rays of a spectrum, however brilliant, nevertheless permitted all the obscure thermal rays to pass. As pure carbon bisulphide is very

[1] *Phil. Trans.* vol. cliv. pages 201, 327.

transparent to rays emitted from solid incandescent bodies, a combination of the two makes it possible to separate, almost entirely, the purely thermal and simply luminous rays in any spectrum.

Nov. 24th, 160th meeting. Sir H. James reported that Captain Vincent, with a party of sappers, had completed a survey of Jerusalem, for which purpose they had been permitted to establish a station within the Haram area, every facility having been given by the Turkish authorities. Captain Vincent, by descending a well, had found a conduit with Roman work, 82 feet beneath the surface, from which three steps led down to running water.[1] Dr. Falconer called attention to the discrepancies of statements about the relative levels of the Mediterranean and the Dead Sea, and the depth of the latter, and hoped that the above-named party would be directed to settle these points.[2]

Sir H. James referred to some anomalies in pendulum observations at Portsoy, and stated that, according to Mr. Otto Struve, the same had been noticed over a tract of country running east and west of Moscow.

Dec. 22nd, 161st meeting. Mr. Busk announced the discovery by Captain Brome of a second cave in Windmill Hill, Gibraltar, in which abundant human remains and stone implements had been found embedded in, or covered by, thick layers of stalagmite, but the excavation had not yet been carried deep enough to disclose any mammalia, except man.

[1] This survey stimulated interest in the antiquities and topography of Jerusalem and Palestine. The Palestine Exploration Society was founded in 1865. Excavations at Jerusalem were begun in 1866 by Captain (afterwards Sir Charles) Wilson and Lieutenant Anderson, with important results. Between 1867 and 1870 Lieutenant Warren (afterwards Sir Charles), with some non-commissioned officers of the Royal Engineers, carried out works which settled many disputed questions in regard to the ancient Temple area and underground Jerusalem.

[2] These discrepancies were mainly due to the fact that in all but two cases the level of the Dead Sea had been determined by barometrical observations. Triangulation by Lieutenant Symonds gave 1312 feet below the Mediterranean; another one by Lynch gave 1317 feet. The result afterwards obtained by the Ordnance Surveyors was 1292 feet (the level varies some 5 feet with the season).

Dr. Williamson described a combination of a glass and a flexible tube for producing a non-conducting vacuum, and Mr. Gassiot mentioned some experiments with electric currents and vacuum tubes.

1865. Jan. 26th, 162nd meeting. Sir R. Murchison stated that the Geographical Society had resolved to send out an expedition under Dr. Livingstone to explore the watershed of East-Central Africa, more especially between the southern end of Lake Tanganyika and the northern one of Lake Nyassa.

Dr. Bence Jones communicated the results of experiments on the absorption of such drugs as iodide of potassium and chloride of lithium. Within twelve minutes, the former had been taken into the system, and the latter was diffused with extraordinary rapidity; for instance, three grains of lithium chloride had been administered to a guinea-pig by the mouth, and that alkali was detected by spectrum analysis in every part of its body, for at least twenty-four hours, being present even in cartilage and in the crystalline lens, but not in the latter till four hours after administration, though it reached the aqueous humour within two hours. In the case of this animal it could be detected in the urine for at least thirteen days.

Sir H. James stated that he desired to determine the level of the Dead Sea by carrying a line to it from Jaffa through Jerusalem, each station being marked.

Feb. 23rd, 163rd meeting. Professor Frankland referred to experiments by himself and Mr. Duppa in the synthesis of organic compounds. They had lately succeeded in forming butyric acid from acetic acid, by substituting two atoms of methyl for two of hydrogen. By submitting acetic ether to the action of sodium they had obtained butyric ether.

Mr. Gassiot spoke of a recent large extension of his constant galvanic battery. It now consisted of 2000 elements, the cells being 3½ inches high and 1½ inches in interior diameter, the elements being carbon and zinc, and the exciting fluid sulphate of mercury. This apparatus, properly kept, had given him a discharge three feet long through a vacuum tube, the longest, he believed, which had yet been obtained. The luminous discharge does not appear till some time after forming connexion, and the luminosity, at short intervals, remits in intensity.

March 23rd, 164th meeting. Dr. Bence Jones gave further details of experiments made to illustrate the absorption of lithia in the human system. He quoted instances to show that 'cataract' resisted this process. Of seven patients who suffered from this malady, in one instance only the lens exhibited a trace of lithium, but when that drug had been administered gradually it made its way to the affected organ, being traceable in the lens and present in the cartilages. Lithia made its way into the urine in from 5 to 10 minutes, and could be detected there for 7 or 8 days after a dose of 20 grains.

Professor Huxley gave results of his study of the brain in *Dasypus* (Armadillo) and *Perameles* (Bandicoot), indicating their special anatomical features and their transitional character between those of the placental and non-placental mammals.

April 24th, 165th meeting (anniversary). Mr. Gassiot said that in experimenting with his mercury battery of 1200 cells he had received a shock which had left a single mark on the positive finger and two on the negative finger. This was analogous with the effects produced on glass by the discharge of Ruhmkorff's coil.

May 18th, 166th meeting. Professor Tyndall stated that his assistant, in experimenting with the solar luminous beam, cut off by an iodine solution, had obtained results like those from the obscure rays of the electric light and of the limelight. It was also found that platinum foil was entirely dissipated in the luminous focus of a mirror 8 or 9 inches in diameter.

Professor W. H. Miller stated that the spider's thread remained intact in the luminous focus of a lens which could melt a metallic wire.

June 15th, 167th meeting. Dr. W. A. Miller stated that, in a spectroscopic examination of the planet Saturn, the spectrum of the planet itself was not so intense as that of the ring, and a dark line in the red was still more intense than in the atmosphere of the earth. This fact led him to infer the existence of an atmosphere around Saturn, which contained a substance similar to one of those present in the earth's atmosphere.

Mr. Busk said that since the last mention of the ossiferous caves on Windmill Hill, Captain Brome had discovered three others, containing relics of human workmanship, the entrance of one being over the edge of the cliff which rose above the 'Governor's Cottage' on the east face of the plateau of Windmill Hill. This cavern contained the remains of several individuals, including four nearly perfect crania, and numerous implements of bone, flint, and other stone. The crania were uniformly dolichocephalic, very like those of the Basques at the present day, and that of a specimen, seen last year by Dr. Falconer and himself at Madrid, which had been found in the ancient workings of a copper mine in the Asturias. We might therefore infer that at the 'polished stone period' a race, resembling the existing Basques, was living all over Spain.

Professor Ramsay announced that he was to visit Gibraltar during the autumn to make a geological survey of the Rock and the adjoining district.

Mr. Busk said that after studying the fossil bones of the Pigmy Elephant, brought by Captain Spratt from the Zebbug Cave in Malta, he held them to represent two distinct species, and not one as had hitherto been supposed.

Oct. 26th, 168th meeting. Sir R. Murchison announced that Mr. S. Baker had arrived in England, and would describe to the Royal Geographical Society on Nov. 13th his discovery of Lake Albert Nyanza, the basin of which lay under the equator and was about 260 miles in length;[1] also that news had been obtained from M. De Chaillu, who was then about 150 miles inland from the Gaboon and was

[1] Its existence was ascertained by Speke and Grant in 1862, but it was explored by Baker (afterwards Sir S.) in 1864.

desirous of making his way, if possible, across the continent. The speaker had also received a letter from Dr. Livingstone, who was fitting out, at Bombay, his expedition for African exploration.[1]

Dr. Bence Jones gave some results of experiments on the rapidity of the absorption of quinine by various parts of the body. These had also proved the existence in it of a fluorescent principle. This Helmholtz had already noticed (in 1853), when he observed that the retina of a man, eighteen hours after death, was still fluorescent, though less so than paper or linen, and more than porcelain, while in 1859 Tetschenow had shown the fluorescence of the lens in rabbits and men to be very strong, exactly resembling, though not quite so strong as, that of quinine, with which in optical respects it agreed. It would be very desirable to isolate, if possible, this fluorescent substance.

Dr. Playfair gave an account of the conclusions arrived at by the Commission for investigating the Cattle Plague. The disease was undoubtedly contagious and very subtle. Inoculation twelve or thirteen times in succession reduced the mortality to about 14 per cent., but as yet no curative appeared to have been discovered. He also stated that at Madras, when smallpox virus had been mixed with five times its weight of milk, no serious symptoms—usually only a single pustule—were observed in 100 children inoculated.

Dec. 21st, 170th meeting. Mr. Sylvester gave an account of some movements of a planetary body about a centre of force which had been described in his 'Astronomical Prolusions,' published in the *Philosophical Magazine* for January 1868.

Colonel Sykes mentioned some exceptionally high readings of the barometer in the current month. At his house in Albion Street, Hyde Park, about 100 feet above mean-tide level, his sympiezometer had recorded 30·9 on the 10th (at 10 a.m.), 30·8 on the 13th, the same on the 17th (at 3 p.m.), and 30·4 on the 21st (at 10 a.m.); the thermometer

[1] That on which, after leaving Zanzibar in 1866, he discovered Lake Bangweolo, was met by Stanley at Ujiji, and died on May 1st, 1873.

readings on these days being from 51° to 52°, and the wind from W. to W. by N. Letters published in the *Times* had recorded similar observations at Leyton, Essex, and at Tunbridge, Kent.

1866. Jan. 25th, 171st meeting. Colonel Sykes referred to the exceptionally high barometric readings mentioned at the last meeting, stating that the atmospheric wave to which they were due appeared to have proceeded in a westerly direction. He urged the importance of a more extensive collection of observations than was at present possible, and of forming an international meteorological society.

Dr. Sclater mentioned that the Zoological Society had obtained a specimen (the first brought to England) of *Arctocephalus Hookeri*, a large seal inhabiting the Southern Ocean.

Feb. 23rd. Colonel Sykes again referred to the above-named atmospheric wave, and suggested that the tempests might be due to the filling up of the vacuum in its rear. He also furnished observations of temperatures in Canada during the first cold term in the current year.

Sir R. Murchison announced that Baron von der Decken's expedition [1] had not been able to ascend the Juba River in Eastern Africa for more than 385 miles.

March 22nd, 173rd meeting. Dr. Carpenter referred to the objections made by Professors King and Rowney to the foraminiferal origin of *Eozoon Canadense*,[2] and read a letter from Professor Dawson, of Montreal, stating that he and Dr. Sterry Hunt were still satisfied that the speaker's view was correct.

April 30th, 174th meeting (anniversary). Dr. Carpenter said that since the last meeting Professor Dawson had examined specimens which consisted entirely of calcareous material, and yet showed the characteristic Eozoonal struc-

[1] Karl Klaus von der Decken (1833-1863) began African travel after leaving the Hanoverian army in 1860. Failing to reach Lake Nyassa, he went thence to Kilimanjaro, ascending to 13,780 feet. Next he explored some of the East African rivers, and was murdered on this journey.

[2] Their views are expressed at length in *An Old Chapter of the Geological Record*, 1881.

ture, which conclusively negatived the hypothesis of Professors King and Rowney that this structure was due to the intermixture of calcareous and siliceous constituents.

Oct. 25th, 177th meeting. Dr. Carpenter read a letter from Professor Wyville Thomson giving an account of a small crinoid dredged by M. Sars [1] from deep water on the west coast of Norway. Though only about three inches long, it was a mature form and related to the Jurassic *Apiocrinus*.

He also mentioned the publication of a memoir by a Russian zoologist on Amphioxus,[2] which is remarkably abundant in the Bay of Naples. He had proved that, notwithstanding the absence of a true spinal column and of some other characters of the vertebrata, it was rightly classed with them, though utterly unlike them in its earlier stages, when it has more resemblance to a medusa.

Nov. 29th, 178th meeting. Col. Sykes called the attention of the Club to the case of a young naturalist, who had been arrested in Japan for digging up skulls in a native cemetery and banished from that country and China.

Professor Frankland spoke of a recently published pamphlet describing experiments on animal respiration and excretion with an apparatus much better adapted for that purpose than any hitherto in use. It consisted of a glass case large enough to contain a man with his workshop and a bed, so that quantitative determinations could be made of the egesta, ingesta and products of respiration both in a condition of rest and after hard work. The results obtained were (1) that the amount of work, if it at all affects the excretion of urea, very lightly lessens it ; (2) that during hard work a considerably greater amount of carbonic acid

[1] It was obtained off the Lofoten Islands by Mr. G. O. Sars, son of the well-known Professor in the University of Christiania, at a depth of about 300 fathoms. A description and figure of *Rhizocrinus loffotensis*, as it was named, is given by Prof. Wyville Thomson in *The Depths of the Sea* (1873), pages 447-451.

[2] *Branchiostoma* (the lancelet), so named by Costa in 1834, two years before it was called Amphioxus by Yarrell, is the only genus of the family. It contains eight or nine species, and belongs to a very archaic type.

is excreted than during rest; (3) that hard work adds very little to the absorption of oxygen during the day, but the amount is greatly increased during the following night. Diabetic and leukaemic patients, however, absorb no more oxygen by night than by day.

Sir H. James said that after completing the recent triangulation of the United Kingdom, the Ordnance Survey had computed the figure and dimensions of the earth from the results, as well as from a combination of all the separate measurements of arcs of meridian in Peru, France, Prussia, Russia, Cape of Good Hope, India, and the United Kingdom. These gave the equatorial semi-diameter as 20,926,330 and the polar one as 20,855,240 feet. The equator was also found to be slightly elliptical, the longer diameter being in 15° 34′ E. long., and the shorter in 105° 34′ E. long.; the semi-diameters being in the one case 20,926,350 feet, in the other 20,919,972 feet. The meridian of 15° 34′ nearly corresponded in the eastern hemisphere with that passing over the greatest quantity of land in that hemisphere and in the western with that passing over the greatest quantity of water. The meridian of 105° 34′ corresponds nearly with that which passes over the greatest quantity of land in Asia and with that which does the same in the western hemisphere.

1867. January 31st, 180th meeting. Colonel Sykes drew attention to the cold of the month, which had been most intense at or near London, while the weather in the extreme north of Scotland had been comparatively mild.

Professor Ramsay stated that in the Miocene Period the vegetation within the Arctic circle indicated a much more temperate climate than the present one, for it consisted of evergreens or at least leaf-bearing trees, the species of which are either identical or so closely correspond with those still existing, that we may fairly suppose them to have flourished under similar climatic conditions. He called attention to the subject, in the hope that experiments might be undertaken to ascertain whether leaf-bearing trees could survive a winter of three, four, or five months without the stimulus of light. In the discussion that followed Dr. Hooker stated that he thought it would be practically impossible to place trees in confinement under the same conditions in regard to heat, light, and ventilation as those in a state of nature, but that, as deciduous trees are dormant throughout the winter in temperate climates, the absence of light was not likely to produce any sensible effect on them during winter.

Feb. 28th, 181st meeting. Mr. A. Smith mentioned results lately obtained by Sir W. Thomson as to the rate ot a watch placed horizontally and suspended by two vertical cords, so that it can take up a vibration the rate of which depends on the torsion of the cords. When this rate is less than that of the balance of the watch, the latter gains, when greater it loses. The change, however, is not gradual, as might have been expected, but sudden, from the maximum of gaining to that of losing. In the pocket chronometer, exhibited by Mr. S. Smith, when the torsional vibration is very slow, the gain is about 1 in 1250, or 70 seconds a day. As the cords are shortened, the gain increases up to 1 in 50, or 28 minutes a day. It then suddenly changes to a loss of 28 minutes a day. When the watch is gaining, the balance and watch vibrate in opposite directions; when it is losing, in the same direction. This can be easily perceived in a chronometer, which only ticks when the balance is moving to the right.

Dr. Carpenter exhibited a specimen of *Eozoon Canadense* recently brought to England by Sir William Logan, in which were two points of interest: (1) it is formed of lamellæ, which curve round in a natural manner to join one another, and enclose the spaces elsewhere separating them; (2) because instead of being preserved in a serpentinous marble it is imbedded in a homogeneous limestone. Hence it cannot be due to any such reaction between calcareous and siliceous constituents, as Professors King and Rowney have supposed. Dr. Carpenter thought that no palaeontologist could doubt, after examining this specimen, that it had an organic origin, and was identical in character, both to the unaided eye and under the microscope, with the ordinary forms of *Eozoon*, though its minute structure was not well preserved.

March 28th, 182nd meeting. Mr. Sclater stated that Professor Huxley, in lecturing at the Royal College of Surgeons on the osteology of reptiles and birds, had pointed out some very remarkable characters in the cranium of the latter, which apparently had not hitherto been noticed, and showed that if these were taken, as he proposed should be done, for a basis of classification, the whole class must have a very different arrangement from that adopted in the Cuvierian system.

May 30th, 184th meeting. Mr. Wheatstone exhibited a specimen of avanturine chrome brought from Paris by M. Pelouse.

Mr. Busk said that, while examining the animal remains from the Brixham cavern, a large part of which belong to the bear, he had ascertained the bulk of them to represent *Ursus priscus*, which he had found by cranial and dental characters to be indistinguishable from *Ursus ferox*.[1] The bones of the true *Ursus spelaeus* were so scanty, that even its occurrence was doubtful, but some of *Ursus arctos* seemed to be present.

Dr. Carpenter described some important improvements recently made by M. Nachet in a binocular dissecting microscope.[2]

June 30th, 185th meeting. Dr. Carpenter described the results of examination under the microscope of thin slices from *Spirifer cuspidatus* and from types which have been confused with it. A true specimen of the first has an imperforate shell, but a shell occurs externally indistinguishable from it, which is perforate, and has such differences in its internal structure that it cannot be placed in the same genus. Of these Dr. Carpenter gave a description, saying that for the latter Professor Winchell had constituted the genus *Syringothyris*. This external isomorphism, associated with such differences of internal structure, was a remarkable thing.

[1] They are considered to be identical by Prof. S. H. Reynolds. See *Pleistocene Mammalia*, vol. ii. part 2, Palaeontographical Society, vol. lx. (1906). So the Grizzly Bear was much more abundant than the Brown Bear, and the Cave Bear the rarest.

[2] An addition to this Minute is placed at the end of those for Oct. 31st.

Oct. 31st, 186th meeting. Dr. Hooker read extracts of a letter from Dr. Hector, written on Sept. 17th from Wellington, New Zealand, in which he said that he had forwarded to England specimens of chert flakes found in cooking ovens with moa bones, together with bones of the embryo chick from the egg of that bird, and drawings of the egg and bones.

Professor Huxley referred to a discussion which had taken place some ten years previously about the age of the reptiliferous sandstones of Elgin, and stated that he had recently obtained evidence in favour of referring them to a more modern age than the Devonian. The quarries at Coton End in Warwickshire, which are worked in sandstones not older than Permian, have furnished fragments of *Hyperodapedon*, the most characteristic of the Elgin reptiles. A no less interesting fact is the discovery of its remains in India, in strata which are believed to belong to the same series as the Damuda beds, in which Labyrinthodonts, with Dicynodonts and other reptiles, have been discovered. So these beds, with the South African rocks containing Labyrinthodonts and Dicynodonts, are probably all of the same age, and thus, as Professor Oldham has suggested, all three may be neither Permian nor Trias, but passage beds between the Palaeozoic and Mesozoic.[1]

Professor Huxley also mentioned that, during a recent visit to Oxford, Professor Phillips had called his attention to the fine collection of megalosaurian remains in the Museum of Geology, and they had concluded after careful examination that some of the bones of *Megalosaurus* had hitherto been wrongly determined, the so-called coracoid being the *ilium* and the clavicle probably the *ischium*. Since his return to London he had found that similar errors had been made in the interpretation of the bones of *Iguanodon* and other

[1] The difficulties presented by the quarry at Cutties' Hillock have now been cleared up (J. W. Judd, *Proc. Roy. Soc.* 1885, p. 394). Of two sandstones, lithologically almost indistinguishable, the upper contains *Hyperodapedon*, with other Triassic vertebrates, the lower well-known Old Red Sandstone fish remains, so that an almost inconspicuous unconformity is the sole record of a great break in time.

Dinosauria. The rectification is important, for it shows the true *pelvis* of *Megalosaurus*, *Iguanodon*, etc., to be more bird-like in character than could have been imagined, and this, with the tridactylate character of the foot in the above-named Dinosaurs, caused him to regard them as the nearest connecting forms, known to us, between the typical reptilia and the struthious or other ratite birds.

Mr. Sclater announced the probable arrival of a living walrus at the Zoological Gardens.

Dr. Carpenter recounted some interesting experiments on a living *Comatula*, undertaken to show that, as he had already thought probable, the sarcode cord which passes through each segment of the arms and pinnules has the function of a nerve-trunk, though it has not the histological character of nerve.

Nov. 28th, 187th meeting. Mr. Grove read a letter from a member of his family, giving an account of a recent ascent of Vesuvius and the present state of the eruption. The explosions occurred with a certain periodicity, the greater ones at intervals of 4 or 5 minutes, with numerous minor explosions between them at intervals of a few seconds.

Mr. Sclater mentioned that, for the first time in England, an eland had that morning been sold to a butcher for food.

