

found on comparing notes that this one, which they both said was large and extremely brilliant, had appeared about *twenty-five minutes past six*.

At night we attended the Governor's last "reception," prior to his leaving the colony. He was handing my wife to her carriage—I was unfortunately in the house—when another fine meteor illuminated the sky. It must have been in the west, or, from the position of the carriage and the buildings, my wife could not have seen it. She says it fell straight down from the zenith, and broke into several pieces. This occurred at 10.45; I had just previously looked at my watch. I also heard of other smaller, though bright, meteors, but did not see them myself. What are we doing, Mr. Editor? Are we going through the tail of a comet? or is cosmic dust igniting? or are these "dire and bloody" portents? Whatever they are, I record them, in the hope that others may have seen and noted them.

British Consulate, Noumea, July 21 E. L. LAYARD

### The Milleporidæ

SPECIAL interest is attached to any direct evidence as to the nature of the reproductive organs in the Milleporidæ, the more especially as no traces whatever of such organs have hitherto been discovered. In the absence of any direct evidence it has been concluded that, from the apparent absence of ampullæ, the gonophores probably develop free of the cœnosteum; and this seemed partly borne out by the general resemblance between the zooids of the Milleporidæ and those of the gymnoblastic Hydroids.

On some dry specimens, however, of a new species of Millepora (*Millepora murrayi*, characterised by its extremely laminated and coalescent fronds, much and palmately divided at their extremities, and by its minute gastropores, .25 mm. wide, and its still more minute dactylopores and even surface) from the Philippines, there occur, irregularly and numerous distributed among the young branchlets of the cœnosteum, large receptacles, which, though the absence of the soft parts prevents any absolute confirmation thereof, can leave no doubt as to the true ampullate nature of the generative organs in this family. These receptacles occur either closely, or widely apart, as circular cavities in the superficial reticulations of the cœnosteum, and are covered above by a very thin and porous layer, which is often broken away. When it is thus laid open, the cavity is seen to be about .75 mm. in diameter. The receptacles are seen on the surface as white, circular, scarcely raised areas about .5 mm. in diameter, with a small pore in the centre; and they are generally rather numerous placed on one or both faces of the palmated branchlets.

By the discovery of the ampullæ in the Milleporidæ, a complete confirmation is given to the relationship which Prof. Moseley has shown to exist between this family and the Stylasteridæ; and it is seen that the two families are even more closely related than had been imagined. The presence of such a structure seems to bring the Milleporidæ into relationship rather with the calyptoblastic than with the gymnoblastic Hydroids, in spite of the general resemblance of its zooids with the latter.

JOHN J. QUELCH

Natural History Museum, South Kensington

### To Find the Cube of any Number by Construction

THE following graphical construction for finding the cube of a number may interest more than the mere mathematician:—

Take a triangle  $ABC$ , in which suppose  $A$  to be the vertical angle and  $B$  greater than  $C$ . Draw the perpendiculars  $AD$ ,  $BE$ ,  $CF$ , thus obtaining the pedal triangle  $DEF$ ; take  $H$  the middle point of the perpendicular  $EG$  on  $DF$ . Then  $\tan CDH = \tan^3 CDE = \tan^3 A$ . If then we take a triangle with vertical angle  $A$  such that  $\tan A = n$ , we see that  $\tan CDH = n^3$ .

The proof of the above result is quite elementary.

September 22

R. TUCKER

### The Failure of the Parsley Crop

WOULD you permit me to ask some subscribers to your paper if it be possible to account for the total failure of the crop of parsley this and last year. Is it owing to any known insect or what? The parsley comes up well, grows to about one inch in height, then begins to dwindle and get yellow, and the whole

summer remains about half an inch high, the only green part being the crown. All the market gardeners are in the same position as myself, only one having a crop, and this was sown in freshly cultivated earth. I have carefully examined leaves and roots under the microscope, but can discover no cause for this disease. Have any of your subscribers been troubled in the same manner, and can any one suggest a remedy? W. H. C. B.

Cheltenham, September 23

### Wasps as Fly-Killers

YOUR correspondent at p. 385, vol. xxx., may be informed that in this part of the world wasps enter dwellings by the open windows in summer-time, and hunt house-flies unmercifully, leaving the dead flies in hundreds on the floors, ready to be swept into a dustpan. This occurs only in the country, and where wasps' nests are near by. Westwood quotes from St. John's "Letters to an American Farmer" that: "The Americans, aware of their (wasps') service in destroying flies, sometimes suspend a hornets' nest in their parlours" (Introduction to "Modern Classification of Insects," ii. p. 246, foot-note).