1868. Jan. 30th, 189th meeting. Dr. Carpenter reverted to the subject of his communication about the physiological structure of crinoids, adding several particulars of much interest.

Professor Flower exhibited a photograph of a drawing from New Zealand, sent by Dr. Haast, which gave (with some restorations) the shapes and sizes of six species of *Dinornis*.

April 27th, 192nd meeting. Mr. Grove, who had examined some rocking stones during a recent visit to Cornwall, exhibited a small model in imitation of the phenomena.

Professor Tyndall gave an account of his recent visit to Vesuvius during the eruption, when he had succeeded in ascending to the margin of the crater and looking down into it.

May 28th, 193rd meeting. Dr. Carpenter exhibited a small specimen of the crinoid obtained at 300 fathoms near the Lofoten Islands (see Oct. 25th, 1866). He also recounted the results of studies by Professor Wyville Thomson and himself of a perfect specimen of the West Indian Pentacrinus. These were (1) the precise conformity of its general plan of structure to that of the pentacrinous larva of *comatula*, before separation from its stem; (2) the close conformity of the visceral apparatus in the two, which, with the contents of the stomach, indicates their food and the manner of obtaining it to be the same, the whole apparatus of arms and pinnules being a trap for minute organisms, which are conveyed to the mouth by ciliary action along the floor of the furrow on the upper surface of every pinnule; (3) the diagnosis of calcareous plates, forming the essential or radial skeleton and those which are accidental, according as they are imperforate or perforated for extensions of the axial cord, has been found to hold good in such a variety of cases that it may be regarded as fundamental in determining the homologies of the skeleton in the whole group of *Crinoidea*. The specimen exhibited showed how readily, if these clues were followed, very aberrant forms might be understood.

Oct. 29th, 195th meeting. Mr. Sclater stated that the Zoological Society had received from Sir George Grey a curious New Zealand lizard, constituting a distinct sub-order, which was sent by Dr. Hector, and called *Hatteria punctata*. Professor Huxley expressed the opinion that this might be a direct lineal representative of *Hyperodapedon*.[1]

Sir R. Murchison exhibited a curious white tissue which had been found lining the hold of a ship which had recently arrived in the Thames laden with maize from Trieste. This was said to be the production of myriads of small maggots.

[1] The Tuatera, now called *Sphenodon punctatus*, which apparently is confined to the small islands off the north-east of New Zealand, is not only the most remarkable of all existing reptiles to which the term lizard can be applied, but is the sole living representative of a distinct family, as well as of an entire order; and the difference between it and an ordinary lizard immeasurably exceeds that by which the latter is separated from a serpent (Lydekker). A foramen in the parietal bones of the skull covers a rudimentary eye. *Hyperodapedon* was among its ancestral forms.

Its texture is very thin but extremely tenacious, and when rubbed it is highly electric. Mr. Busk, in a discussion about its nature and origin, remarked that he had seen material from Mexico very similar but yellow in colour, which is said to be made by spiders and found hanging from trees.

Nov. 26th, 196th meeting. Mr. Busk, reverting to the above-named tissue, said that Mr. Stainton [1] had suggested it might be the work of a small Tineina, and similar cases had been previously observed.

1869. Feb. 25th, 199th meeting. Sir W. Armstrong described a machine invented by Captain Andrew Noble for measuring very minute intervals of time, which was being employed to measure the velocity of a projectile in passing through the gun. The principle of the machine was that an electric spark, emitted by a series of pointed wires, arranged at fixed intervals, marked the circumference of a number of smoke-blackened discs, which rotated with a high velocity about an axis. It had proved remarkably successful in measuring even the smallest variations in the time occupied by the shot in passing through successive intervals of the gun. It had also been observed that a much milder kind of gunpowder had been found to give a higher average pressure than that generally used, notwithstanding its lower maximum pressure. This probably was due to the fact that the higher temperature, accompanying more intense pressure, caused greater absorption of heat by the gun, with a consequent loss of propelling power.

March 18th, 200th meeting. Mr. Gassiot spoke of a very powerful electrical machine by which a spark could be obtained 19 inches in length.

April 26th, 201st meeting. Dr. Hooker exhibited drawings of some curiously-shaped stones, found by Mr. W. T. L. Travers, F.Z.S., on the isthmus between Lyell's Bay and Evans' Bay, near Wellington, New Zealand. They have a strong resemblance to works of human art, occur in great

[1] Henry Tibbats Stainton (1822-1892), a distinguished entomologist, author of papers and works on British insects, Secretary of the Ray Society 1861-1872, F.R.S. 1867.

abundance, and vary in size from half an inch to several inches in length. Mr. Travers believed that, notwithstanding their artificial aspect, they were formed merely by the cutting action of wind-driven sand, as it drifted over an exposed boulder bank which forms the higher part of the isthmus. Dr. Hector, while adopting this view, had remarked that if they had been elsewhere associated with works of human art, they would have been referred to the so-called stone period.[1] Dr. Hector thought that the Umus of the Maoris (the kjökkenmöddings of New Zealand) were places likely to favour the production of these stones, being generally on rising ground among sand dunes. Sir P. Egerton said that Lord Selkirk had given him a stone, polished by driving sand, which he had found in Egypt nine years ago. This he would bring to the Club (see next page). Mr. Evans felt some doubt about the origin assigned to these stones, but reserved his opinion till he had an opportunity of examining them.

May 27th, 202nd meeting. Mr. Sclater said that a few days previously a living specimen of the rare mammal *Ailurus fulgens*, the correct zoological position of which is still doubtful,[2] had arrived at the Zoological Gardens. It had been obtained near Darjeeling, and brought to England by Dr. Simpson.

June 17th, 203rd meeting. Mr. Prestwich referred to the subway then being constructed under the Thames, which was expected to be finished in about two months. The tunnel was about 9 feet in diameter, and some 20 feet below the bed of the river, being cut entirely through the London clay, at the rate of about 9 feet a day.

[1] They are described and figured by Mr. J. D. Enys in *Quart. Jour. Geol. Soc.* vol. xxxiv. (1878), page 86. Specimens have been placed by myself in the Sedgwick Museum, Cambridge, with sand-worn stones from near Wady Halfa, Egypt, given to me by Colonel H. G. Lyons, F.R.S. These *dreikanter*, etc., have been often noticed in recent geological literature.

[2] *Aelurus fulgens*, the panda, is placed by the late W. T. Blanford, *The Fauna of British India* (*Mammalia*), page 189, in the *Procyonidae* (racoons, etc.). The genus contains but a single species peculiar to the Himalayan region.

Sir Philip Egerton exhibited a stone, polished by blown sand, which Lord Selkirk had picked up in March, 1849, on the east side of the Red Sea not far from Suez near the wells of Mabouk. These are on a flat strip of land between the sea and a range of hills. Here the wind is always blowing up and down, and the driven sand [1] polishes the exposed surfaces of the stones.

Oct. 28th, 204th meeting. Mr. Prestwich announced that the Thames Tunnel had now been completed, still wholly through the London clay, to 120 feet beyond the river, on the south side, where the corresponding shaft was being constructed.

Dr. Carpenter stated the general results of the Deep-Sea Dredging Expedition of the current year. In the cold area of the Atlantic the temperature was ascertained to be as low as 30° F. Its fauna was arctic in character and very rich, including, at 650 fathoms, thousands of Arctic echinoderms (*Comatula escrichtii*, etc.) with dwarfed forms of ordinary British species. From depths of 550 to 700 fathoms in the warm area numerous species of *Holtenia* and *Hyalonema* were obtained. Hardly a species was common to the two areas, which in places were within ten miles of each other. A depth of 2435 fathoms had been reached in the north of the Bay of Biscay, 250 miles W. of Ushant. Here a considerable variety of animal life, representing nearly every division of the invertebrata, had been found in the Atlantic mud, among which was a new crinoid and certain chalk fossils hitherto regarded as extinct.

Professor Huxley announced that his examination of specimens of *Thecodontosaurus* had proved it to belong to the *Dinosauria*.

Nov. 25th, 205th meeting. Professor Flower gave some particulars of a fin-whale (*Balaenoptera* [2]) which recently had been stranded in Layston Harbour, near Portsmouth, and produced some hairs from its beard.

[1] See April 26th, page 183.

[2] Four species, according to the *British Museum Guide to the Mammalian Galleries*, are occasionally stranded on the British coasts.

Mr. Paget mentioned that a patient, whose tongue he had recently excised, was nevertheless able to speak articulately within twenty-four hours after the operation.

Dec. 16th, 206th meeting. Mr. Grove called attention to some recent changes in the planet Jupiter, the south pole, usually dark, having become brilliantly light. This was succeeded by a dark belt variegated with light; afterwards by an extremely bright belt where it was usually dark.

Dr. W. A. Miller read a letter from Dr. Robinson[1] giving an account of the progress made with the new telescope which Mr. Grubb (now Sir Howard), of Dublin, was constructing for the Royal Society.

1870. Jan. 27th, 207th meeting. Mr. Evans exhibited a stone implement discovered in gravel on Southampton Common 180 feet above the level of the river Itchen.[2]

Mr. Grove referred to a paper recently published in *Nature*[3] by Mr. Barrett, and made some remarks on the correspondence between the spectrum of light and the gamut of sound.

Sir R. Murchison spoke of Mr. Hayward's recent travels in Kaschgar and Yarkand, saying that he was now preparing to explore the table-land of Pamir, which had not been visited since the days of Marco Polo.

Sir B. Brodie called attention to a recently invented mechanical process for separating the starch and gluten of rice and other flour.

Feb. 24th, 208th meeting. Professor Frankland said that river water contained an appreciable quantity of arsenic. In Lancashire he attributed it to the iron pyrites used in the alkali works, and had estimated that thus 1500 or 1600 tons of arsenic were introduced yearly into Great Britain. He had found the metal in the London sewage at Barking to the amount of 0·004 in 100,000 parts, and accounted for

[1] Dr. Thomas Romney Robinson (1797-1882), Fellow of Trinity College, Dublin, in charge of the Armagh Observatory, F.R.S., and distinguished for his physical and astronomical writings.

[2] Implements from this locality, perhaps including the one mentioned above, are described in J. Evans, *Ancient Stone Implements of Great Britain* (ed. ii.), pages 613-5.

[3] W. F. Barrett, *Nature*, vol. i. page 286.

its presence by the large consumption of coal in the Metropolis, from which the arsenic passed off in smoke, for he found it even in London rainwater to the extent of 0·008 in 100,000 parts.

Professor Cornu,[1] of Paris (a guest), spoke of an optical study of the deformation of elastic bodies and the employment of a new source of photogenic and monochromatic light.[2]

March 31st, 209th meeting. Mr. Sclater said that a remarkable new fish had been obtained from one of the rivers in Eastern Queensland by Mr. Krafft, curator of the Australian Museum at Sydney, which appeared to be intermediate between *Lepidosiren* and the Ganoid fishes. It was referred by him to the genus *Ceratodus* (Agassiz), but it appeared to be nearer to *Dipterus*; though probably it would require a new genus. Professor Huxley remarked that the discovery had a special interest for those who, like himself, had asserted *Lepidosiren* to be closely connected with the Ganoids.

April 25th, 210th meeting (anniversary). Mr. Gassiot stated that when the electric discharges from an induction coil are passed through vacuum tubes with uranium-glass globes, these become intensely illuminated, owing to the high refrangibility of electrical light. But on heating one of the globes with a spirit lamp, the peculiar luminosity disappears, which, however, is recovered if the globe be allowed to cool.

Colonel Sykes enquired whether, when sea water freezes, the salt is or is not eliminated. The opinion expressed was that the salt in this water was only mechanically present and could be eliminated by repeated freezing.

Oct. 24th, 213th meeting. Professor Peirce,[3] of New York, Director of the American expedition to observe the eclipse

[1] M. A. Cornu (1841-1902), Professor of Physics at the École Polytechnique, Paris, who wrote many important papers on the phenomena and properties of light.

[2] The Minute, no doubt supplied by the Professor, is in French, with two pen-and-ink diagrams, and does not admit of condensation.

[3] J. M. P. Peirce, Professor of Astronomy and Mathematics at Harvard University, Cambridge, U.S.A.

of the sun on Dec. 22nd (a guest), described its plan. His Government had granted £6000 for the purpose, and twenty-five observers were to be sent to the Mediterranean, one party to Spain, the other to Sicily. The corona would receive special attention. Comments were made on the action of the Admiralty, which, by refusing a ship, had caused the collapse of the English expedition, but it was stated that the Government would now be more willing to consider the matter. The members present were in favour of repeating the application, though it was doubtful whether there would be sufficient time for the needful preparations.

Nov. 24th, 214th meeting. A singular atmospheric phenomenon, witnessed at Copenhagen in July 1851, but of which a scientific explanation had only recently been given, was mentioned by Mr. Gassiot. About sunset a light blue luminous cone shot through the sky, followed by four others going in the same direction and of the same colour. Their diameter was a little less than that of the sun, the fifth being smaller than the others. It was followed by irregular masses, with an apparently strong internal movement.

Mr. Huggins described the preparations for observing the coming eclipse of the sun, the Government having now offered the necessary assistance in transport and money.

1871. Jan. 26th, 216th meeting. Mr. Huggins gave some particulars of the late solar eclipse. At Oran, where he was stationed, clouds hid the sun during totality. He exhibited photographs, taken by Lord Lindsay, Mr. Willard of the American expedition, and Mr. Brothers. One of the first-named showed a larger amount of halo on the side of the moon on which the brighter part of the corona round the sun was visible. This probably had to a great extent a terrestrial origin, namely in the light scattered by the imperfect transparency of our atmosphere. In the photographs, taken by Mr. Willard in Spain and Mr. Brothers in Syracuse, similar dark rifts are seen in the corona, which suggests that the light in which they occur is exterior to the earth's atmosphere and probably near the sun.

March 30th, 218th meeting. Mr. Busk described an effect produced by different-coloured chalks. During a lecture at the Royal College of Surgeons, what was written in blue on the blackboard seemed to be in the same plane as it; that in red to project two or three inches from it; and that in white to occupy an intermediate position. The effect was seen by two of the audience, whose attention he had called to it. Some members present mentioned similar appearances which they thought might help in explaining the phenomenon.

June 29th, 220th meeting. Dr. Hooker gave an account of his recent three months' expedition to Marocco.[1] The general coolness of the climate, due to the prevalent north-west winds and the cold southerly current along the Atlantic coast, had especially struck him. His party went from Tetuan to Mogador by sea, and thence to Marocco. From that city they visited the main chain of the Atlas, some 20 miles south of it, and reached a height of 12,000 feet. Though snow falls on the highest parts throughout the year, it is only permanent as patches in gullies. No glaciers now exist, but they discovered a moraine at a height of about 7000 feet. No truly Alpine plants were found, the vegetation, so far as it extended upwards, being purely Spanish.

Oct. 26th, 221st meeting. Mr. Paget said that the brain of the late Mr. Babbage,[2] which had been examined in accordance with his desire, was rather below than above the average weight and slightly asymmetrical. It would be placed in the Museum of the Royal College of Surgeons.

Nov. 23rd, 222nd meeting. Dr. Carpenter communicated some results of his expedition to the Mediterranean, during the past autumn, on H.M.S. *Shearwater* while on its way to survey the Red Sea. The evidence of an outflow under-

[1] It began on April 1st and ended on June 21st. He was accompanied by Mr. John Ball, the well-known Alpine botanist, and Mr. G. Maw. The journey is described in their *Journal of a Tour in Marocco and the Great Atlas*, 1878.

[2] Charles Babbage (1791-1871), so eminent in mathematics and mechanical science, noted especially as inventor of the calculating machine. He had died on Oct. 18th.

current from the Mediterranean to the Atlantic, which had been ascertained during the previous year,[1] had been fully confirmed by soundings near Gibraltar. The results of dredging in the eastern and western basins, though not yet fully worked out, showed the foraminifera, at any rate, to correspond, in the former basin, with the Red Sea species, and in the latter with Atlantic species. The deeper parts of both basins were azoic, a consequence, he believed, of the small proportion of oxygen in the bottom waters, due to the entire absence of currents in those regions.

Dec. 21st, 223rd meeting. Sir C. Lyell, referring to Dr. Carpenter's remarks at the last meeting, gave some additional particulars from a report sent to the Admiralty by Captain Nares, who thought that the Mediterranean tide acted and reacted down to the bottom of the Strait, causing an outflow during flood tide and an inflow during the ebb. At the surface the constant inflowing current is much checked by the flood tide, but is strong during the ebb, except when easterly winds prevail. Admiral Richards, however, considered that the time (six days) devoted to observation was not enough to warrant conclusions about the relative volumes of the outflow and inflow, especially as an easterly wind prevailed for most of the time.

1872. Jan. 25th, 224th meeting. Mr. Huggins gave particulars of the late solar eclipse from accounts by Dr. Jansen and Colonel Tennant. These showed it could no longer be doubted that the corona belongs to the solar atmosphere, and the latter observer stated that the rifts on the corona had again been noted.

Dr. Hooker stated that Mr. New, of Mombasa, had made a partial ascent of Kilimanjaro, and had brought back a few plants.[2]

[1] Sir Wyville Thomson, *The Depths of the Sea* (1873), pages 189-195, or W. B. Carpenter, *Proc. Roy. Soc.* vol. xx. p. 535.

[2] In August, 1871, he crossed the snow-line (probably rather above 13,000 feet) at the south-east base of Kibo, discovering on his return the little crater lake Jala, and observed that the vegetation on Kilimanjaro is divisible into six zones. See Hans Meyer, *Across East African Glaciers* (translated 1891), page 11.

Feb. 29th, 225th meeting. Professor Cornu (see p. 186) (guest) mentioned that he had obtained the reversal of several of the spectral lines of certain metals by placing the metal or its chloride in the path of either the induction spark or the electric arc: namely aluminium, sodium, lead, copper, and thallium, one line; silver, two lines; magnesium, zinc, and cadmium, three lines. He had failed to get reversal of any lines in iron, cobalt, bismuth, antimony, or gold. He had come to the conclusion that a very thin layer of vapour (so thin as to be imperceptible at the distance of the earth from the sun) was sufficient for this reversal. But he thought it needless to assume that a continuous atmosphere, however thin, existed around the sun, the absorption being always local, and taking place spontaneously by the external refrigeration around each incandescent point.

Mr. J. Evans exhibited some objects of bronze and their moulds, belonging to the later part of that period, from a find at Harty in Sheppey.

Mr. Sclater stated that the Zoological Gardens had recently received a living specimen of *Rhinoceros Sumatrensis*.[1]

March 25th, 226th meeting. Mr. Spottiswoode, referring to Professor Cornu's communication to the last meeting, said that on observing with his large automatic spectroscope the spectrum of metallic sodium in a Bunsen burner he had noticed a well-defined absorption line on the centre of each of the bright lines D_1 and D_2, giving them the appearance of being double. The absorption lines therefore were much narrower than the corresponding bright lines.

April 23rd, 227th meeting (anniversary). Professor Huxley, who had recently returned from Egypt, said he had been very much impressed by the signs of aerial denudation in the valley of the Nile, though the climate apparently was almost rainless.[2]

[1] Afterwards it gave birth to a calf. W. T. Blanford, *Fauna of British India* (*Mammalia*), page 477.

[2] The word 'aerial' must refer, I think, to action of streams rather than of winds. In that sense it is very conspicuous above Cairo between the right bank of the Nile and the eastern hills. See A. J. Jukes-Browne, *Geol. Mag.* 1877, page 477.

May 23rd, 228th meeting. Dr. Hooker said the Ipecacuanha plant had been lately established in the Himalayas, and was thriving luxuriantly.

Mr. Siemens explained the working of the pneumatic despatch tube lately fitted up under his superintendence at the General Post Office.

Oct. 24th, 229th meeting. Dr. Carpenter said that a strong under-current, as H.M.S. *Shearwater* had discovered, flowed at a depth of about 20 fathoms through the Dardanelles into the Black Sea. This he had predicted two years ago, so he regarded it as confirmatory of the general theory of under-currents.

Nov. 21st, 230th meeting. Sir John Lubbock, who had lately visited the Plain of Troy, said that it did not correspond with Homer's description so well as several recent writers had asserted. He had opened the so-called Tumulus of Hector, without finding any sign of an interment, but he admitted that his exploration was not a complete one.

Mr. Sclater gave an account of the Livingstone search expeditions about to be despatched from England; one, commanded by the Messrs. Grandy, to work from the west coast of Africa by the river Congo, the other by Lieutenant Cameron and Dr. Dillon from Zanzibar by Lake Tanganyika The Zoological Society had urged on the leaders the importance of making collections of Natural History, and had offered a grant in aid.

Dec. 19th, 231st meeting. Dr. Carpenter said that though the *Challenger* had encountered rough weather on its way from Sheerness to Portsmouth, it had arrived there, as he had ascertained on a visit yesterday, without the slightest injury to the scientific appliances, of which the provision was most satisfactory.

Sir Benjamin Brodie referred to a movement, both external and internal, to stimulate the universities to the promotion of science and the encouragement of original research. Mr. Grove thought that for this purpose fellowships, tenable for a term of years, but irrespective of marriage, might be helpful.

1873. Feb. 27th, 233rd meeting. Professor Tyndall described his recent visit to the Niagara Falls, stating that he considered the disturbance of the surface in the centre of the Rapids, three miles below the Falls, to be due, not to inequalities of the bottom, but to the meeting of two sets of waves thrown by the rocks on each bank diagonally across the stream.

June 19th, 236th meeting. Dr. Hooker said that a collection of plants, sent by the *Challenger* from Bermuda, so far as examined, showed the flora of these islands to be closely related to that of the southern United States with a considerable mixture of tropical forms.[1]

Sir B. Brodie described results of his experiments on decomposing carbonic acid gas by induced electricity, in the course of which he had demonstrated ozone to be a triatomic form of oxygen.

Professor Mayer,[2] of New York (guest), gave an account of his experiments on the elongation of iron bars by magnetism.

Oct. 30th, 237th meeting. Professor Sylvester exhibited a model of an instrument invented by Captain Peaucellier, of the French Engineers, for converting circular into rectilinear motion. With certain additions, it could also convert spherical into plane motion. By a suitable combination of a number of these, the working point could also be made to describe any algebraical curve up to the sixth order (inclusive). This result he thought might be extended to curves of any degree, and that a connected train of these machines would be capable of reproducing whatever motion could be obtained by any combination of jointed rods. Such a train would serve as a universal calculating machine for extracting the roots of numbers and performing still more recondite algebraical operations, so that he believed Peaucellier's machine would prove to be of the highest practical importance.

[1] The subject was discussed afterwards by Mr. Moseley, of the *Challenger*, "Notes on the Vegetation of Bermuda," *Jour. Linn. Soc.* xiv. (Botany), page 317.

[2] Perhaps Dr. A. M. Mayer, Professor of Physics and Director of the Laboratory at the Stevens Institute of Technology, Hoboken, U.S.A.

Professor Tyndall described the results of experiments, made off the South Foreland, to ascertain the best means of producing sounds to serve as fog signals at sea. Of the various contrivances tested, the most powerful was a steam siren, with twelve radial slits worked under a pressure of 70 lbs. The experiments had shown the extraordinary extent to which even the most powerful sounds were affected by the state of the atmosphere, the direction of the wind, and the like, but not by falling rain, as had been supposed. A very probable cause of the obstruction of sound, even on a perfectly calm and optically clear atmosphere, was the formation, under a hot sun, of strata of air in different degrees of saturation by aqueous vapour, from the surface of which the sound apparently was partially reflected. In one instance the loudest sounds, on a perfectly calm and clear day, were inaudible at three miles from the shore till after sunset. Also, when the observers came between the shore and the stratified portion of the atmosphere, they noticed the reverberation of the sound from the air to be very loud and distinct.

Nov. 27th, 238th meeting. In a conversation on Professor Sylvester's communication to the last meeting, Mr. Huggins stated that M. Martin, of the Paris Observatory, had given perfectly flat surfaces to mirrors for heliostats by using convex and concave instead of flat tools, the process being carefully watched and tested from time to time.

Dec. 18th, 239th meeting. Professor Cleık Maxwell exhibited an instrument for applying polarized light to detect the state of strain in a moving viscous fluid. This was placed in a hollow brass cylinder with glass ends, within which another metal cylinder was made to rotate, and parallel to it a polarized beam was passed through the fluid. Liquid Canada balsam showed the effects well, but he had failed to obtain them with gum mucilage or syrup. This method appeared to be capable of indicating the nature of viscosity in different substances.

1874. Jan. 29th, 240th meeting. Mr. Busk spoke of two skulls of the tiger, recently brought by Mr. R. Swinhoe from China, one from Fychoo in the south, the other from Manchuria in the north, where the winter is very severe and much snow falls, under which the tiger burrows. This form is covered with long hair. But the two, so far as can be inferred from their skulls, are specifically identical, and indistinguishable from the Bengal tiger.

Professor Tyndall described an instrument, the invention of his assistant Mr. Cottrel, to illustrate the action of flame in reflecting sonorous vibrations. A sound is transmitted down one of two tubes which are placed at an angle and is there reflected from a broad batswing flame down the other, on to a sensitive flame at the farther end, which was readily affected.

Feb. 26th, 241st meeting. Principal Elliot,[1] of Harvard University (a guest), in a conversation about the introduction of small birds into America for the destruction of caterpillars, said that though the common house-sparrow had easily found food and multiplied rapidly, it was necessary in Boston and Cambridge to supply them with water during the dry season, for without this they would die out.

Mr. Siemens gave an account of a vessel constructed for laying deep-sea telegraph cables, which had recently been built under his superintendence at Newcastle-on-Tyne. It was 5000 tons burden, and could contain 1800 miles of cable. Both ends being alike, it could move either way, and could turn quickly round, as it was propelled by twin screws.

March 26th, 242nd meeting. Dr. Carpenter gave an account of the parts of a swing-bridge which he had recently seen in Sir W. Armstrong's works at Newcastle-on-Tyne for spanning that river. It would be turned by hydraulic pressure on a central pier, leaving on either side a space of 70 feet. The total weight would be about 1800 tons, but the turning machinery could be worked by one man.

[1] The name is twice written Elliott in the Minutes, but I think it can only be Charles William Elliot, born at Boston in 1834, who became Principal of Harvard in 1869 and was most successful in reorganizing that University, resigning his position in 1900. He also wrote on Chemistry.

Professor Frankland made some remarks on the winter temperature and climate of Davos, where he had recently spent about seventeen days. The weather phenomena were almost opposite to those experienced in England. The warmest wind was from the north-east, and the thicker the snow upon the ground, the higher the temperature. Davos, though about 5200 feet above the sea, enjoyed an almost perpetual calm and bright sunshine, with a nearly uniform temperature from sunrise to sunset. The rivers freeze from the bottom instead of the top, and give off vapour even at the freezing point. Anyone desirous of warming himself sits still in the open air, but moves about if the contrary.

June 18th, 245th meeting. Mr. Gassiot exhibited prints from blocks suited for use in newspapers, to show the daily meteorological condition. The map outlines were already stamped on them, and those required to show these conditions were engraved with Mr. F. Galton's drill pentagraph.

Mr. Galton stated that the Meteorological Committee had recently applied the planimeter—an instrument for obtaining areas mechanically—to calculating the mean values of meteorological observations, as recorded on the engraved sheets of their quarterly reports, with quite satisfactory results.

Sir John Lubbock referred to a recent order of the Public Schools Commissioners which made the teaching of Physical Science, with examinations, generally obligatory in such schools, and gave some details in regard to it.

Professor Prestwich spoke of a memoir on deep sea temperatures which he had submitted to the Royal Society.[1] In it he had collected and classified all available temperatures from 1849 to 1865. So far back as 1823 temperatures of 35° to 36° F. were obtained at depths of 8000 to 10,000 feet, and many concordant observations showed a constant temperature at great depths in the Mediterranean. It was not the case, as D'Urville had assumed, that the greatest depths always had the temperature of the greatest density, viz. 39° F.

[1] *Proc. Roy. Soc.* vol. xxii. page 462.

Dr. Günther observed that Capt. Kellett's observations in the North and West Pacific agreed with the more recent observations made with the latest improved appliances.

Nov. 26th, 247th meeting. The substance of Professor Wyville Thomson's paper on some observations made by the *Challenger*, to be read this evening to the Royal Society,[1] was given by Professor Huxley. It showed that the Globigerina ooze—the modern representative of the chalk—extended to a depth of about 2250 fathoms, and then gave place to red clay. The organisms, which are the chief constituents of this ooze, live near the surface, and their dead shells are constantly falling to the bottom, where they lie in various stages of decay; the red clay, composed of alumina silicate and red oxide of iron, being their insoluble residue.

In a conversation which followed, some members attributed the removal of the carbonate of lime to free carbonic acid in the sea-water, and thought that the red clay, instead of being due to the disintegration of older rocks, might have been formed simultaneously with the ooze. A discussion followed on these subjects, and especially on the solvent power of sea-water and the presence of free carbonic acid at great depths in association with ice-cold water derived from the melting of polar ice.

Dec. 17th, 248th meeting. Dr. Carpenter, who was absent from the last meeting, expressed dissent from some of Professor Thomson's conclusions. The latter had indeed proved the young thin-shelled globigerinas to float at the surface, but their shells, in growing older, as Dr. Wallich and himself had shown, became so much thicker that they sink to the bottom, where they continue to live. Only those who have studied sections of the shells can appreciate this thickening. That the globigerinas, which he and Dr. Wallich had collected, were alive, was shown by the exact conformity of their sarcode with that of other foraminifera. Water, which they had obtained from immediately above the bottom, was quite turbid from the number of young

[1] *Proc. Roy. Soc.* vol. xxii. page 423.

globigerinas floating in it, which he thought must either have subsided to this level while still living, or, after having been born there, must be on their way to the surface, there to live till they had reached full growth, when their increased weight would cause them to sink. While agreeing with Professor Thomson that the red clay was derived from the foraminifera, he thought it a metamorphic form of the iron alumina silicate, which often replaces, as in sundry greensands, the sarcode of the foraminifer after its death. In Captain Spratt's dredgings from the Aegean he had found particles of red clay among the glauconite grains, which suggested by their shape that they had been formed in the interior of chambers, which had afterwards been removed by solution.

Dr. Playfair called attention to some important Indian coal-deposits, which had recently been found in the Nizam's Dominions. Political considerations, which it was hoped would be overcome, prevented English capitalists from working them. Valuable deposits of iron ore also occurred near some of them.

1875. March 18th, 251st meeting. Mr. Sylvester exhibited a model of a new machine on the principle of Capt. Peaucellier's parallel motion instrument (see page 192). It had the form of a fan united at the ends by transverse bars jointed in the middle. When the latter were straight, the radii were equidistant ; when they were bent in alternate directions, the angles formed by the radii are alternately larger and smaller. This Vandyck fan, as he proposed to call the instrument, could be easily applied to dividing an angle into three parts, and Professor Clerk Maxwell had suggested using the principle in constructing a spectrum apparatus, for it ensured a regular angular movement of the prisms.

June 17th, 254th meeting. Sir J. Paget exhibited a facsimile of a letter of William Harvey, lately found in the British Museum. It was written from Flanders, where he was travelling with the Duke of Lennox, and addressed to Secretary Dorchester, to complain that his patent as King's

Physician had not been respected, another person having been appointed, without justification, to receive his salary. A second letter, similarly found, written officially to Prince Rupert, describes a visit to Prince Maurice, and states that the army was suffering from fever. He mentions that, having found some one in a very bad state, he determined not to give him any medicine.

Professor Flower exhibited a piece of the Demerara submarine telegraph, the gutta-percha coating of which had been cut through (and its action stopped) by the rostrum of a sawfish, one of the teeth of which was left in the coating. Dr. Günther said the sawfish is supposed to feed on the intestines of other fish, its mouth being lined with rows of very minute teeth, so that it probably used its rostrum to cut them open. In this case it was very likely near the bottom.

1876. Feb. 24th, 259th meeting. Dr. Siemens explained the principle of an apparatus, which he called a bathometer and had devised for ascertaining the depth of the sea without using a sounding wire. This was done by measuring the effect produced by a diminution in density of the attracting body. As the material of the earth is more dense than sea-water, gravitation at its surface should be greater than at that of the ocean. The instrument for measuring the difference consisted of a vertical tube with cup-like extremities, containing mercury, which pressed upon an elastic steel diaphragm, supported in the centre by carefully tempered steel springs. It was so arranged as to compensate for variation of temperature, and being open at both ends was not affected by that of atmospheric pressure. The effect of latitude had been calculated in fathoms of depth, and tabulated for use with the instrument. Dr. Siemens said that a comparison of the instrument's readings with those obtained from Sir W. Thomson's sounding wire justified the expectation that it would indicate to the mariner changes of depth long before he reached really dangerous ground.

An attraction meter had been constructed on the same principle. At each end of a horizontal tube of wrought iron, a similar horizontal tube is fixed, the openings from the one to the other being incomplete and only below their horizontal mid-section. The transverse tubes communicate by a glass tube of small diameter at a higher level than the wrought-iron one. The first tube is filled with mercury, but the second pair only to half their depth ; the remainder being filled with coloured alcohol, except for a bubble of air in the centre of the glass tube. The whole apparatus is mounted on three set screws to maintain its level. When a heavy object is brought near one end of the instrument the mercury is attracted thither and the bubble moves away from the attracting body. Dr. Siemens explained how the sensitiveness of the instrument might be increased, suggesting the application of it to measuring and recording the attraction of the sun and moon which gave rise to the tides.

May 18th, 262nd meeting. Sir W. Grove described some experiments which he had made with a modification of Crookes' radiometer,[1] giving a summary of the results. Though these were somewhat negative, they tended, in his opinion, to show that all the effects were due to residual air.

June 15th, 263rd meeting. Sir W. Grove described experiments with a new electrometer, made for him by Mr. Crookes, and with the old one after being re-exhausted. As a result its action had become normal. The experiments showed the effects of attenuation of air upon discharge and induction not to be the same. When it has commenced and is increasing, the discharge passes more and more rapidly till it becomes a glow, but further attenuation stops it entirely, while induction does not appear to be in any way lessened by extreme attenuation. A radiometer also appears to be a most delicate electroscope. By tilting it till the vanes touch the glass, the interior of this may be electrified, and it will then remain for days in that condition. Every endeavour had been made to discharge or neutralize the electricity on the glass surface, but it remained charged,

[1] The Minutes include a diagram and description of the instrument, but without the one the other would hardly be intelligible.

showing what a perfect insulation a good vacuum is. Mr. Huggins mentioned that Mr. Crookes had told him he was now convinced the effects were due to residual air, so that there would be no rotation of the vanes if the vacuum were perfect. Also he had found a degree of rarefaction at which the effects of rotation reached a maximum, beyond which they diminished.

Nov. 23rd, 265th meeting. Sir James Paget mentioned a case, which he had recently come across, where embryonic characters were retained in many members of the same family. It was known that the branchial fissures found in the early stages of embryonic life, instead of closing in the later, were retained as small blind sinuses in the neck, the existence of which was betrayed by their exuding little drops of white mucus, by which, whenever the possessor was affected by catarrh, the outside of the throat was smeared; the reason being that, though not in direct connexion with the bronchial membrane, they sympathized with it. In this particular case the anomaly existed in a gentleman, his father, his sister, and four of his eight children. It was accompanied by another embryonic condition, which he believed had not hitherto been observed, namely a sinus on the upper part of the helix of the ear, large enough to admit a very fine probe. This was, he believed, a relic of the second branchial fissure. Five of the children had this peculiarity.

Mr. Sclater stated that he had just received from the Marquis G. Doria information of the discovery of a large species of Echidna on Mount Arfak in New Guinea. This was an important fact, for hitherto it had been believed that the monotremes were restricted to South-east Australia and Tasmania.

Dec. 21st, 266th meeting. Professor Abel described experiments with shells when the bursting charge was contained in a small metal cylinder, and the space between it and the inner surface of the shell was filled with water. These experiments, of which he gave particulars, showed that the shell burst into a much larger number of fragments than if it had been filled wholly with gunpowder, and their number was proportional to the rapidity of explosion of the bursting charge. Again, not only is a shell broken into many more pieces by using a very small charge of guncotton, but these also are scattered with much violence, and thus are as effective against troops as the comparatively complicated shrapnel shell. By way of illustrating the detonating power of this water-shell, a wrought-iron gun, having a bore seven inches in diameter, after it had been tilted up and filled with water, had lowered into it a charge of two pounds of guncotton. When this was exploded the gun was split up to the muzzle in three places, and the external coils of wrought iron were torn open.

Sir W. Grove spoke of his own experiments in obtaining gases by passing sparks through water. When that was wholly deprived of air and perfectly inelastic, the containing globe or tube invariably burst, but the pieces remained on the table instead of being blown away.

1877. Jan. 25th, 267th meeting. Dr. Günther gave a summary of the memoir on Gigantic Land Tortoises,[1] which he was to read that evening to the Royal Society, including some earlier memoirs. The isolation of these tortoises was remarkable, for they occurred only in the Galapagos Islands and in Mauritius (where they had become extinct) with the adjacent islands. No intermediate traces of them had been found except some fragmentary bones in Malta. In European Museums specimens of these tortoises were rare, owing either to the fragility of their shells, which made them liable to injury on shipboard, or to the majority of naturalists having referred them all to a single very variable species. But the materials which he had gathered showed them to belong to three distinct groups: one, in the Galapagos; another, in the Mascarenes; and the third, in Aldabra Island; each group being represented by several races, the majority of which had become extinct during the last century. The date of their disappearance in Mauritius could be fixed

[1] See Günther, *Gigantic Land Tortoises Living and Extinct in the Collection of the British Museum*, 1877.

within a few years, for none were left in 1875. In Rodriguez they were now carefully preserved. There were hopes of introducing them into Fiji, where the climate ought to suit them. They fed on succulent plants.

Feb. 22nd, 268th meeting. The results of experiments to test the effects of extreme cold on the vitality of seeds were communicated by Dr. Hooker. He had supplied those of peas, celery, mustard and cress to the late Arctic expedition,[1] which, after its return, were planted at Kew. The temperature of the ship's interior, where the seeds were ordinarily kept, was not below 30° F. With the peas six experiments were made, when they were submitted to −60° F. for periods varying between five minutes and twelve hours. Of these 65 to 75 per cent. had grown. Other peas were kept on deck till January, during which time the temperature fell to −50° F., and of these 66 per cent. had grown. Parallel experiments were made with the other seeds, twelve in each set, the periods in part of them varying from five minutes to twelve hours, and the temperatures between −50° and −60°; in the rest, from one hour to twelve hours and the temperatures from −25° to −40°. The mustard and cress were invariably killed by this exposure; the celery had not yet germinated.

In a conversation which followed, Mr. Simon referred to the powerful effect of frozen carbonic acid in destroying living tissue, and thought that the destructive action of the extreme cold might be a direct, not an indirect one. Dr. Debus remarked that water in capillary tubes may be reduced to 5° F. before it will freeze. Dr. Hooker referred to the wheat brought by Sir G. Nares from Polaris Bay, where it had been for three years exposed to the cold, yet 70 per cent. of it had grown. A single pea and a single grain of maize found among it also grew.

Professor Ramsay said that when he, with Mr. James Geikie, visited Gibraltar last autumn, at the request of the Foreign Office, to investigate the water supply for the town

[1] The one under Captain Nares, during which Captain A. H. Markham, with sledges, reached lat. 83° 20′ N. in 1876.

and garrison, he made a complete geological survey of the Rock and the neighbouring part of Spain. They had afterwards gone along the coast of Africa from Ceuta to Cape Spartel, staying several days at Tangier. Just outside the gateway of that town, which leads to the sands, they had found in a cliff, close to the sea at high water, contorted strata of shale and sandstone, overlain by coralline sand and beds of quartz-sand and gravel, looking rather like the English Crag. In the half consolidated material of this they discovered, lying on the denuded surface of the shales and sandstones, the tooth and a fragment of the jaw of *Elephas antiquus*.[1] This, the forerunner of the existing African elephant, had not hitherto been found on that continent, though it occurs in the bone-caves of Gibraltar, in England, and in other parts of Europe. He also made some remarks on the direct communication between Africa and Europe in comparatively recent geological times.

Conversation then turned to the apes on the Rock of Gibraltar, which Professor Ramsay said were 'pretty numerous.' Dr. Sclater observed that when he was there in 1861, they were reduced to three females, and he had urged the introduction of others lest the breed should become extinct.[2]

May 31st, 271st meeting. Mr. Huggins exhibited specimens of artificial corundum, recently made by M. Feil, of Paris, the well-known maker of optical glass. They consist of about 90 per cent. of alumina, fused, under certain conditions, with small quantities of oxides to give the colour of rubies, sapphires, and amethysts. Examination with polarized light distinguishes them from the naturally formed stones, but they have the same hardness, lustre, and other physical properties. The subject was resumed on June 21st, when Sir W. Grove said that M. Becquerel many years ago had shown him a pill-box full of small rubies which were

[1] See, for an account of the geology of Gibraltar, A. C. Ramsay and Jas. Geikie, *Q.J.G.S.* xxxiv. pages 505-539. The tooth is the right ultimate upper molar. It and the section are figured on page 514.

[2] See *Vacation Tourists*, 1861, pages 206, 207.

identical with real stones and appeared to be crystalline. The question of making them for sale had been considered, but they proved to be insufficiently perfect. By means of a battery M. Deprez had produced diamond crystals from a solution the composition of which was kept secret. They were stated to be identical with the real stones, but had a smoky tint. Some of them had been exhibited at the French Academy.

Dr. Debus spoke of an analysis which he had made of the colouring matter of some green muslin. In a square yard of one specimen he had found 60 grains of arsenide of copper (Scheele's green), and of another, 10 grains. The colour adhered so slightly to the muslin that, on washing it, all the green was removed. He cut a square yard of the first-named sample into fifty pieces, and gave one for analysis to each of that number of students, and in 20 minutes the room was so full of the fumes of arsenic that doors and windows had to be opened. A ball costume contains from 18 to 20 yards of muslin. An olive-green dye, recently introduced, which is a mixture of arsenious acid and chromate of potash, appears to adhere to the material more firmly than Scheele's green.

Oct. 25th, 273rd meeting. The subject of poisoning by arsenical dyes was resumed, and Professor Huxley mentioned a case of severe illness which was traced to the arsenic in the paper of a room. Dr. Carpenter said that he had been unable to obtain evidence of a glazed paper producing an injurious effect. Mr. Abel observed that he had found green glazed paper to contain more arsenic than green flock paper. Professor Frankland suggested that the flock itself might not contain much arsenic, but this might be in the underlying substance which reinforced its colour, and from which it might be more easily detached than from glazed paper.

Mr. Huggins referred to his remarks on artificial rubies, and said that M. Kreil had succeeded in crystallizing the fused alumina and thus in making true rubies, one of which he exhibited. The mass was kept in a state of fusion for eight days. It was now proposed to use gas furnaces, by which a uniform temperature could be maintained for weeks together.

Dec. 20th, 275th meeting. Sir W. Grove compared observations of the planet Mars, which he had made last September under very favourable circumstances, with others made in 1862, when the planet was also unusually near the earth. They showed considerable differences. In 1862 the dark markings were in the south hemisphere of the planet, and had jagged or festooned edges. This year a dark patch, shaped like an open hand with fingers and thumb pressed together, lay across the equatorial regions. The changes might be due to clouds in drift, but more probably these produced an effect on permanent markings. His telescope was 4·6 inches aperture, made by Cooke, of York. He said, in reply to a question by Mr. Ball, that the markings were substantially the same, though not identical, for the short periods during which he had observed them this year. Mr. Huggins, though he had not been able personally to observe the planet, because his own telescope was employed on spectroscopic investigation, had inspected some admirable photographs taken at Madeira by Mr. Green. Here the changes since 1862 were not so great as Sir W. Grove supposed, since the old markings, though modified, retained their essential character.

1878. Jan. 31st, 276th meeting. Dr. Burdon-Sanderson said that he and Mr. Ewart, of University College, had been investigating Dr. Koch's discoveries of the bacillus which caused splenic fever, an extremely contagious and fatal disease of cattle. The organism, so rapidly developed in the blood and tissues, and particularly the spleen of the affected animal, can also be cultivated, retaining its virulence, in other soil. It can be communicated to a healthy animal either by the insertion of a bit of the plant or by inoculating it with the blood from a diseased one. Mr. Ewart had been able to study the development of the protophyte from the spore onwards more completely than had hitherto been done, and had found it to afford characters even more sharply defined than the disease. The speaker had brought from Breslau the original matter from which the organism was grown, and it had been developed from the blood of an animal, which had died five years before.

Feb. 28th, 277th meeting. After Dr. Burdon-Sanderson had shown some photographs of the magnified organism, described at the last meeting, Sir J. Hooker produced two pieces of wood, scored and grooved by drifting sand; one from an old juniper tree (of a species believed to attain the age of 2000 years) which was growing on the crest of a ridge between two valleys at a height of about 9000 feet on Mount Stanford in the Sierra Nevada (North America). The wind blowing across this crest carries with it granite sand, which cuts grooves in the wood, parallel with its direction, and had thus entirely removed the bark, together with an unknown thickness of subjacent wood. The other specimen came from a prostrate limb of a living tree (*Pinus albicaulis*), growing at an elevation of about 8000 feet on a ridge of Mount Shasta in Upper California. The limb lay in the direction of the prevalent wind; here the grooves, cut by the volcanic sand, were disposed lengthwise.

March 22nd, 278th meeting. Dr. Hooker exhibited a specimen of petrified wood, which he had obtained from a museum in Utah, the pores of which contained silver. The origin of the ore is unknown, but large quantities of the metal are said to be extracted from wood of this description.

Dr. Allen Thomson showed a piece of wood in which a bone of the foot of a large ruminant was embedded; and several suggestions were offered to explain its presence.

Dr. Siemens stated that if any motive power, such as that produced by falling water, were expended in generating an electric current, and this, after transmission through a copper rod 2 inches in diameter and thirty miles long, were used to drive a machine, the mechanical effect would be one-half that of the original power.

April 29th, 279th meeting. Mr. Galton exhibited specimens of composite photographic portraits, formed by throwing faint images of the portraits of different persons on the same sensitized plate. He described the process, and said that the single figure, which was the aggregate result, had a surprising air of reality. He thought such photographs would be useful to anthropologists in enabling them to obtain more typical figures of races and families than they now possessed. In hereditary enquiries also composites of brothers and sisters could be compared with those of their near ancestry.[1]

Dr. Carpenter said the late Mr. Appold used a stereoscope to combine two portraits of himself, one with a serious, the other with a smiling expression. The result was an excellent likeness.

Mr. Busk thought the process might be applied to produce typical figures of the skulls of different races. Some members considered that persons had more points of resemblance than was generally supposed, Dr. Carpenter saying that to English observers Japanese looked very like one another, though probably to themselves they seem as dissimilar in aspect as we think our own people to be. Sir Philip Egerton quoted the case of sheep, where the apparently close resemblance might be equally illusory.

June 20th, 281st meeting. Mr. Abel exhibited specimens to illustrate the ravages of white ants at St. Helena, and more recently at Pointe de Galle. At the latter place quantities of thick rope had been rendered useless, the strands in many places having been cut through. At the former one, they had reduced a district of James Town to ruins, leaving only the bare stone walls. Thence they went to the barracks, Ladder Hill, and then to the arsenal, attacking the woodwork of the stores, shell-bottoms, rifle-plugs and the like. Mr. Abel exhibited specimens of these, of papier-maché wads and office-records; teak was the only kind of wood which they did not attack. The frequent use of whitewash was the only protective agent, not because the lime in it was poisonous to them, but because the glare of the white walls

[1] A specimen of a composite photograph, nearly full-faced, is inserted in the Minute Book. One would suppose it to be the likeness of an individual, where the photograph wanted rather more clearness of outline.

was offensive. Sir Joseph Hooker said the white ant had been introduced from Africa into St. Helena only about fifteen years ago.

Oct. 31st, 282nd meeting. In reply to a question about the principle of Edison's electric light, Dr. Siemens said that he had only heard of it that day, but understood that two iridium wires had their ends formed into cups, which were brought near together in opposition in the middle of a small glass globe, partially exhausted. Thus a current of high intensity, passing between them, formed a zone of light. It was, however, a question whether the edges of the cups might not be dissipated.

Sir W. Grove said that zinc in a minutely pulverized state was largely deposited on the walls of the containing vessel from two zinc points *in vacuo*. Professor Frankland gave his experience that after working for months with platinum points, though they were not sensibly diminished, a deposit of the metal had discoloured the containing tube. With aluminium points there was no apparent diminution of substance, but no discoloration of the tube.

1879. Feb. 27th, 286th meeting. Professor Maskelyne exhibited a large and richly-coloured emerald from Santa Fé de Bogotá (Colombia), attached to a characteristic piece of the rock in which it occurs. The crystal looked as if it had been chipped at the edges by ill-usage, which, however, could not be the case, for he had himself carefully detached the matrix in which it had been all but embedded. Two other crystals of emerald in the British Museum, which he had also freed from the enclosing rock, had the same chipped character. His interpretation was that the emerald had not been formed in the rock where it now occurred. This was a limestone of Cretaceous age, with calcite and dolomite crystals, some pyrites, and a large amount of powdery carbonaceous material, quite unlike the mica-schists in which it is elsewhere found. Possibly this chipped character may explain the story that the emerald in Colombia is soft when first found, but is hardened by exposure.

May 29th, 289th meeting. Mr. Huggins exhibited a small photograph[1] printed by a process recently patented by Mr. Willis. The paper, prepared with ferric oxylate, is floated, after removal from the negative, on a hot bath of neutral oxylate of potash to which a solution of a platinum salt has been added. The picture is developed in a few seconds, the advantages consisting in the artistic effects of the grey and black tones of the platinum, the pureness of the whites, and the absence of glaze. As the platinum is deposited in the paper, the print should be very durable.

June 19th, 290th meeting. Dr. Henry Draper,[2] of New York (a guest), exhibited two photographic negatives illustrating by the coincidence of the bright lines the presence of oxygen in the sun. The photograph also shows some of the iron lines, and the coincidence between these and the dark lines in the sun indicates that the two spectra, that of the oxygen and of the sun, are correctly adjusted one to the other.

Mr. Moseley produced a roll of Japanese pictures illustrating a legend corresponding in many respects with that of Jack the Giant-killer. They are bold outline sketches, a style much admired by the Japanese, and tell this story, though not accompanied by a descriptive text. A terrible giant dwelt in the mountains of Oyeyama, near Kioto, who carried off certain princesses from the Mikado's court. The hero sets off to rescue them, accompanied, as usual, by twenty trusty attendants. Disguised as pedlars, with their weapons in their packs, a hermit shows them the way up the mountain and a princess guides them to the castle gate, where hideous gnomes brandishing the giant's arms are on guard. The owner receives them graciously and invites them to supper, at which both he and his gnomes get drunk. The avengers

[1] A copy is inserted in the Minutes.

[2] Henry Draper (1837-82) was an enthusiastic, original, and distinguished observer in astronomy and chemistry; the son of John William Draper (1811-82), who was born in England and emigrated to Virginia in 1833, ultimately being Professor of Chemistry at the University of New York. He also wrote many valuable memoirs on physical and physiological subjects.

arm themselves, the hero decapitates the giant at a blow, the gnomes are killed in fight, the princesses are rescued, vehicles are procured, and the whole party returns to the capital in triumph, with the heads of the giant and two gnomes as trophies.

Oct. 30th, 291st meeting. Mr. Evans exhibited a black slate tablet of Roman work, about one and five-eighths of an inch square and five-sixteenths of an inch thick, with four incised inscriptions, which indicated eye-salves.[1] It had been found in the neighbourhood of Bonn, and he believed its date to be the third century of the present era. Upwards of a hundred such stamps were now known and had been noticed by various authors, among them the late Sir James Y. Simpson.[2]

Dec. 18th, 293rd meeting. Mr. Galton communicated some results of a recent enquiry into the difference in the power of mental imagery in various classes of persons. This power is not necessarily associated with ability, is more developed in females than in males, and shows a strong tendency to hereditary transference through both sexes. A small percentage of persons invariably pictured numerals in definite diagrammatic forms, and these were described and delineated in letters from them which he produced. They stated that each numeral had its definite place on the diagram and could be thought of only in that one. The diagrams were invariably the same, and had been so as far back as they could remember.

1880. Jan. 29th, 294th meeting. Professor Maskelyne referred to a correspondence in the *Times*[3] about the artificial production of diamonds by Mr. Mactear, of the St. Rollox Works, Glasgow, who had supplied him with some of the material, a crystalline dust, no piece being larger than a very small pin's head, with which he had experimented. It could not scratch sapphire or even

[1] Copies of the lettering are given in the Minutes, and an impression in sealing-wax of one of the stamps.

[2] *Monthly Journal of Medical Science*, January and March, 1861.

[3] Dec. 31st, 1879, and subsequent numbers.

topaz, and was soluble in hydrofluoric acid. Thus it was not diamond.[1] He had repeated the experiments with Mr. Mactear at the British Museum on a large scale, devoting some days to the work. A crystalline dust was the result, which was not soluble in the above-named acid, but it proved to be so ultimately in other reagents; Mr. Mactear himself was now satisfied that he had not succeeded in producing a diamond.

Mr. Moseley exhibited some microscopic sections of corals received from Dr. G. von Koch, of Darmstadt. To prepare them the corals were first hardened in absolute alcohol; then soaked in a solution of gum sandarach, copal, or Canada balsam in absolute alcohol, after which they were allowed to dry slowly. Sections are then cut with a fine saw and rubbed down in the usual manner. The method can probably be adopted in very many cases where a soft tissue is associated with a hard skeleton.

Feb. 26th, 295th meeting. Professor Maskelyne, referring to Mr. T. B. Hannay's claim to have produced artificial diamonds, said that he had received some specimens from him. They were diamonds, but not all of them were complete crystals, and it had been doubted, especially by Professor Roscoe, to whom Mr. Hannay had sent specimens, whether he had really made them. One of the specimens, which Professor Maskelyne had examined, had every appearance of being a fragment from a natural diamond crystal much larger in size, and all of them were a minute dust. Mr. Hannay had not yet entirely explained the process,[2] but very great pressure (some 2000 atmospheres) and a rather, but not extremely, high temperature were essentials; the materials employed apparently being an alkaline metal, such as sodium or lithium, and a hydrocarbon, associated with a nitrogenous compound containing carbon that was sufficiently stable under the circumstances

[1] A more detailed account of his experiments is given by Professor Maskelyne in *Nature*, vol. xxi. page 203.

[2] Mr. Hannay gave a fuller account in a paper read before the Royal Society, "On the Artificial Formation of the Diamond," *Proc. Roy. Soc.* vol. xxx. page 450, and in a communication to *Nature*, vol. xxii. page 255.

of the experiment. On its presence, success, which was not always obtained, seemed to depend.

March 18th, 296th meeting. On further discussion of the alleged manufacture of diamonds, Professor Frankland stated that he had recently endeavoured to find a solvent for the diamond. After carefully weighing one, he had exposed it to the action of the following solvents: (1) to boiling pentasulphide of phosphorus (530° C.) for ½ hour, (2) to melted cyanide of potassium at a red heat for ¼ hour, (3) to melted chloride of zinc at a red heat for ½ hour, (4) to chrysocene[1] at low redness in a sealed tube for 1 hour, (5) to bisulphide of carbon, heated to 320° C. in a sealed tube for 6 hours, (6) to zinc ethyl in a sealed tube at 320° C. for 2 hours, (7) beneath melted aluminium at a white heat for 4 hours. After all these experiments the diamond was quite unaltered in appearance and had not lost 0·001 of a grain in weight. Discussion arose on the degree of confidence to be placed on the experiments, so far as reported; some members holding that those, who claimed to have manufactured diamonds, had either deceived themselves or been victims of deception. Sir W. Grove said that either there must have been fraud or the results must be accepted.[2]

May 27th, 298th meeting. Mr. Hannay's paper, read that afternoon at the Royal Society, on the artificial production of diamonds, was the main subject of conversation.

June 17th, 299th meeting. Professor Allman gave an account of the new freshwater *Medusa*,[3] lately discovered by Mr. Sowerby in the *Victoria regia* tank at the Botanic Society's Gardens in Regent's Park, on which Professor Lankester had read a paper that afternoon to the Royal Society, and he was about to read one that evening to the Linnaean Society. It was the first example of a *Medusa*

[1] The word is clearly written in the Minutes, but I have failed to ascertain, though I have consulted a friend who is an authority on chemistry, what substance is intended.

[2] This is the last meeting recorded in the first volume of Minutes.

[3] Accounts are given at greater length in *Nature*, vol. xxii. page 147 (Lankester), page 178 (Allman), and page 179 (Romanes). See also under "Medusa, freshwater," in the index to that volume.

living in fresh water. Hundreds, even thousands of the animals, a considerable number of which had arrived at the adult stage, may be seen swimming in the tank, the temperature of the water being from 80° to 90° F. They are from one-eighth to half an inch in diameter, the great majority appearing to be males. These *Medusa* are allied to the *Trachomedusae* and *Narcomedusae* of Haeckel, but are a new generic form, for which he had proposed the name *Lymnocodium*. He and Professor Lankester had agreed on the specific name *Sowerbii*. Whether it is developed directly from the egg or from an intermediate hydroid trophosome, is not yet determined, but the former appears to be the more probable, as no hydroid polyp has been observed in the tank. It may be supposed that the *ova* were introduced with the roots of some foreign plants, perhaps from the West Indies.

Nov. 25th, 301st meeting. Mr. Galton spoke of the progress made in applying the system of composite photographs to delineate the more characteristic features of disease. This was being done at Guy's Hospital. Sir J. Paget said that hitherto the physiognomy of diseases had not been accurately portrayed.

Dec. 16th, 302nd meeting. Professor Roscoe referred to a paper by Mr. Carnelley of Sheffield (to be read that evening at the Chemical Society [1]), which maintained that *in vacuo* ice, corrosive sublimate, and camphor may be raised to temperatures high above their melting points without being liquefied.

1881. Jan. 20th, 303rd meeting. The subject of Mr. Carnelley's paper was resumed, and doubts were expressed by one member in very positive terms whether his experiments and conclusions were valid.[2]

Mr. John Aitkens's communication to the Royal Society

[1] The Minute on Dec. 16th says, "read to the Chemical Society," but on Jan. 20th, "to the Royal Society." It was read to the latter Society (*Proc. R.S.* vol. xxxi. page 284).

[2] According to the Minutes this member offered to bet another more favourably disposed £100 to £1, but the exact terms of the bet could not be settled, though some members so far unbent as to make the endeavour.

of Edinburgh was also discussed, in which he maintained that the small globules of liquid, constituting fog and clouds, are invariably formed round minute particles of dust or other solid matter suspended in the air. Professor Tyndall expressed great doubts in regard to Mr. Aitkens's contention, for his own observations had convinced him that dense clouds can be produced in optically pure air. Without denying that such particles may promote the condensation of vapours, he did not hold this to be necessary in the formation of fogs or clouds.

Feb. 17th, 304th meeting. Mr. Ball referred to a recent discussion at the Royal Society, in which the presence of fish in the hot springs of the Sahara was treated as an established fact, though he thought it required further investigation. Last winter he visited the Fontaine Chaude, a mineral spring near Biskra in the Sahara, in which the waters have a temperature of 108° to 110° F., and fish of the genus *Cyprinodon* are said to live. He was, however, assured by the official (Arab) custodian that the fish never came directly from the spring into the reservoir, but are found further down in the rivulet which flows from it. Still, as this, like so many streams of the Sahara, is lost in the sand, it is difficult to explain their presence in it. It may be connected with another fact, which appears to rest on the testimony of competent observers such as Charles Martins, that minute fish had been observed in water brought up from great depths by artesian wells newly opened in the Sahara. Dr. Asa Gray[1] (guest) said that somewhere in the United States springs frequently brought up small fish with leaves. Sir J. Hooker had heard of fish inhabiting hot springs in the Himalayas, and Mr. Moseley had seen goldfish thriving in the hot springs at Bath, and

[1] Dr. Asa Gray, born on Nov. 18th, 1810, at Paris, New York, after taking the degree of M.D., devoted himself to the study of botany, and for fully thirty years was Professor of Botany at Harvard. He was a strong but not uncritical supporter of Darwin's views on the 'Origin of Species,' and wrote important books on the flora of North America, besides numerous special memoirs. Justly ranked among the leading botanists of his time, he died Jan. 30th, 1888.

had been told of their living in the condensing tank of a steam engine in Lancashire where the temperature was over 90° F.

March 17th, 305th meeting. The news of the assassination of the Czar of Russia led to a conversation on explosives, which was followed by one on the electric lighting of part of the City of London.

May 19th, 307th meeting. Professor Stokes gave an account of a paper on the "Velocity of Light," just read to the Royal Society by Messrs. James Young and George Forbes.[1] In their experiments they used, instead of the single reflector employed by Cornu, two distant reflectors of the light of the artificial star, so placed that, in the observing telescope field two stars are at first seen, one being 3 miles, the other 3¼ miles away, so that, on measuring the velocity of the toothed wheel, the stars were eclipsed successively instead of simultaneously, the critical velocity being that which made the two stars of equal brightness, not that which, as in Fizeau's and Cornu's experiments, made them vanish. Besides this a bluish light was observed when the increasing speed of rotation brought a star near its position of eclipse, and a reddish light when it had just passed this, indicating that the blue light travels faster than the red in air. It had been supposed that the differences in velocity, inferred from astronomical phenomena, were due to ponderable matter in the air and that *in vacuo* both travelled alike, but in these experiments there was a difference, though in the contrary direction. This discovery leads to new ideas of the luminiferous ether, with its apparently opposed properties of fluidity and solidity.

Sir J. Hooker referred to the effect of the cold in 1879 on the noted pine forest which fringes the eastern coast of Italy for several miles from Ravenna southwards. In the part recently visited by himself and Dr. Asa Gray every pine tree, young or old, had been killed, and they were told this was the case through the whole extent of the forest. Other trees or shrubs growing with them, such as juniper

[1] *Proc. R.S.* vol. xxxii. page 247.

or berberry, had not suffered, nor could he hear that the *Pinus pinea* had been killed, though he saw at Rome that it had suffered severely.

Mr. Bowman said that a Committee of the Ophthalmological Society (of which he was President) had examined about 18,000 persons of all ordinary positions to test the existence of colour blindness. They had found more or less of it in 4·76 per cent. of the males and only 4 per cent. of the females, red blindness being a little in excess of green blindness, while total colour blindness was excessively rare. Among those examined were about 8000 of the metropolitan police, some soldiers, many public schools, including Eton, with private schools; also some special classes of persons. Among 1679 Jewish children colour blindness was more frequent than among others of the same age and state, but it was principally red blindness. Among 707 children of the Society of Friends colour blindness was above the average, amounting in one school to 12 per cent. of the boys and 6 per cent. of the girls. This excess might perhaps be due to interbreeding. The Secretary of the Committee, Dr. Brailey, had taken the chief share of the investigation, which was being continued and to which the attention of Government would be drawn, because of its importance in regard to those who might be employed for signalling.

June 16th, 308th meeting. Dr. Carpenter gave an account of the Falls of Niagara when visited by his son, Mr. W. Lant Carpenter, in the first week of February last. Their aspect had been greatly altered by the accumulation of ice. When springs discharged into the gorge, icicles, sometimes 70 or 80 feet long, had formed. The ice-mountains built up on rocky foundations by the accumulation of frozen spray were exceedingly high; one of them, in front of the American Falls, rising to within 20 feet of their top. He was informed that an ice-cone of this kind in the Yosemite valley had actually attained a height of 600 feet. On Feb. 8th he found the whole of the fall over Table Rock completely frost-bound. Enormous icicles hung from the rock above and mountains of frozen spray rose from below.[1] The forms of the frozen spray on neighbouring trees were most remarkable.

Dr. A. Thomson referred to the shipwreck on January 24th of the Danish mail-steamer on the coast of Iceland.[2] The large, mound-like accumulation of frozen spray on the forepart of the ship threatened to submerge it, and obliged the captain to run the ship on shore. But as the actual wreck was caused by its striking a sunken rock, the captain and the crew suffered great hardships from the cold and continued storm.

Oct. 27th, 309th meeting. Mr. Galton referred to the remarkable variations of temperature in different regions during the past season. Packed ice had drifted to within ten miles of Iceland, from which Greenland polar bears had swum ashore, yet in Smith Sound the water had been remarkably open. Professor Frankland said that in Norway a very low temperature had prevailed, when in England it was very hot, and Dr. Carpenter remarked on the great and persistent cold in Scotland during the whole summer and autumn.

Nov. 24th, 310th meeting. Professor Dewar exhibited photographs on glass, illustrating communications to the Royal Society, from himself and Professor Liveing, on the reversal of the lines in metallic vapours. They showed that, as a rule, the rays of high refrangibility are the most readily reversed and must therefore possess the greatest emissive power. Many of the plates had almost the whole of the iron rays reversed in the ultra-violet. On some plates, lines, due to an emission spectrum of water, appeared. Further experiments showed it to be a consequence of the spark being taken in moist gases. This has an important bearing on the continuity of flame spectra.

It was mentioned that the meeting-room and vestibule of the Royal Society were lighted for the first time by electric

[1] A photograph (as stated in the Minutes) is given in *Nature*, vol. xxiii. on page 512. It was taken in January, 1881.

[2] He quoted from the description in *Nature*, vol. xxiv. pages 106-7, where a picture is given of the steamer with its ice-loaded bows.

lamps. These were on the Swan system and arranged under the direction of Dr. Siemens. "The shaded light was steady, pleasing, and ample for the exhibition of diagrams and apparatus, as well as for the general illumination of the hall."

1882. Jan. 20th, 312th meeting. Dr. Carpenter described the results of his examination of a limestone from Sutherland at the request of Professor Heddle.[1] Parts of it exhibited that regular alternation of calcareous lamellæ and those of a magnesium silicate which characterises *Eozoon Canadense.* The latter, however, instead of being serpentine, is chondrodite, a magnesium silicate containing fluorine. This, however, has been recognised by Professor Sterry Hunt, to whom he had sent specimens, in certain limestones of North America. These are of the Laurentian era, so there can be little doubt the Sutherland limestone belongs to it and not to the Silurian, as hitherto supposed. The laminated specimens do not indeed exhibit the microscopic structure characteristic of the best preserved specimens of *Eozoon*, but he had found this in the parts with a more acervuline habit, and he considered the resemblance to an organic structure, presented by the grains of chondrodite as they lay loosely scattered in the calcareous areolae, to show that this was not merely due to metamorphic action, as Messrs. King and Rowney had maintained in the case of *Eozoon.*

Feb. 23rd, 313th meeting. Dr. Siemens gave the substance of a paper which he was to read on March 2nd to the Royal Society on the "Conservation of Solar Energy." It suggested how the vast amount of heat and light, supposed to be radiated into space, could be to a large extent recovered by the sun. The explanation rested on the postulates, (1) that interstellar space is filled with attenuated matter including aqueous vapour and carbon compounds, (2) that

[1] The crystalline limestone (or dolomite) of Ledbeg is described by Professor Heddle, *Mineralogical Magazine*, vol. v. pages 274-281. The structure is represented on Plate VII. Figs. 1 and 2, and some "simulating *Eozoon*" are given on Plate VIII

these are capable of being dissociated by radiant solar energy, (3) that they are then drawn towards the sun in consequence of its rotating velocity, impinging on its polar surface and passing away again into space at its equatorial. Thus the dissociated material on approaching the solar photosphere would flash into flame, and in passing from the polar to the equatorial region it would give rise, through mixture with the lower and heavier solar atmosphere, to vortices and sunspots. The gases, which passed away equatorially, would consist of products of combustion, which at last would be sufficiently rarefied to be again dissipated by the radiant solar energy. By this theory zodiacal light, the appearance of comets, and the *aurora borealis* might be reconciled.

Sir W. Grove said that, even assuming the postulates, he could not accept the conclusions; for it would appear that the force given off from the sun, after expending itself in producing certain changes in matter, would return to the sun and add to its heat—that is, to its energy—which had been already expended. Professor Dewar objected that as dissociation varied chiefly as a function of the temperature, and was only affected within narrow limits by alteration of pressure, it had yet to be proved that extreme rarefaction of the gases would suffice to render them capable of being dissociated by the radiant solar energy.

March 23rd, 314th meeting. In reference to Dr. Siemens's communication to the last meeting, Dr. Debus expressed doubts whether an action, such as the sun had been supposed to exert on gases and vapours, could rightly be termed dissociation. This gave rise to a discussion, in which Professors Dewar, Frankland, and Odling took part, and it was the general feeling that though there were precedents for using the term as Dr. Siemens had done, decomposition would be the more appropriate.

Mr. Galton quoted a statement from a newspaper to show the loss of radial energy in sunbeams as they pass through the lower atmosphere. A party, which ascended the Schilthorn (9747 feet) on a bright day in the depth of winter, found that the snow had melted from patches of rock facing the south, on which alpen-roses [1] and other mountain plants were in full bloom. Dr. Günther said that in winter insectivorous birds abounded in the Alps at heights of some 5000 feet, since insects were very numerous about that level on the sunny faces of precipices.

April 24th, 315th meeting. Professor Huxley referred to the recent death of Charles Darwin,[2] stating that when the intelligence reached the Royal Society, the President (Dr. Spottiswoode) at once communicated with the Dean of Westminster in order that this great leader in science might be laid in the Abbey. He spoke of the ceremony, and of the cordial recognition of the nobility of Darwin's character and the far-reaching influence of his work by leaders of public opinion, including several representatives of orthodox theology.

May 25th, 316th meeting. Captain Noble gave an account of some experiments on which Professor Abel and himself had been recently engaged. Their object was to ascertain (1) to what degree, if any, the erosive action of gunpowder, so serious with the large charges now used, depended on the chemical condition of the powder, (2) whether the tensions developed by the different compositions used in the experiments were materially different, and whether the pressures exerted by the larger charges, now used, were much greater than those of smaller charges. They experimented with five descriptions of powder, (*a*) one of the ordinary composition, (*b*) one in which the proportion of saltpetre was reduced, but those of sulphur and carbon increased, (*c*) one with the proportion of sulphur halved, (*d*) and (*e*) without any sulphur; these having been tried at the suggestion of Sir W. Armstrong, who thought that its presence might cause the formation of iron sulphide and

[1] This can hardly be accurate as regards the alpen-roses, for the rhododendron, even at about 5000 feet, does not flower till July.

[2] Charles Darwin died April 19th, 1882. A memorial presented to Dr. Bradley, Dean of Westminster, is printed in *Life and Letters of Charles Darwin*, vol. iii. pages 360-1. The funeral took place on April 26th, the grave being a few feet from that of Isaac Newton.

thus materially affect the erosion. With respect to this, the experiments showed that the erosive action depended much on the kind of powder used, but appeared to be independent of the amount of sulphur, for the one which produced the smallest effect had the largest proportion of that mineral. The heat developed by the explosion appeared to be the most important factor. To measure the amount of erosion, the powder was placed in a steel vessel with a very small vent, through which the products of explosion had to escape, and their effects were measured by the quantity of steel removed. Captain Noble described a curious effect produced upon a screw in one experiment, when a large charge—about 24 pounds—was fired, giving a tension of about 43 tons.

Sir H. Lefroy exhibited some samples of merino wool from Tasmania, remarkable for its fineness, and for the high price (1400 guineas) that had been paid for the sheep that had produced it.

June 15th, 317th meeting. Mr. Galton exhibited an instrument which he had made to verify the attitudes of an animal in rapid motion. By tapping a stud, a slit on a screen was made to move rapidly in front of an eyehole, thus affording a momentary glance of an object. Thus the eye (far more sensitive than any plate in a photographic camera) could obtain a distinct image of the animal at an instantaneous phase of its motion. He thought naturalists would find the instrument useful in observing the habits of birds and insects, and physicists for such things as plants in rapid motion.

Nov. 9th, 318th meeting. Before the minutes (by an inadvertency there was no meeting on Oct. 26th) a cutting from the *Times* is inserted, recording the death, on July 19th, of Professor F. M. Balfour, with his guide, Johann Petrus, of Stalden, on the Aiguille Blanche de Peuteret.[1]

[1] The letter is reprinted, accompanied by some further information, in the *Alpine Journal*, vol. xi. pages 90-93; pages 101-103 giving an *In Memoriam* notice. The first ascent of this dangerous peak was made Aug. 28th, 1913 (*Alpine Journal*, vol. xxviii. pages 81, 82).

Nov. 25th, 319th meeting. In regard to Mr. Galton's instrument,[1] Professor Tyndall referred to M. Töpler's experiments on the intermittent flashing of a singing flame, as one of a class of phenomena to which that mode of observation might be applied, and Professor M. Foster thought it might be used in connexion with the velocity of light.

Dec. 14th, 320th meeting. Sir H. Lefroy stated that he had known many instances of lightning striking buildings on the Bermudas, though the area of the islands was only about 12,400 acres, and asked whether anything in the condition of oceanic islands could explain this frequency. Professor Stokes said that ascending currents of air, charged with moisture, which is condensed on their rising high enough, are favourable to thunderstorms. As the Bermudas, in a hot climate, are surrounded by ocean, and have low and warm surfaces, they would cause ascending currents in the moisture-charged air that passed over them, which, though not large enough to cause great tempests, would suffice to produce many small thunderstorms.

Professor Dewar described the results of his recent experiments on the amount of hydrocarbon acetylene produced, when different forms of electric discharge pass between graphite poles in an atmosphere of hydrogen. The most interesting fact was the increase in the partial pressure of the acetylene in the resulting mixture as the initial pressure of the hydrogen is diminished. Thus, at the pressure of the atmosphere, the acetylene amounts to 12 per cent. by volume, but when the pressure in the hydrogen is only one-eighth of an atmosphere, it rises to 22 per cent. This may be called a true manufacture of illuminating gas by electricity. Benzol is always found mixed with the acetylene.

Professor Stokes asked whether any substance capable of producing changes in the plane of polarization had yet been artificially produced. Professor Dewar replied in the affirmative, for racemic acid can be obtained from glycoxalic and succinic acids, both of which have been

[1] See Minutes of June 15th.

produced by synthesis, and as racemic acid could be broken up into dextro- and levo-tartaric acids.

1883. Jan. 18th, 321st meeting. Professor Newcomb,[1] of the U.S. Observatory, Washington (a guest), described the methods employed by the American expeditions in photographing the transit of Venus. Instead of pointing the telescope directly at the sun, they kept it fixed, and threw the sun's image into it with a heliostat. The telescope could then be of any length required, and the sun's image did not need enlargement by the eyepiece. After describing some details in making and recording the observations, he said that this method had not overcome two difficulties which affected astronomical observations, namely the tremulousness of the atmosphere and the difference in its refraction of the reddish light of the sun's limb and of the whiter light of the central part of its disc on which Venus is projected.

Professor W. James,[2] of Harvard College, U.S.A. (a guest), gave a brief account of investigations into the sense of dizziness experienced by deaf mutes. As the semicircular canals of the ear are now supposed to be the organs of this sense, and as they or their nerves are presumably destroyed in a large number of these mutes, such persons ought not to be liable to dizziness in whirling. An examination of over 600 such persons showed about one-third to be in this abnormal condition. But of these a certain number spoke

[1] Professor Simon Newcomb, who was born on March 12th, 1835, graduated at Harvard, was appointed Professor of Mathematics in the United States navy and to the Naval Observatory at Washington. He organized an expedition to observe the transit of Venus in 1874, and observed that of 1882 at the Cape of Good Hope. In 1884 he also became a Professor at the Johns Hopkins University. He has made many additions to astronomical science and has written a number of memoirs and books on different branches of it.

[2] Professor William James was born at New York on Jan. 11th, 1842, and graduated at Harvard as M.D.; afterwards receiving the LL.D. degree at Princeton, and those of Ph.D. and Litt.D. at Padua. He became Professor of Physiology, of Philosophy and of Psychology at Harvard, and was also appointed Gifford Lecturer at Edinburgh. He wrote not a few valuable books and memoirs on philosophical and psychological subjects, on human immortality and on pragmatism, dying about 1912.

of experiencing an extraordinary bewilderment in diving under water with closed eyes, through not knowing what direction was 'up' and 'which' down. This fact proves the use we can make of these canals in self-orientation, for the deaf mute, in the above circumstance, has none of the three means of learning his bearings.

March 8th, 323rd meeting. Dr. Carpenter described his recent visit to the Johns Hopkins University, Baltimore, at which Professor Sylvester was now a member of the staff, and its Principal and Governors endeavoured to attract students by offering them the best possible teaching on each subject. He had been present at the opening of the current session, and had seen at least 100 students, many of whom had come to follow a high course of mathematical study under Professor Sylvester.

He had also been shown the working of the machine, devised by Professor Rowlands and constructed under his superintendence, for ruling lines very close together on surfaces of speculum metal, as large as 5 inches square, for purposes of spectroscopic analysis. The machine was then ruling 30,000 lines to the inch on a concave speculum, and could work up to 36,000. Professor Rowlands' design had been carried out by the workman then in charge of it, and his ability was said to be by no means exceptional, since the better early education of the American workman comes out in a greater capacity for understanding his work and in taking a stronger interest in it. The screw, which is the essential feature of the machine, was devised by Professor Rowlands himself, who had shown him, as a specimen of the work which these gratings could accomplish, two photographs of the ultra-violet spectrum which were together between 3 and 4 feet long. They showed a wonderful series of sharply-defined and well-separated lines. Mr. Lockyer, who also saw these results, considered them a new departure in celestial photography.

It was also part of the system of the Johns Hopkins University to elect young men, who showed marked ability in any department of research, to fellowships for a term of years. The results were already excellent, of which he gave some instances.

April 30th, 324th meeting. Professor Huxley gave an account of the International Fisheries Exhibition, about to be opened in South Kensington. Though not the first of its kind, for there had been one at Berlin, it was of exceptional size and interest. A novelty would be a Fisheries Congress, somewhat on the model of the British Association, from which valuable results were expected.[1]

Oct. 10th, 327th meeting. Dr. Carpenter gave an account of the recent opening of the electric tramway between Kilrush and the Giant's Causeway, the working machinery of which had been devised by Sir W. Siemens.

Some interesting autograph letters by Linnaeus were shown by Mr. Evans.

Nov. 22nd, 328th meeting. General Strachey called attention to a remarkable atmospheric disturbance, shown on Aug. 26-27, by all the photographic registers of barometers in Europe, which he traced to the great eruption of Krakatoa in the Strait of Sunda. The difference in the absolute time of the shock at different places indicated a rate of transmission about equal that of sound, and the disturbance originated about $27^d\ 3^h\ 20''$ of G.M.T.[2]

Dec. 13th, 329th meeting. Mr. Galton referred to his recent examination of a curious anthropometric record in the ledgers of Messrs. Bury, wine and coffee merchants, 3 St. James Street, who kept excellent scales in which their customers weighed themselves at frequent intervals. Among them were many of the aristocracy, including all the Royal Dukes, sons of George III., and other notable persons. One of his objects was to ascertain whether the 'hard living' of that time had produced a marked variation in weight. It

[1] The Minutes show that Professor Maskelyne spoke in eloquent terms of the loss of Professor H. J. S. Smith, of Oxford, who had died on Feb. 9th.

[2] The extraordinary twilight glows in November, 1883, attracted general attention in Britain, and a memoir on the eruption, with some excellent illustrations, was published by the Royal Society, in the *Report of the Krakatoa Committee*, 1888.

appeared to have this effect to some extent, but hardly so much as he had anticipated.

1884. Jan. 17th, 330th meeting. Dr. Günther described the curious fate of a small fish of the Indian Archipelago—the *fierasfer*—which inhabited, as a commensal, the body cavity of certain holothurians.[1] For some unknown reason, one of them had got between the mantle and the shell of a pearl oyster (*Avicula margaritifera*), by which it was killed, and, before it could decay, was covered with a layer of mother of pearl, thin enough to let it be seen in an apparently perfect state through its transparent shroud.

Feb. 14th, 331st meeting. Professor Stokes said that some crystals of chlorate of potash had been sent to him which showed by reflexion splendid colours. The mineral crystallizes in the oblique system, usually in plates perpendicular to the plane of symmetry. The tint differs from one crystal to another, and alters with the inclination of the crystal. When a face is viewed at a given angle, and rotated in its own plane, the tint disappears twice in a complete rotation. He had found that all crystals exhibiting this colour-phenomenon had a very thin twin structure present, the individuals being about one-thousandth of an inch thick. To reflexion from this the colours are due, but he was not yet in a position to give a complete explanation.

May 22nd, 334th meeting. Professor Moseley exhibited a specimen of *Utricularia vulgaris*, from marshes near Oxford, which he had received from a young naturalist, son of a tradesman in that city, showing that its bladder traps are capable of catching newly-hatched fishes, numbers of minute roach being held in various positions by them.[2]

June 12th, 335th meeting. According to Sir J. H. Lefroy, information had been received from Zanzibar that Mr. Joseph Thomson had returned in safety from exploring the region east of the Victoria Nyanza.

Oct. 23rd, 336th meeting. Professor Tyndall said that

[1] Perhaps the subject of the engraving in *The Royal Natural History*, vol. v. page 438. (Günther, *Proc. Zool. Soc.* 1886, page 318.)

[2] For more details, see *Nature*, vol. xxx. page 81.

in Switzerland last summer, at a height of 7000 feet, the sky, one night, had been completely overcast at the beginning and quite clear at the end, yet the difference shown by a thermometer, lying on swansdown, from one suspended in the air, had been in the one case 9° F., and in the other only 10°. His observations at Hindhead had given him confirmatory results.

Sir J. D. Hooker said that the plants, collected by Mr. H. H. Johnston in the high district west of Kilimanjaro and by Mr. Thompson from the neighbourhood of the same mountain, had been received at Kew, and showed the trees to be of South African and Abyssinian types.

Dr. Sclater exhibited a specimen of the edible bird's nest, and asked whether this was certainly composed of fucoid material or, as some said, of a consolidated salivaceous matter.

Nov. 27th, 337th meeting. Professor M. Foster said that he had examined a piece of the bird's nest exhibited at the last meeting, and had found no cellulose, or fibrine, or pectine, but only mucine, which seemed to form a kind of lattice of threads. Sir Everard Home had described the glands which secreted it. They were present also in the neck of the common swift. Sir J. D. Hooker, however, said that he had noted in another piece of the nest a tissue resembling that of some of the gelatinous algae.[1]

General Strachey reported that at the meeting of the Prime Meridian Conference, which began on Oct. 1st at Washington, U.S.A., the following resolutions were adopted: (1) that the meridian of the Observatory of Greenwich should be the initial meridian for longitude; (2) that the meridian longitude should be counted in two directions up to 180°, east longitude being + and west longitude −; (3) that the conference propose the adoption of a universal day for all purposes for which it may be found convenient, not to interfere with the local or standard time, where desirable; (4) that the universal day be a mean solar day, to begin for all the world at the moment of mean midnight

[1] See Jan. 29th, 1888.

of the universal meridian, coincident with the beginning of the civil day and date of that meridian, and be counted from zero up to 24 hours.

Resolutions in favour of a speedy arrangement for the beginning of the astronomical and nautical days at mean midnight, and for the extension of the decimal system to the division of angular space and of time were also adopted.

1885. Jan. 15th, 339th meeting. Sir J. Hooker stated that a cursory examination of the plants collected by Mr. H. H. Johnston during his expedition to Kilimanjaro, which had recently been received at Kew, showed the flora to be nearly related to that of Abyssinia. Dr. Sclater said that the zoological collection, sent to the British Museum, was smaller than had been anticipated, because Mr. Johnston had lost the services of his collectors, but promised to be interesting and valuable.

Feb. 12th, 340th meeting. Captain Noble described brown powder and its value as an explosive. It differed from ordinary powder in the presence of bituminous matter and a larger proportion of water. In explosion it developed a greater amount of hydrogen gas, and that rendered its explosive energy much greater. Coarse powder lights very slowly, but when ignited burns very quickly, and thus is not wasted. Experiments showed it to have much erosive power due (1) to the pressure, (2) to the temperature developed in the explosion. A low temperature developed much gas, a high one little, and the temperatures were very different for different powders. He also gave an account of firing heavy charges at Spezzia, where, on one occasion, 850 pounds of powder were fired, and a shot, weighing 2010 pounds, was projected with an initial velocity of 1985 feet per second.

April 27th, 342nd meeting. Professor Frankland spoke of the occurrence of vegetation in the hot springs of the Yellowstone Park, U.S.A. He found it abundant in the water immediately after issuing from the earth, where its temperature could not be less than 190° F. As the water cooled, the character of the organisms visibly changed.

Mr. Moseley said he had observed similar organisms in hot springs of the Azores and West Indies. There *Oscillatoriae* were found at the higher temperature.[1]

May 14th, 343rd meeting. Dr. Sclater said that the Orient Steam Company had selected Agos Garcia, the southernmost of the Chagos Islands, for a coaling station. These were coral islands, and land birds were said to be few, but their fauna and flora were almost unexplored. There was now some hope of this being done.

June 11th, 344th meeting. Lord Rosse described the results of experiments made at Parsonstown Observatory during the eclipse of the moon on Oct. 4th, 1884, to ascertain how long it took for the moon's heat to follow the light. Careful observations, made during the later part of the eclipse, showed a defect of heat as compared with light, when the penumbra was off the moon, for about two hours afterwards, the heat then being to the full amount about in the ratio of 30 to 35.

Nov. 26th, 346th meeting. The death of Dr. W. B. Carpenter,[2] by the ignition of the contents of a spirit-lamp while he was taking a vapour bath, caused a conversation, in course of which Professor Tyndall said that in an experiment, when he was heating some alcohol in a glass tube over a spirit-lamp, the tube burst, the spirit ran over his clothes and ignited. He tried to extinguish the flame with his hands, but as fast as he brushed it out, it kindled again. He tore off his coat, and lay down on the floor, when some students threw a coat over him and quickly put out the flame.

1886. May 27th, 352nd meeting. Sir H. Roscoe mentioned the discovery of a new chemical element which it was proposed to name Germanium.

Professor Frankland said that, on a recent visit to Vesuvius, though the volcano had not reached an explosive stage, scoria and small pieces of viscid lava were being shot up fairly continuously to a height of 150 or 200 feet, with a

[1] Professor Moseley's notes, as he mentioned at the time, had been worked up by Mr. Thiselton-Dyer and communicated to the Linnaean Society.

[2] On Nov. 10th.

surging sound, audible for a considerable distance on the flanks of the mountain. Replying to his request for an explanation, Mr. Ball and Professor Bonney suggested that an escape of steam, strong but steady, might make the noise and have sufficient force to eject fragments of scoria. Lord Rosse said that he heard a similar noise when he visited Vesuvius.

Professor Allman described a tubular hydroid, which he had recently examined. It had been dredged up by the *Challenger* Expedition from a depth of four miles. The unbroken stem must have been about seven feet long, and the polyp at the end, when expanded, about nine inches in diameter; the corresponding dimensions in a shallow water form being not more than a foot and less than an inch. The stem was formed of an elastic tissue, peculiar in character. The animal was a kind of rose colour.

June 10th, 353rd meeting. M. Cornu (a guest) described a method of controlling by electric magnets a bad astronomical clock by a good one. Lord Rosse said he had overcome a similar irregularity in the working of an equatorial clock by the use of electro-magnets with very small battery power.[1] Professor Hughes objected to M. Cornu's method, that no electrical arrangement could overcome the minor errors incident on the employment of electric contacts with the controlling clock. This M. Cornu admitted, but said that such sources of error were so small, that they might be safely neglected where practical not absolute perfection was sought.

Oct. 28th, 354th meeting. Dr. Huggins exhibited a specimen of the new metallic element Germanium (page 229) discovered by Professor Winkler in an ore of silver. It filled up one of the lacunæ in Mendeléeff's series.

Nov. 25th, 355th meeting. Professor Bonney read part of a letter from Mr. Coutts Trotter, describing a destructive volcanic eruption in Niua-fu,[2] one of the Friendly Islands,

[1] Lord Rosse gave a description in *British Association Report*, 1884, pages 636-7, to which he referred.

[2] *Nature*, vol. xxxv. pages 127, 128, gives an account of the eruption and of the glass.

where a new-formed crater had done great damage by burying the vegetation under volcanic dust, some of which he exhibited. It consisted of small fragments of felspar and of a basic glass (tachylite), but not of scoria. The first outbreak corresponded very closely with the New Zealand eruption of June 10th, and the principal one with the Charleston earthquake on Aug. 31st.

1887. Jan. 13th, 357th meeting. Mr. Thiselton-Dyer stated that the yeast plant of Guinness' Brewery, Dublin, had been found to differ from similar organisms in other breweries. Differences also had been observed between the yeast at the surface and that at the bottom. The yeast plant in a first-class brewery appeared gradually to attain a permanent form; probably through one variety, under specially favourable circumstances, gradually overpowering the others.

Feb. 10th, 358th meeting. Dr. Günther exhibited a series of plates, prepared for a forthcoming volume in the *Challenger* Expedition series,[1] to illustrate the deep-sea fishes. All of them, with one exception, belonged to known types, living near the surface (such, for example, as the shark, cod, eel, and sea-devil), but specialized and modified to adapt them to their altered conditions of life. Probably all is darkness at greater depths than 100 fathoms. The modification takes place along two lines. In one the eye is very large, with a space beneath it filled with a slimy substance, supposed to be capable of emitting light, so that the fish may be said to carry its own lantern. In the other case the eye is aborted, and the fish blind. Then the light-emitting organs are dispersed in various ways about the body. For instance, in *Lophius*, the lantern is at the end of the 'fishing rod,' its supposed function being to attract smaller creatures, which are snapped up, the jaws generally having a wide gape. One or two of the illustrations showed eel-like fishes which had swallowed, whole, other fishes much thicker than themselves, so that the stomach was hugely distended.

[1] *Reports of Challenger Expedition* (*Zoology*, vol. xxii.).

May 12th, 361st meeting. Professor Flower read a letter, dated Wadelai, November 3rd and 8th, 1886, containing the latest intelligence received from Emin Bey. He announced the despatch of several skeletons of the chimpanzee as well as of the diminutive native tribe, called Akkas, especially one of a very old woman.[1] He expressed his intention of continuing to collect for the British Museum, and showed no anxiety as to his own position.

Professor Bonney exhibited and described some sands given to him by Sir W. Bowman and Mr. J. B. Martin, which were reported to have been ejected with jets of water during the Charleston earthquake [2] at the end of August last. They consisted of quartz, felspar, two micas, and hornblende, with a little tourmaline and perhaps zircon : evidently the débris of crystalline rocks, and very probably derived from the Archaean ridge west of Charleston, which is probably the source of the Tertiary and later materials of the lower lands. They had no special character, showed no signs of abrasion, and had more resemblance to the detritus of a river than of the sea-shore.

June 16th, 362nd meeting. Mr. Thiselton-Dyer discussed the alleged formation of pearls in the interior of the cocoa-nut. They are described in the *Herbarium Amboinense*, written about two centuries ago. Since then they have been occasionally mentioned. Dr. Sidney Hickson recently obtained two specimens in the Malay Archipelago, but no European is known to have found one in the nut. The story is either a fraud of long standing, or it is true. On the one hand, no similar products are reported from other regions where the cocoa-nut is cultivated ; on the other, we cannot

[1] This race of dwarfs, whose average height does not exceed 4 feet 10 inches, lives to the south-west of the Albert Nyanza Lake, and was first made known by Schweinfurth in 1874. Their projecting jaws and protruding lips give them an ape-like aspect, and they are very low in the scale of humanity.

[2] It occurred on August 31st, and disturbances continued for two or three days. For an account see *Nature*, vol. xxxiv. page 460. For a similar incident in the neighbourhood of New Madrid on the Mississippi during the earthquakes of 1811-12, see Lyell, *Principles of Geology*, vol. ii. page 109 (ed. 12).

pronounce it impossible, because carbonate of lime is deposited as rounded concretions in the presence of mucilage, and the chemical conditions inside a cocoa-nut do not seem to differ essentially from those under which a pearl is formed in the pearl oyster.

Nov. 24th, 364th meeting. Professor Maskelyne exhibited a new electric lamp which had been tried with complete success in the Yorkshire collieries. Its weight is 4 pounds 2 ounces, and it gives a light of 1¼ candle-power, which is maintained by a secondary battery of novel form, the positive being zinc, the negative a special preparation without metallic lead. The lamp shown could run with undiminished light for 9 hours. The glow burner is protected by a dome of toughened glass. This, when broken, flies into fragments, releasing a spring which cuts off the current and instantaneously extinguishes the light. The lamp had been tested successfully in the most explosive gases of the Yorkshire collieries.

Dec. 15th, 365th meeting. Professor Judd gave the results of his recent studies of quartz crystals. A lamellar structure has been proved to be developed by strain in many minerals, and Leydolt and Descloiseaux have shown quartz crystals to be built up of lamellae having different properties, the latter observer having demonstrated that the Airy's spirals, exhibited by equatorial sections of such crystals, are due to the overlapping of lamellae of right-handed and left-handed quartz. He exhibited a specimen showing an intergrowth of two left-handed individuals. An equatorial section of this, when etched by hydrofluoric acid, exhibited lamellae, which, with a polariscope and convergent rays, gave Airy's spirals, but further examination showed this lamellar structure to be restricted to parts of the crystals which had been subjected to deforming strain. We were therefore justified in inferring that lamellar structure could be developed by mechanical means in quartz as in calcite and many other minerals.

1888. Jan. 19th, 366th meeting. Professor Newton referred to the discussion on edible bird's nests on Nov. 27th, 1884 (page 227). A few days since Mr. John Young, of the War Office, who had recently made a voyage round the world in his yacht *Golden Fleece*, placed in his hands a mass about 18 inches by 12 inches, consisting of some 25 nests which had been detached in his presence from a lofty overhanging cliff (hardly to be called a cave). Some of the outside nests contained eggs or young; others, more or less incrusted by these, were evidently much older, but nearly all the nests are overspread and permeated by fronds or fibres of (? algae or lichen), in some cases to such an extent as to hide them. He had requested Mr. J. P. Green to examine the mass and determine, if possible, the nature of the vegetable growth and its relation to the material of the nest, which is made by a species of *Collocalia*.[1]

March 15th, 368th meeting. Sir W. Grove described some experiments which he made at the Royal Institution about the year 1846, when the slow deposit of crystals by the voltaic arc was attracting attention. By this means M. Depretz was reported to have obtained crystallized carbon, though not in a transparent form. It occurred to him that, as strong sulphuric acid abstracts the water from moist sugar and leaves behind a residue of black amorphous carbon, so if pure white sugar were added to a weak solution of sulphuric acid, the result under voltaic action might be the crystallization of carbon in a transparent form. Employing a battery and apparatus, which he described, he used three tubes, hermetically sealed. Two were filled with a solution of white sugar to which a few drops (not the same number) of sulphuric acid had been added, but he could not remember whether the third tube contained any. Each tube was then connected with a battery, so that the current passed through them in a vertical direction, and they were left in a dark vault for about 10 months. The negative wires were then found in all three cases wholly coated with a black deposit, which was spangled from top to bottom

[1] Nearly allied to the British swift (*Cypselus*). Mr. Green found the material to be closely related to mucin. It is secreted by the salivary glands. See Newton, *Dictionary of Birds*, s v *Swift*, and Chambers' *Encyclopaedia*, s.v. *Edible Birds'-Nests.*

with very brilliant crystals of the cubic system, not more than 0·01 inch in diameter. So far as he remembered, but he was not certain, they scratched glass. An expert, to whom M. Gassiot had shown them, said they were too small to give conclusive evidence, but he saw no reason why they should not be diamonds. All were used up in applying tests. He had intended to repeat the experiments, but soon afterwards he left the London Institution and returned to active practice at the Bar. He had, however, done so at his own house, with small batteries, but the only result was a black deposit on the negative electrodes.

May 17th, 370th meeting. Mr. Ball, who had recently visited the Canary Islands, made some remarks on their flora, which is remarkable for the large number of endemic plants, not growing in any other part of the world. Of about 400 described species, some inhabit all or several of the islands, but the majority are confined to a single island, and this is generally Teneriffe. Perhaps all these may not be true species, but we might safely say that the Canary Islands produce 300 such species, besides about 50 species common to them and Madeira. and in some cases also to the Azores, but not known elsewhere. Among the species strictly confined to the Canaries are several groups which give a very special aspect to the vegetation, nine of the genera being elsewhere unknown. Among the former is the *Sempervivum*, of which 60 species (possibly 40 of them quite distinct) have been described. An allied species had been found by Sir J. Hooker and himself in the Great Atlas and a shrubby *Sempervivum* near Mogador ; so one might suppose this group of plants, which has multiplied so greatly in the Canaries, to have an African origin. This may be said with more confidence of the cactoid *Euphorbiae*, which are so marked a feature in the Canarian flora, and of the genus *Sonchus*, about 10 species of which are peculiar to those islands ; there are also three African genera, excluding the groups already mentioned, which are peculiar to the Canaries. We know too little of the African coast for the 15° of latitude between the mouth of the Sus river and French Senegal to justify any confident statement, but, apart from species extending to other regions, we know only of about a dozen common to North-west Africa and the Canaries, and there are three African genera (excluding the groups already mentioned) which are represented in the latter by species peculiar to the islands. On the other hand, we find, besides the genera and species strictly confined to the Canarian archipelago, three distinct genera, known only in the Azores and Madeira, and the above-named 50 species, several of which extend also to the Azores. This extension is the only fact which lends any support to the theory of an ancient Atlantis, advanced by the late Edward Forbes.

June 14th, 371st meeting. Captain Noble described the effect of shells charged with explosives of great power. The pebbles of the shingle near the spot were in some cases reduced to powder, a result apparently of the violent compression of the surrounding air.

Nov. 1st, 372nd meeting. Mr. Galton gave an account of his recent visit to the Bureau des Signalement at Paris to study M. Alphonse Bertillon's system of identifying criminals by measurements of different parts of the body. Doubts had been expressed, which to some extent he also had felt, whether the method would succeed, but his experience had been convincing. The measurements were made and recorded quickly, the system of storing and classifying the descriptions was simple, admitting of easy reference, and the results, as he saw from examples, were most successful. The system was now adopted in France.

Dec. 13th, 374th meeting. Dr. Sclater described a mound composed of angular blocks in an earthy matrix resembling a moraine which he had seen, during a recent visit to Algeria, at the entrance of the gorge of the Chifa, where it debouches from the Atlas. Also he had noticed another mound like a moraine on the road between Algiers and Constantine. Some members doubted if these could be moraines, as they were only a few hundred feet above sea-level.

1889. May 16th, 379th meeting. Dr. Sclater exhibited the mummy of a species of falcon, probably *Dissodictis ardesiacus*, from Egypt. The possibility of dissolving the bitumen, used in the preserving process, was discussed, so as to allow of examining the various parts of the bird. In Cuvier's time a mummy of the Sacred Ibis had been thus successfully treated, but the process was now unknown.

June 6th, 380th meeting. Lord Rosse mentioned a fall of black rain,[1] on April 12th last, over a considerable area of Central Ireland, as, for instance, at Lisbeg, near Eyrecourt in County Galway, where the tanks were subsequently emptied to get rid of the black water (none being preserved). It also fell at Cangort Park in King's County and at Golden Grove near Roscrea, which is about 20 miles from Lisbeg. A few black drops (compared to ink and to bog-water) fell at Dundrum, near Cashel. He exhibited a small bottle of the rain taken at Ballymore Castle. It had now lost the inky appearance and become of a pale reddish brown, but contained an amount of dark solid sediment. Dr. W. J. Russell had examined it and found neither crystalline nor organic structure, but a character like that of London rain, except that it did not give an acid reaction. The cause of the blackness cannot yet be satisfactorily explained.

Dec. 12th, 382nd meeting. Mr. Evans described the opening of a barrow at Youngsbury near Ware. The hinge was found of a wooden box which had enclosed an urn and a glass bottle, containing bones of man and roe-deer, pieces of charcoal, and fragments of incense (proved by burning). The pattern on the bottle is identical with one found at Harpenden sixty years ago, and the interment belonged to the later half of the second century.

Professor Dewar made some remarks on the zero of absolute temperature. Van der Waals had shown that the critical point of a substance could be calculated from data which were derived from a knowledge of the isothermal curves, employing for the purpose the observations of Andrews. The subsequent investigations of Amagat can now also be used. From these the critical points of oxygen,

[1] See also *Nature*, vol. xl. page 202, and page 158 of this book.

hydrogen, and nitrogen can be calculated. Later investigation has confirmed the accuracy of the numbers for oxygen, but for nitrogen the calculated value of the critical point was 50° too high. As hydrogen has not yet been liquefied,[1] it may be inferred that its calculated critical point is above the true value, which is confirmed by the fact that hydrogen does not liquefy at the calculated critical temperature, which is about −174° C. The increasing inaccuracy in the cases of nitrogen and hydrogen, compared with the accuracy in that of oxygen, is due to the much lower value of their respective critical points, and to the fact that, as the isothermal curves are observed at ordinary temperatures—about 15° C.—they are being gradually further removed from the critical points. Hence, isothermals must be observed at much lower temperatures to obtain anything like an accurate calculated value for hydrogen. Wroblewski constructed such curves, and they show the critical point of hydrogen to be −240·4° C. (or 32·6 absolute with a critical pressure of 13·3 atmospheres), the density at the contact point being 0·027; both critical point and density are below those of any other substance. Calculated from these data the boiling point of hydrogen, at ordinary atmospheric pressure, would be between 20° and 22° absolute temperature, the difference between critical and boiling point being about 10°, while it is about 50° in the case of nitrogen and carbonic acid. So if we had liquid hydrogen, we should have to lower its boiling point 20° to reach the zero of absolute temperature. As such reduction can be effected when oxygen, nitrogen, and other substances are evaporated under diminished pressure, there is no apparent reason for doubting that, with a supply of liquid hydrogen, we could arrive at, or very near to, the zero of absolute temperature. Before this could be reached, hydrogen would be a solid mass, probably having the appearance and characters of a metal.

[1] Its critical temperature (−233° C.) and the boiling point (−243° C.) were ascertained by Professor Olszewski (*Nature*, vol. li. page 488). He also obtained a momentary liquefaction of the gas, but Professor Dewar himself succeeded on May 10th, 1898, in reducing the gas to a static liquid. For an account see *Nature*, vol. lviii. page 49.

1890. March 13th, 385th meeting. Mr. Evans described a small glass bottle (about three inches in diameter) of Roman make, inside which five glass rods extended from the base of the neck to a point a little above the bottom, at angles of about 45° with the axis of the bottle, and thus seeming to support the neck. He suggested that, while the bottle was still soft and before it had reached its full size, a blunt rod, like a knitting pin, had been pushed into the side at five different points and the viscous glass carried as tubes to the base of the neck, where they were finally attached by the help of a blowpipe. This done, the bottle would be reheated and blown to its full size, the tubes by this action being welded into rods. By adopting this device, Mr. Powell, whose practical knowledge of glass is so great, and Mr. C. V. Boys, so successful in constructing glass apparatus, had made a similar vessel.

May 8th, 387th meeting. Professor Judd exhibited a crystal of beryl, well formed, though somewhat water-worn, weighing 2650 grains, with a specific gravity 2·703. It was clear, and its colour between aquamarine and emerald. It had been obtained in Ceylon by Mr. Barrington Brown. He had also brought from Burma the specimens (exhibited) of rubies in a matrix of highly crystalline limestone.

Oct. 30th, 389th meeting. Professor Dewar exhibited a specimen of liquid nickel carbon monoxide, discovered by Mr. Mond while experimenting with an improved form of Grove's gas-battery in order to find a way of obtaining hydrogen cheaply for commercial purposes. While trying various modes of separating the two oxides of carbon from their mixture with hydrogen in the gas-battery he found that nickel united with the carbon monoxide in the proportion of one volume of the former to four volumes of the latter, forming a gas at ordinary temperatures, which is reduced by pressure to a heavy, colourless, highly refracting liquid. As neither cobalt, nor iron, nor any other metal forms a similar compound, this gives a ready method of distinguishing nickel from any metal resembling it. That is the more important, because nickel and cobalt have the same atomic weight and because it negatives the suggested existence of a new element present as a constant impurity in the two metals. It also shows the possible existence of a group of elements, forming compounds of the type RO_4.

Sir F. Bramwell mentioned an attempt, made many years ago at the old Vauxhall Gardens, to prepare hydrogen gas for commercial purposes by passing steam over charcoal. It aimed at producing as little carbon monoxide as possible, the carbon dioxide being got rid of by passing the gas through a solution of caustic soda.

Dec. 11th, 391st meeting. Professor Frankland gave the results of experiments on the fitness of electric lamps for use in coal mines. He found that the small spark from small storage batteries could not ignite explosive mixtures of marsh gas or coal gas or even of hydrogen with air. Hence no such spark, caused by a breaking circuit or otherwise, can cause danger in a fiery mine. He was still making experiments to ascertain whether the breaking of the globe and momentary contact of the incandescent filament with an explosive mixture would be dangerous.

1891. Jan. 15th, 392nd meeting. Professor Newton read a letter from Professor Stirling, giving a description of a recently discovered Australian mammal, which proves to be a marsupial, not a monotreme as at first supposed.[1] It has a bird-like pelvis and four or five of the cervical vertebrae are fused, but has marsupial bones, though these are exceedingly small. The eyes are pigment spots under the skin, and it burrows underground in the sand for long distances. He could not send a specimen to England, for he had only four, none of them in good condition, since they had travelled 1500 miles wrapped in a kerosene rag, and they supplemented each other. Professor Flower said the animal represented a new order in the marsupials, which now afforded representatives of the mammalian orders

[1] A drawing of *Notorhyctes typhops* was exhibited at the Royal Society Conversazione on June 17th, by Professor Newton (*Nature*, vol. xliv. page 188). The first account of the animal, found at a station on the overland route from Adelaide to Port Darwin, is given by Professor Stirling, *Nature*, vol. xxxviii. pages 588-9.

of carnivora, herbivora, and insectivora. Mr. Thiselton-Dyer remarked that some vegetable types showed a tendency to assume forms characteristic of very different orders. For example, the genus *Senecio* includes many adaptive types, such as tree-like, succulent, and climbing forms.

June 18th, 397th meeting. Mr. d'Abbadie[1] (guest) drew attention to the nature of hazes, by which, even in the driest atmosphere, the sun is often obscured and mountains, at a distance of three or four miles, are invisible. Though so common as to have received a special name in the languages and dialects of many savage tribes, their true nature has not been fully studied, nor their origin determined. He also gave some account of his scientific travels, especially on magnetic surveys in Africa and Arabia.

1892. June 16th, 406th meeting. Captain Noble gave an account of some experiments on explosives. It was generally agreed that for artillery the pressure employed should not exceed 17 tons per square inch. The maximum pressure with the new explosive compounds did not exceed that of the old, but in some cases, and especially with cordite, fifty per cent. more energy was imparted to the projectile, the pressure on the interior part of the gun being increased, but not that on the chamber. The results given by the old gauge were incorrect, because the products of explosion were forced into the gauge. It was not advantageous to increase the velocity of the projectile above 2000 feet per second, though one of 3000 feet might be obtained. Owing to the resistance of the air a better result is got by increasing the weight of the projectile. He mentioned that cordite of large diameter is blown from a gun imperfectly burnt, the residue being cordite in all respects similar to the newly-prepared material.

Oct. 27th, 407th meeting. Mr. Crookes said that a study of the phosphorescent spectrum of yttrium had suggested that it was really a compound. Progress had been made

[1] A. T. d'Abbadie (1810-1897) lived in Paris and studied meteorological and astronomical subjects, writing on these and on earthquakes, shooting stars, and gravitation.

in a work which had lasted for many years, and but for 'accidents' might not be completed for another half century. Two of them, however, had lately much facilitated the enquiry; one being the precipitation of one of the constituents in a pure state, as a crystalline salt, namely, that giving a close pair of green lines in the spectroscope; the other being the discovery of a mineral accompanying gadolinite[1] from Texas, in which fractionation had already advanced to a considerable extent.

1893. Jan. 26th, 410th meeting. Professor Rücker gave the results of experiments, made in the eastern part of London by himself, Professor Ayrton, and others, which proved that the neighbourhood of a railway worked by electricity would be injurious to a physical laboratory.

Feb. 16th, 411th meeting. Professor Newton mentioned the discovery of another deposit containing bones of large mammals at Barrington, near Cambridge, similar to the one described fourteen years ago by the Rev. O. Fisher.[2] *Bison priscus* and *Megaceros hibernicus* are the more abundantly represented, but there are a considerable number of teeth and some bones of *Hippopotamus amphibius*, with bones of a female *Elephas antiquus* and her calf, teeth of bear (*Ursus priscus*), and of a large *Felis*, with other representatives of the river gravel fauna. The excavation was now being carried on, by favour of the owner, on behalf of the Woodwardian Museum.[3]

April 27th, 413th meeting (46th anniversary). Captain Noble gave an account of experiments with explosive compounds. With a large charge of cordite and a light projectile he had obtained a velocity of nearly 5000 feet per second. He had used six different kinds of explosives.

[1] A silicate of beryllum, iron, and yttrium.

[2] See *Quart. Jour. Geol. Soc.* 1879, page 670. Since the above date many valuable remains, now contained in the Sedgwick Museum at Cambridge, have been obtained from this and another pit. See for a full account (with illustrations) *Proc. Geol. Assoc.* vol. xxii. pages 268-278. The late Professor Hughes thought the gravel probably older than the Chalky Boulder Clay.

[3] The former title of the Sedgwick Museum.

A 100 pounds projectile could acquire a velocity of 3400 feet per second, but a 40 pounds one a velocity of 4930 feet, and that could be considerably increased by enlarging the chamber and increasing the gravimetric density of the charge. The solid products of combustion of brown prismatic powder (one of the above six) favoured deposit in the tube, for it became fluid at the temperature of the explosion. A dirty gun made a sensible difference in the velocity, amounting to a loss of 9·5 per cent. of energy. Cordite and ballistite produced no deposit. In the experiments three guns had been used—of 50, 75, and 100 calibre (ratio of length to diameter)—that of 75 calibre, fired with brown prismatic powder, gave, when clean, the same velocity as that of 100 calibre, when foul. He indicated how the velocities were measured, and said that higher could be obtained, but they were not practically useful, because of the high resistance of the air. He also mentioned that when nitroglycerine is mixed with diatom-earth, or any inert substance, detonation takes place as if it were not so mixed, but when gun-cotton is dissolved in nitroglycerine, as in the manufacture of cordite, this will not detonate. The difference of action between gun-cotton and cordite is shown by filling a cast-iron shell with each. When exploded by a fulminate, the one is broken to pieces, the other reduced to powder.

Oct. 26th, 416th meeting. Dr. Günther described the habits of a small ant (*Occophylla sp.* ?) found on the west coast of Africa. Colonies of it form nests, double the size of a man's fist, in young shoots of the coffee plant. When a nest is complete, the ants capture a small spider *Gastracantha curvispina* to cover it with a web, and construct for this a separate cell, opening into the interior of the nest, where they keep it a prisoner and feed it, to repair or renew the external web. Eight or nine of the spiders have been examined, and all prove to be males.

Mr. Galton said that early in the year he had made experiments to ascertain whether he could work sums in arithmetic by other faculties than sight or hearing, on one or other of which some calculators depend. He taught himself by means of a simple apparatus for smelling different odours, and practising for a few minutes night and morning, to consider peppermint as one unit, camphor as two units, carbolic acid as three, etc., and was able to translate the earlier part of the addition table into these scents. He thought that a child, if it began early enough, would not find a process of this kind more difficult than learning addition in the usual way. But, having got thus far, he did not think it worth while to continue the experiments, and found that the faculty temporarily acquired had already been almost lost.

1894. April 19th, 422nd meeting (47th anniversary). Mr. Galton described a visit to an institution at Nice for rearing prematurely born children. It was furnished with flat glass cases like incubators, which could be kept at any desired temperature, and in each lay a swaddled child, not yet of the normal age for birth; the facts being noted on a placard. Apparently it was a private speculation, but it received Government approval in 1891, and that of the French Academy of Medicine in 1893.

May 24th, 423rd meeting. Dr. Debus referred to the fundamental law in modern chemistry supposed to have been discovered by Avogadro in 1812. But, as the Italian chemist was aware, John Dalton clearly stated the principle in 1808.[1] He, however, dropped it because he found such remarkable discrepancies on comparing the atomic weights with the densities of the gases. But a more exact determination of the former showed that they really correspond. The discovery of this law seemed to him not less important than that of gravitation by Newton.

Sir A. Noble described an apparatus for determining the rate with which high explosives part with their heat to the chamber enclosing them. Cordite gases are remarkable in this respect. A charge of it, giving in a closed vessel a pressure of a little over 6 tons per square inch, has that reduced in 0·07 of a second after the explosion to 6 tons, in 0·17 second to 5 tons, in 0·75 second to 4 tons, in 1·75

[1] See H. E. Roscoe, *John Dalton and the Rise of Modern Chemistry*, 1895.

second to 3 tons, in 3·5 seconds to 2 tons, and in 7 seconds to 1 ton, while in 13 seconds the pressure is well below that amount. He had corroborated the results by two or three experiments. Powder gases exploded at the same pressure took triple the amount of time, but this perhaps might be expected because of the larger charges fired and the lower temperatures developed.

June 14th, 424th meeting. Professor G. Darwin stated that, on a recent consideration of the 'three bodies problem,' he had found a possible mode of motion for a satellite, which would give it three changes of moon and one full moon in a single lunation. Its orbit would be a figure of eight relatively to the sun and planet, the latter lying in the larger loop of the eight. Such an orbit is, however, very unstable, so that the satellite, if slightly displaced, must soon cease to move, even approximately, in its primitive orbit, with the result that, sooner or later, it will either come into collision with the planet, or be drawn towards and fall into the sun. Thus all unstable orbits will gradually be eliminated from a solar system, those that are stable alone remaining. By considering the stability or instability of various periodic orbits he was in hopes of throwing light on the actual distribution in space of planets and satellites.

Professor Victor Horsley gave a brief account of Erlach's experiments with a solution of methylene blue. When this is introduced into the system during life, the colouration or non-colouration of any tissue showed whether oxidation or reduction took place in that part of the body. During life (he had repeated Erlach's experiments on a large scale) no reduction took place in the muscles (including the head) and the brain; in the lungs the blue was rapidly deoxidized and the tissues remained colourless. At the moment of death the colour instantly fades from tissues, where in the living state it is very pronounced, showing the occurrence of an active and universal reduction.

Oct. 25th, 425th meeting. The members discussed some subjects in electricity, such as Professor Lenard's observations on cathode rays, the currents about magnetic poles, Lord Armstrong's hydroelectric machine and its suggested relation to the lightning that accompanies volcanic eruptions, the reported new gas discovered by Lord Rayleigh and Professor Ramsay in association with atmospheric nitrogen,[1] the manufacture of aluminium, the preparation of pure fluorine, the synthesis of diamonds, and the fractionation of yttrium.

1895. Feb. 14th, 429th meeting. Professor Frankland gave the results of a three years' investigation of the bacterial life in Thames water. He found the number contained in a cubic centimetre to vary between 630 and 56,630, the largest number, as a rule, being found in winter with a low temperature, and the smallest in summer with a high one. The causes affecting the development of microbic life had all received attention, and he exhibited curves illustrating its relation to each of them. He inferred from them (1) that though a few coincidences existed between low temperature and a high number of bacteria, some other conditions, as a rule, entirely masked the effect of the latter ; (2) the amount of sunlight during the past three days has no substantial effect on the number of microbes present in a cubic centimetre of water ; (3) this depends on the rate of flow of the water, or, in other words, on the rainfall.

March 14th, 430th meeting. Sir H. Roscoe dwelt on the recent great development by the Institute of Preventive Medicine in the preparation of antitoxins. Within the last few days about 400 doses of the antitoxin of tetanus had been distributed to the Pacific Islands at a cost of one shilling each. The preparation of diphtheritic antitoxin now took only eighteen hours, and 300 doses of it were sold daily by Messrs. Allen and Hanbury at a cost price of eighteen pence for thirty cubic centimetres, or three average doses. The effect had been to reduce by one-half the deaths from that disease.

April 24th, 431st meeting (48th anniversary). Mr.

[1] They announced the discovery of argon (as they called the gas) at the Oxford meeting of the British Association. See *British Association Report*, 1894, page 614.

Crookes mentioned some recent experiments by Victor Schumann, of Leipzig, on the photography of rays of very high refrangibility. Having found that the short length of air, through which the light has to pass from the electric spark to the spectroscope, has a very decided absorptive action on those rays, he had constructed a spectroscope from which the air can be exhausted. Mr. Crookes showed a photograph of a certain part of the hydrogen spectrum, exhibiting more than 300 lines and representing about one-eighth of the whole hydrogen spectrum, which contains from 1500 to 2000 lines.

May 16th, 432nd meeting. Mr. Blanford spoke of a fossil flora, information of which had recently come to him from the province of San Luis, Argentina. It was remarkably interesting, because a series of fossil floras had now been found in Australia, India, and South Africa, ranging in age from Carboniferous to Jurassic or Neocomian, the older of which were quite different from the Carboniferous and Permian floras of Europe and North America, and so much resembled those of Mesozoic age, that the Australian and Indian coal-beds had for long been considered Jurassic, but the higher Indian, Australian, and South African floras did not differ so much from those in the north. Dr. Kurtz had now found, in Argentina, a small number of plants identical with those in the Karharbari and Talchir beds of India, the Ecca-Kimberley beds of South Africa, and some of the lower Newcastle beds of Australia, thus indicating that a more or less connected tract of land, comprising parts of India, Australia, South Africa, and South America must once have existed, which, however, was separated by a break, impassable by plants, from that occupied by the flora of North America and Europe. Another interesting matter was that, in each of the first-named four countries, traces of glaciation have been observed in connection with the beds containing the Upper Palaeozoic flora.[1]

[1] Sometimes referred to as the "Glossopteris flora," and considered to be of Permo-Carboniferous age. This and the signs of glaciation are mentioned in Sir A. Geikie's *Text-book of Geology*, pages 1057, 1066, etc.

June 20th, 433rd meeting. Dr. Sclater exhibited specimens of the silicified wood (*Nicolia*), which he had brought from the 'petrified forest' in the Suez desert, some 7 miles from Cairo in a direction south of east. From the way the trunks were lying he had little doubt the trees had been brought down by water and stranded on the shore of an ancient estuary.

Nov. 21st, 435th meeting. In the absence of Professor Dewar, Mr. Crookes described a simple, rapid, and inexpensive method of preparing liquid air. One end of a strong copper tube, about a quarter of an inch in external diameter, is connected with a steel bottle, about one cubic foot in capacity, containing air at 180 atmospheres pressure. The other end (a few feet distant) is twisted into a close spiral about nine inches long and two inches in external diameter. Inside this a glass tube, exhausted to a high vacuum, is tightly slipped, and the whole put into a vacuum-jacketed glass cylinder a couple of inches longer than the copper-spiral, the end of which is open. On turning the tap of the high-pressure cylinder, the compressed air rushes into the lower part of the outer cylinder. In expanding it abstracts heat from surrounding bodies, but as the vacuum jacket, inside and out, almost completely isolates thermally the upper spiral, the temperature of the stream of expanding air is lowered till it reaches its own liquefying point, when liquid air begins to roll down the outer cylinder. Last Saturday he saw Professor Dewar perform the experiment at the Royal Institution, when liquid air began to appear in about five minutes after the tap was turned on, and in ten minutes seventy cubic centimetres of liquid air had collected, the compressed air expended amounting to about fifty cubic feet at the normal atmospheric pressure. If the high pressure cylinder be filled with oxygen or nitrogen, they also are liquefied, and with a similar apparatus Professor Dewar has succeeded in obtaining liquid hydrogen.[1]

[1] A fuller account of the experiments, with figures of the apparatus, is given in *Nature*, vol. liii. pages 329-331, from a paper read by Professor Dewar to the Chemical Society on Dec. 19th, 1895, and printed in their *Proceedings*.

1896. Feb. 13th, 438th meeting. Professor John Milne[1] (a guest) described some photographic records of earthquakes which he had obtained at Shide, Isle of Wight, from a horizontal pendulum. This, from time to time, showed sudden movements. As these might be due to local earthquakes, he intended to compare their records with those from an apparatus which would be set up at Carisbrooke. Earthquakes originating in Europe and other distant places were also noted. Occasionally tremor-storms lasting from ten to seventy hours occurred, which so far blurred the photogram as to obliterate a separate record; the rate at which the film was moved being too quick for obtaining satisfactory diagrams of diurnal tilting. He hoped that instruments, equivalent to that at Shide, would be established at about fifteen stations round the world; their chief object being to determine the rate at which earthquake motion is propagated, not only round the earth but possibly through its interior.

April 23rd, 440th meeting (49th anniversary). Sir Joseph Hooker exhibited a small instrument made for measuring sections of plants. It was on the plan of a pair of proportional compasses, but so arranged that the distance between the pointed ends is recorded by the opposite end of one of them on a scale attached by a pivot to the other limb.[2]

May 7th, 441st meeting. Dr. Sclater described the way in which the eggs of the Surinam water-toad (*Pipa americana*) were deposited on the back of the female, observations

[1] Professor John Milne, who founded seismographic observatories in Britain and made most important contributions to seismology, was born in Liverpool, Dec. 30th, 1850, studied at the School of Mines in Jermyn Street, and then in Cornwall, after which he undertook work in Newfoundland, Labrador, and the Peninsula of Sinai. In 1872 he obtained a post under the Japanese Government, and on his way to take up this, crossed Europe and Asia from England to Shanghai. A prolonged period of earthquake disturbances in Japan enabled him to study their phenomena, on which he wrote some valuable memoirs. Returning to England in 1895, he settled at Shide (Isle of Wight), where he established an observatory, devising instruments for registering secondary shocks, and recording, classifying, and publishing his observations. (See an excellent biography in the *Geological Magazine*, 1912, 337.) He died July 31st, 1913.

[2] A pen-and-ink sketch of the instrument is inserted in the Minutes.

having been made of two pairs, which had copulated in the hot pond of the Zoological Society's Gardens. The female, when spawning, extruded from her cloaca a long bag-like organ, no doubt a prolongation of its lower part. This was bent over on her back, and the male, when *in copula,* pressed on it, squeezing out the eggs, one by one, and arranging them on her back—fecundating them, as was supposed, while doing this. Oviposition ended, the male left the female, and the extruded part of the cloaca returned into her body. Much more, however, remained to be discovered, for these were the first observations that had ever been made.

Nov. 19th, 444th meeting. Dr. Frankland related the experiences of a party sent to observe the total eclipse of the sun on August 9th from an island on the western side of Vadsö (Norway). After the necessary preparations had been made, their party, twenty in number, was landed there about 2.30 a.m. The sun shone at intervals through banks of clouds, but was invisible when a bugle note indicated the first contact. Another sounded five minutes before totality. A general gloom had already set in, the fleecy clouds had become yellow, the sea and distant hills deep indigo-blue. A rifle shot announced the beginning of totality, and now a dark shadow swept over the heavens and the earth at the rate of about two miles a second. It came on in great waves, blackening every fleecy cloud and appearing to bring down the sky and the clouds upon their heads. An observer called the time from a chronometer, every ten seconds, to 104 seconds, when totality ceased; the sky and landscape rapidly resuming their ordinary aspect. The darkness during totality was not great enough to prevent one from reading a book, for much light was reflected from masses of cloud near the horizon and outside the range of totality. It would doubtless have been more intense had the sky been clear.

1897. Jan. 21st, 446th meeting. Sir F. Bramwell described the roller boat of M. Baxin, on which a paper had been read the previous evening at the Society of Arts. It consisted of a rectangular platform carrying deckhouses, mounted on six hollow lenticular rollers, each about 40 feet diameter and 12 feet thick, actuated by engines of 150 horse-power, and an engine of 500 horse-power works a screw-propeller, which rotates between the pairs of rollers. The friction of the water should thus be reduced to a minimum, as the boat rolls over it without cutting through it.

Feb. 11th, 447th meeting. Sir A. Geikie gave a summary of the results of Admiralty soundings in the Pacific. Submarine peaks had been discovered, over areas hundreds of square miles in extent, with bases averaging about 20 miles wide and with flat tops, which are 25 or 26 fathoms below high-water mark, and do not vary in depth more than a few feet. These must be the cinder cones of volcanoes, now extinct, which the waves have cut down to the level where they ceased to have any erosive power. On three submarine peaks corals had grown, and atolls were being formed.

March 11th, 448th meeting. Sir John Evans called attention to the discovery by Mr. Joseph Landon, of Saltley, near Birmingham, in the highland gravels of the Rea, of at least one well-formed palaeolith, made of quartzite. The absence of these implements from the region north of a line drawn from the mouth of the Severn to the Wash had been explained by supposing it to have been then covered by ice, but as similar palaeoliths had already been found at Creswell Crags in north-east Derbyshire,[1] non-discovery might be the better reason, and a careful search in the older gravels of northern rivers might result in a large extension of the area occupied by palaeolithic man.

June 17th, 451st meeting. Dr. Russell gave an account of experiments on the action of metals and some other bodies on photographic plates which he had been describing that afternoon to the Royal Society. When repeating Becquerel's experiments on uranium, he had found zinc to act in the same kind of way, a fact which, though he was not then aware of it, had been already observed by Colston.

[1] See J. M. Mello, *Quart. Jour. Geol. Soc.* 1876, pages 240-244, and W. B. Dawkins, *ibid.* pages 249-256.

A bright zinc plate, however, would not only produce a complete picture of markings on it, when laid on a sensitive plate, but this action also occurred through considerable distances, and even if such substances as celluloid, gelatine, gutta-percha tissue, goldbeater's skin, vegetable or real parchment were interposed between the two plates. Other metals and their alloys, such as mercury, magnesium, cadmium, nickel, cobalt, aluminium, lead, tin, antimony, pewter, or fusible metal, acted in the same way. Copal and some other varnishes produced similar effects, and a picture of such a thing as a skeleton leaf could be obtained by putting it between a photographic plate and a sheet of zinc, or piece of glass, covered with copal, but pure paper, after being soaked in a solution of certain salts, prevented the passage of any such action. Wood also was similarly active, and a good picture was obtained by laying a piece of it on a photographic plate. Printers' ink in many cases had the same effect, and remarkably clean dark pictures came from placing either the blank or the inked side of a page of print on such a plate. Pill boxes, in which some of the uranium salts had been kept, were found to have a similar effect, for they were usually made of straw-board covered with white paper, and the former could act, though to a less extent, like zinc and copal.

1898. Jan. 20th, 455th meeting. Professor Anderson Stuart[1] (a guest), from the University of Sydney (Australia), gave an account of that University. It was incorporated by Royal Charter in 1850, and at the present time received from the State an annual subsidy of £12,000, besides other pecuniary aid. Its buildings were well situated, and its students numbered about 600, including 80 women. No distinction was made between the sexes, and no difficulties

[1] Sir Thomas Anderson Stuart was born at Dumfries on June 20th, 1856, and, after taking the M.D. degree with special distinction at the University of Edinburgh, became Professor of Physiology in the University of Sydney. There he has been for not a few years an energetic worker in medical and allied scientific subjects, and was a leader in organizing the three expeditions for making a deep boring into the atoll of Funafuti in the Ellice Islands. He was knighted in 1914.

had arisen. It had four faculties—arts, law, medicine, and science; the teaching was professorial, not tutorial, and the staff, including lecturers and demonstrators, was 46 in number.

April 28th, 458th meeting (anniversary). Professor Judd gave an outline of the progress made in investigating the structure of a coral reef by boring. The committee, appointed by the Royal Society, had selected the atoll of Funafuti, one of the Ellice Islands, of which Captain Field in H.M.S. *Penguin* had made a very complete survey. Two borings were put down in 1896 by Professor Sollas, and a third in 1897. This, under charge of Professor Edgeworth David,[1] of Sydney University, had reached a depth of 698 feet. The materials obtained had been sent to England for examination, and it was hoped that the committee, formed in Sydney to co-operate with the Royal Society, would be able to continue the deep bore-hole and to sink one, with the aid of the Lords of the Admiralty, into the bed of the lagoon.[2]

June 16th, 460th meeting. Professor Rücker communicated the results of experiments with a self-recording magnetometer, recently set up in South Kensington. The self-registered curves (which he exhibited) showed periodic magnetic disturbances, of about 3 minutes' duration, superposed on the photographic trace of the instrument. On every week day they began about 6 a.m. in the morning and continued till about 11.15 p.m., but there is no trace of them during the night or on Sunday, when the electric trains of the South London Railway are not running. Careful comparison with records, obtained at Greenwich Observatory, of trains running on the South London Electric

[1] Tannatt William Edgeworth David, C.M.G., F.R.S., Professor of Geology in the University of Sydney, was born in 1858, and graduated from New College, Oxford (of which University he is now a D.Sc.). Besides his valuable work in Funafuti as head of the second expedition, he was scientific officer on the Shackleton Antarctic Expedition from 1907 to 1909, making the ascent of Mount Erebus, and leading a party to the South Magnetic Pole.

[2] In 1898 the boring was carried down to 1114 feet, and two, near together, were sunk into the bed of the lagoon, one to a depth of 144 feet. See Minutes for Feb. 8th, 1900.

Railway, showed them to be very similar to these in character and probably due to the same cause. This inference was confirmed by experiments made at Chelsea (2¼ miles from the railway) and at a point about ½ a mile from it, the disturbances at both places showing an increase over those registered at South Kensington, and becoming larger as the railway was approached.

1899. April 27th, 467th meeting (anniversary). Sir G. G. Stokes, on being asked to account for the difference in luminosity of mantles consisting of pure thoria in comparison with those formed of 99 per cent. of thoria and 1 per cent. of ceria, when heated by cathode rays or the Bunsen flame, explained the physical conditions to which such difference was due. These were that thoria, from its molecular structure, is little disposed to vibrate with the frequencies corresponding with the less refrangible end of the spectrum and the invisible rays beyond. But, if it can be thrown into a state of high molecular agitation, by a cause permanently at work, so that the intake of energy balances that given out by radiation, much less of the output is lost (for illuminating purposes) by being in the form of vibrations with low frequency. Thus a comparatively large part of the output is in the form of vibrations of higher frequency, which are needed for illumination. To explain how the thoria is to be thrown into a state of high agitation, we must suppose that, when a mantle of it is thus affected by the Bunsen burner, this is mainly produced, not by direct contact with the products of combustion, but by taking up from the ether the violent agitation, produced in it by, and emanating from, the various molecules born by the combustion. At any moment only an extremely small fraction of the molecules that have just been born can impinge on the mantle before their agitation has to a great extent subsided by communication to the ether and in part to the molecules in their immediate neighbourhood. We have, therefore, mainly to look to the agitation in the ether for getting up agitation in the molecules of the thoria. That will be, in very great measure, of high frequency, belonging to the ultra-violet part of the spectrum. But if thoria be nearly transparent for that part, the etherial vibrations will mostly pass through without disturbing it, and thus fail to produce the very high agitation desired. But when the thoria is mixed with a small quantity of a suitable oxide, such as that of cerium or of uranium, which is opaque for rays of high refrangibility, their molecules take up agitation from the ether and pass it on to the thoria by molecular conduction. If a large quantity of the oxide were mixed with the thoria it would be injurious, because then it would freely emit radiations of comparatively low frequency, and so a great quantity of the agitation, which it takes up from the ether disturbed by the combustion of the gas would be wasted on etherial vibrations of a kind which are not wanted. But when thoria is agitated by the so-called cathodic rays, that is, by molecular bombardment, the process is wholly different and the foreign oxide is not required.

1900. Feb. 8th, 474th meeting. Professor Edgeworth David, of the University of Sydney (a guest), gave an account of the boring which had been put down in the atoll of Funafuti (see page 253) to a depth of 1114 feet, and described his own stay on the island in 1897, while the first part of that bore-hole was being made.[1] In this last expedition two borings, near together, had been made in the bed of the lagoon by the aid of Captain Sturdee, one to a depth of 144 feet, the other of 94½ feet. The result of the three expeditions was to obtain maps and a study of the geography, geology, botany, and zoology of the atoll, and make a complete section of it, which passed partly through coral rock, partly through calcareous sand, and the materials obtained had been sent for study to the British Museum. He considered that the evidence tended to show that at Funafuti and other atolls in the Ellice group, algae, like *Halimeda* and *Lithothamnion*, were not less important than corals and foraminifera in their construction, and that the existence of large

[1] An interesting account of this visit was written by Mrs. Edgeworth David in *Funafuti, or Three Months on a Coral Island*, 1899.

coral blocks at the depths attained in the floor of the lagoon and of masses of reef-building corals at depths of more than 1000 feet, favoured the view that in these atolls subsidence had predominated over elevation.[1]

April 5th, 476th meeting (anniversary). Sir W. Crookes stated the results of his recent studies of uranium and its compounds in regard to their radio-active properties. That these were inherent in them had been taken for granted, but he had found that by chemical fractionation they can be divided, one portion having strong radio-active properties, the other almost, or entirely, without them. The strongest of the former is capable of darkening a photographic plate in five minutes, while the extreme one of the latter scarcely produces a visible effect after an exposure of 150 hours. He had succeeded in separating the active body from uranium, but not, as yet, in obtaining it unmixed. It was not polonium, for its radiations pass easily through glass and metal, while those of polonium are stopped. Whether or not it is radium, is at present doubtful, for, though it closely resembles that body in some of its characters, it differs in others, as described in the researches of M. and Mme. Curie.

Nov. 22nd, 480th meeting. Dr. Blanford pointed out that the distribution of the garial (*Garialis gangetica*) favoured the idea of a depression in the upper part of the Bay of Bengal. It is a crocodile inhabiting rivers only, being never found like *Crocodilus palustris* in ponds or marshes, or like *Crocodilus porosus* in tidal waters or the sea. It occurs in the Brahmaputra, Ganges, and Indus, with their larger tributaries, and in the Mahanadi in Orissa and the Koladyni in Arakan. The simplest explanation of its presence in these two rivers is that they were once tributaries of the Ganges. This would require the Bay to have extended not farther north than about 19° N., where now its depth is about 800 fathoms. At Calcutta a well section

[1] A full report of these expeditions and of the materials obtained, with maps and illustrations, is given in *The Atoll of Funafuti, Report of the Coral Reef Committee of the Royal Society*, 1909.

has afforded clear evidence of a depression of 460 feet—or, so far as it was carried. It is true signs of slight elevation are shown in the Bay of Bengal. There are none of great depression on the Arakan coast, but about midway, between the mouths of the Mahanadi and the Koladyni rivers, is the 'Swatch of no Ground,' a channel 1800 feet deep in the sea-bed, which on either side is only about 100 feet below the surface of the water. This could not be due to submarine erosion, and, if a result of subaerial, it must have been formed when the land was at least 2000 feet above its present level, which accords with the distribution of the garial.

Sir A. Geikie mentioned an interesting discovery made by the Geological Survey in the Isle of Arran. Here the granite and other eruptive rocks have been for some time past considered to be referable to the great period of Tertiary volcanic activity, when so much igneous material was extruded in the north-western portion of the British Isles, but no actual proof of their age had been obtained before last summer, when a tract, about two miles in diameter, was found on the west side of the southern half of Arran, which obviously marks the site of a volcanic crater, for it is occupied by coarse agglomerates, with abundant bosses and dykes of various intrusive rocks. In these agglomerates are blocks of sedimentary strata, containing fossils, which show some of them to be Rhaetic, others Lower Lias, together with large masses of white limestone, indistinguishable from the hard chalk of Antrim and full of Cretaceous foraminifera and sponges. This shows that the southern part of Arran, when the eruptions occurred, must have been covered with sedimentary rocks resembling those preserved under the basalt of Antrim. These probably extended into the south of Scotland, from which they have since been removed by denudation. This justifies the inference that the main topographical features of that region have been, to at least a great extent, carved out since the time of the chalk.

APPENDIX

I. LIST OF THE 47 ORIGINAL MEMBERS OF THE PHILOSOPHICAL CLUB.[1]

April 12.

Mr. D. T. Ansted.
Sir H. T. de la Beche.
Mr. T. Bell.
Mr. W. Bowman.
5 Mr. W. J. Broderip.
Mr. R. Brown.
Sir P. de M. G. Egerton.
Dr. W. Falconer.
Prof. E. Forbes.
10 Mr. J. P. Gassiot.
Prof. J. Graham.
Mr. W. R. Grove.
Mr. L. Horner.
Mr. C. Lyell.
15 Dr. W. A. Miller.
Sir R. I. Murchison.
Mr. R. Owen.
Mr. R. Partridge.
Dr. J. Pereira.
20 Mr. J. Phillips.
Dr. J. F. Royle.
Col. E. Sabine.
Dr. W. Sharpey.
Mr. E. Solly.
25 Mr. W. Spence.
Col. W. H. Sykes.
Mr. C. Wheatstone.

May 6.

Adml. F. Beaufort.
Mr. S. H. Christie.
30 Mr. M. Faraday.
Mr. J. T. Graves.
Sir J. F. W. Herschel.
Mr. W. Hopkins.
Prof. J. McCullagh.
35 Dr. W. H. Miller.
Mr. G. Newport.
Mr. G. Rennie.
Sir J. Richardson.
Rev. A. Sedgwick.
40 Capt. W. H. Smyth.

June 3.

Major P. T. Cautley.
Mr. J. Goodsir.
Mr. J. H. Green.
Sir W. S. Harris.
45 Dr. J. D. Hooker.
Mr. W. H. Fox Talbot.
Dr. N. Wallich.

II. LIST OF TREASURERS OF THE PHILOSOPHICAL CLUB.

1847-1850. W. R. Grove.
1850-1851. J. F. Royle.
1851-1854. W. R. Grove.
1854-1857. J. D. Hooker.
1857-1860. W. A. Miller.
1860-1863. W. B. Carpenter.

[1] Grouped in alphabetical order and according to the evenings on which the assent of each was announced, with the titles then generally given to them.

1863-1866. G. Busk.
1866-1869. T. Thomson.
1869-1872. P. L. Sclater.
1872-1874. W. H. Flower.
1874-1876. Sir R. Strachey.
1876-1879. F. Galton.
1879-1882. A. Thomson.
1882-1884. J. H. Lefroy.
1884-1887. T. G. Bonney.
1887-1889. J. Ball.
1889-1892. J. W. Judd.
1892-1895. W. T. Blanford.
1895-1898. W. Crookes.
1898-1901. W. G. Adams.

III. LIST OF MEMBERS OF THE ROYAL SOCIETY CLUB, WITH WHICH IS INCORPORATED THE PHILOSOPHICAL CLUB.

1902-3.[1]

President.

1870. Huggins, Sir W., K.C.B., D.C.L., LL.D., P.R.S.

Honorary Members.

1874. Bramwell, Sir F. J., Bart., D.C.L.
1867. Buckton, G. B.
1870. Foster, Sir M., K.C.B., LL.D.
1866. Galton, Francis, M.A., D.C.L.
1873. Günther, A. C. L., M.A., Ph.D.
1864. Hay, Adm. Rt. Hon. Sir J. D., Bt., G.C.B., D.C.L.
1847. Hooker, Sir J. D., G.C.S.I.
1890. Kelvin, Lord, D.C.L., LL.D.
1879. Lister, Lord, M.D., D.C.L., LL.D.
1881. Newton, Prof. A., M.A.
1889. Ommanney, Adm. Sir E., C.B.
1871. Salisbury, The Marquess of, K.G.
1862. Sclater, P. L., Ph.D.
1866. Simon, Sir J., K.C.B., D.C.L., LL.D.
1855. Stokes, Sir G. G., Bart., LL.D.
1865. Strachey, Sir R., G.C.S.I.
1860. Williamson, Prof. A. W., D.C.L., LL.D.

Ex-officio Members.

1884. Christie, W. H. M., C.B., M.A.
1868. Evans, Sir John, K.C.B., D.C.L.
1890. Geikie, Sir A., D.Sc., LL.D.
1889. Kempe, A. B., M.A.
1900. Larmor, J., M.A., D.Sc.
1874. Rayleigh, Lord, M.A., D.Sc.
1886. Rücker, Sir A. W., M.A., D.Sc.
1886. Thorpe, Prof. T. E., C.B., D.Sc., LL.D.

[1] Reprinted from *Annals of the Royal Society Club*, by Sir A. Geikie, p. 485. The date before each name is that of election.

Ordinary Members.

1888. Abney, Capt. Sir W. de W., R.E., K.C.B., D.C.L.
1889. Adams, Prof. W. G., D.Sc.
1900. Armstrong, Prof. H. E., LL.D.
1860. Avebury, Lord, D.C.L., LL.D.
1897. Barry, Sir J. Wolfe, K.C.B.
1902. Beddard, F. E., M.A., F.Z.S.
1886. Blanford, W. T., LL.D.
1881. Bonney, Rev. Prof. T. G., D.Sc.
1895. Boys, Prof. C. V.
1887. Brunton, Sir T. Lauder, M.D.
1890. Clifford-Allbutt, Prof. T., M.D.
1886. Clifton, Prof. R. B., M.A.
1892. Common, A. A., LL.D.
1889. Creak, Capt. E. W., R.N., C.B.
1882. Crookes, Sir William.
1893. Dallinger, Rev. W. H., LL.D.
1894. Darwin, Francis, M.A.
1874. Debus, Heinrich, Ph.D.
1881. Dewar, Prof. James, M.A., LL.D.
1898. Dunstan, Wyndham R., M.A.
1898. Ewing, Prof. James, B.Sc.
1890. Fletcher, L., M.A.
1897. Forsyth, Prof. A. R., M.A., D.Sc.
1896. Foster, Prof. G. Carey, B.A.
1881. Gladstone, Prof. J. H., D.Sc.
1902. Glazebrook, R. T., M.A.
1889. Godman, F. D., D.C.L.
1897. Greenhill, Prof. A. G., M.A.
1899. Griffiths, Principal E. H., M.A.
1881. Harcourt, A. G. Vernon, LL.D.
1890. Horsley, Sir Victor, B.S., M.D.
1892. Hudleston, W. H., M.A.
1902. Jackson, Capt. H. B., R.N.
1886. Judd, Prof. J. W., C.B.
1900. Langley, J. N., M.A., D.Sc.
1891. Liveing, Prof. G. D., M.A.
1885. Lockyer, Sir J. Norman, K.C.B.
1897. M'Clean, F., LL.D.
1895. MacMahon, Major P. A., D.Sc.
1873. Maskelyne, N. Story, M.A.
1902. Matthey, G.
1898. Meldola, Prof. R.
1898. Miers, Prof. Henry A., M.A.
1895. Mond, L., Ph.D.
1875. Müller, Hugo, LL.D.
1871. Noble, Sir A., Bart., K.C.B.
1868. Odling, Prof. W., M.A.
1900. Poulton, Prof. E. B., M.A.
1895. Ramsay, Sir W., K.C.B., D.Sc., LL.D.
1891. Reinold, Prof. A. W., M.A.
1893. Roberts-Austen, Prof. Sir W., K.C.B.
1880. Roscoe, Sir H., D.C.L., LL.D.
1875. Rosse, the Earl of, K.P., D.C.L., LL.D.

1879. RUSSELL, W. J., Ph.D.
1874. SANDERSON, SIR J. S. BURDON, BART., LL.D.
1880. SCOTT, ROBERT H., M.A., D.Sc.
1900. TEALL, J. J. H., M.A.
1898. THOMSON, PROF. J. J., M.A., D.Sc.
1898. THORNYCROFT, SIR J. I.
1897. TILDEN, PROF. W. A., D.Sc.
1902. TURNER, PROF. H. H., D.Sc.
1881. TYLOR, PROF. E. B., D.C.L.
1899. WELDON, PROF. W. F. R., M.A.
1886. WHARTON, REAR-ADM. SIR W. J. L., K.C.B.
1887. WILSON, COL. SIR C. W., K.C.B.

PROF. W. G. ADAMS, MAJOR MACMAHON, and PROF. C. V. BOYS, *Treasurers.*

IV. ADDITIONS AND CORRECTIONS.

AT the third meeting of the Club it was announced that a Book for the Minutes had been presented by Sir H. T. de la Beche, a Treasurer's Box by Mr. Gassiot, and a Seal by Mr. T. Bell, for which thanks were voted.

Sir W. Flower (page 60) was born in 1831.

In the biographical note on Sir J. Evans (page 62) *for* 1889 *read* 1898.

On page 72, in first line of biographical note on Lord Rayleigh, *for* as *read* and.

The note about Dr. N. Wallich on page 152 is needless, for a short biography of him, as an original member, is given on page 24.

In the biographical statements I have relied especially on the *Dictionary of National Biography*, supplemented in some cases by obituary notices in the Proceedings of the Royal and other Societies, and occasionally (in those of later date) by personal knowledge.

While this sheet was passing through the press, the death of Dr. F. du Cane Godman (page 84) was announced as having occurred on Feb. 20th.

On page 230 a tubular hydroid is said to have been dredged up on the *Challenger* Expedition from a depth of four miles. That is stated in the Minute Book, but it did not occur to me till too late that this depth was considerably greater than any reached from the *Challenger*. The hydroid, subsequently named *Monocaulus imperator*, is described by Professor Allman; see his Report on the Hydroids, Part ii, page 5 and Plate 3 (*Challenger* Reports, Zoology, vol. xxiii.). It had a stem more than 7 feet long and was brought up from a depth of 2900 fathoms, off Yokohama, in lat. 34° 37′ N., long. 140° 32′ E.

My thanks are due to not a few friends, too numerous for separate mention, for their help in difficulties arising from incorrectly written words in the Minute Books or from my own ignorance, but especially to Professor H. G. Plimmer for his care in transmitting to me those Books, and above all others to Professor W. W. Watts, Sc.D., F.R.S., my old friend and former pupil, who has read all the proofs of Section II. and has detected several misprints and other errors which had escaped my notice. Such errors insist on creeping into books, and this is not likely to be an exception, for I have hardly ever read a new one without detecting two or three misprints. But I fear there may be others. As the communications made to the Philosophical Club range over a wide field of knowledge, it is occasionally possible that a statement may not be accurately reported, and if the author of it were absent from the reading of the Minutes, this may have passed unnoticed. Some such cases I have observed and corrected, but others, in subjects with which I am unfamiliar, have no doubt passed undetected. In other cases, to one or two of which I have called attention, the speaker has been wrongly informed. Lastly, the 'somebody who blundered' may have been myself. After a certain time in life we become too well aware that accuracy does not increase with years. So for mistakes of my own making I crave the reader's pardon and ask him to remember Horace's genial dictum: "*Scimus, et hanc veniam petimusque damusque vicissim.*"

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