GEORGE LAWSON

Dalhousie College, Halifax, Nova Scotia, September 8

### GEORGE BENTHAM

WE recently announced the death of the veteran botanist, George Bentham, when within a few days of his eighty-fourth birthday. His life, from a very early age, was one of incessant mental activity, and of much change and vicissitude during its three or four first decades. Through his birth, connections, and various residences on the continent of Europe, as well as in England, he became acquainted with many men famous in literature, science, and art, and his career is rendered especially notable from its intimate association with his uncle Jeremy, the jurist, in the arrangement of whose papers and preparation of whose works for the press he was actively engaged for not a few years, and with whom he resided on the most intimate terms as companion and secretary till the death of that relative in 1832. This and the scientific value now attached to the "pedigree" have suggested the expediency of entering with some detail into the family history and early life of Mr. Bentham (for most of which we are indebted to information imparted by himself) before detailing his botanical career and writings.

About the year 1750 Jeremiah Bentham, an attorney or solicitor, one of a family of scribes who, as fathers and sons, had inhabited the Minories since the beginning of the seventeenth century, migrated to the West End of London, purchasing property in Queen's Square Place and Petty France (now York Street, on the south side of Birdcage Walk, St. James's Park). He had two sons: the elder, Jeremy, the well-known writer on Jurisprudence, the younger, Samuel (subsequently Sir Samuel), father to George, the botanist. Samuel devoted himself to the study of naval architecture, and at the age of twenty-two visited the arsenals of the Baltic for the purpose of improving himself. From thence he travelled far into Siberia, and became intimate with Prince Potemkin, who induced him to enter into the service of the Empress Catherine, at first in a civil, and afterwards in a military, capacity. In the latter he took a distinguished part in a naval action against the Turks on the Black Sea. For this he received the Cross of St. George, and was given the command of a regiment quartered in Siberia, which enabled him to penetrate eastward to the frontier of China. After ten years of absence he returned to England, and was shortly afterwards promoted to the rank of general. The death of Catherine followed soon after, when he was offered employment in England by his friend Earl Spencer, then First Lord of the Admiralty, who was anxious to avail himself of Gen. Bentham's ingenuity and experience in



improving the civil branch of our naval system. This he accepted, resigning the Russian service, and attained the post of Inspector-General of Naval Works. His son has been heard to say that amongst other improvements introduced by Gen. Bentham into the dockyard were the steam sawmills and the machinery for the eccentric turning of blocks, through his employment of the late Isambard Mark Brunel, whom he brought over to England.

In 1796 Gen. Bentham married the eldest daughter of Dr. George Fordyce, F.R.S., the well-known physician and author. Mrs. Bentham was a woman of great ability and energy; she had actively aided her father in the preparation of his works, and with still greater perseverance she devoted herself to assisting her husband in his arduous labours, drawing up as well as writing out his voluminous reports to the Admiralty, and accompanying him on his visits of inspection to the dockyard, which were often of several months' duration. Up to the age of eighty she wrote a most beautiful hand, and it is within the recollection of readers of this article that letters in the *Times*, under her signature, when she was considerably over ninety years of age, appeared during the Crimean War, urging the introduction of improvements in our war material, especially great guns, which her late husband had suggested.

It was during one of the annual inspections of the Portsmouth Dockyard that George was born, at Stoke, then a village near Portsmouth, and now absorbed in that town. He was the second son, and had three sisters, one of them older than himself. All were forward children: on their fourth birthdays the two elder sisters made the clothes they wore on those days and wrote out a list of their possessions; and before he was five years old, George wrote copies, enjoyed reading Miss Edgeworth's "Easy Lessons" with his brother, and began to study Latin. The whole family were taught reading by the words, not letters or syllables.

In 1805 Gen. Bentham was sent by the Admiralty on a mission to St. Petersburg, having for its object the building in Russia of ships for our navy, and he took his family with him. There they remained for two years, during which time the education of the children was intrusted to a talented Russian lady, who could speak no English; and the young people, showing a remarkable facility for the acquisition of languages, were able before leaving to converse fluently in Russian, French, and German. Latin was acquired under a Russian priest, and, at six years of age, music, to which George subsequently became passionately attached, was commenced.

War between England and Russia breaking out in 1807, Gen. Bentham was recalled. The homeward route was by Revel and Sweden, and the voyages were notable. At Revel they embarked for Stockholm in a Russian frigate, a bad sailer, with a crew hardly any of whom had before been at sea; and, after driving backwards and forwards in the Baltic under continuous gales, they landed on the fourteenth day at Carlskrona! In Sweden they were detained several weeks, long enough for the two brothers and their elder sister, by dint of perseverance and hard study, to learn enough of Swedish to converse in that language and read it with tolerable ease. From Gothenburg they sailed for Harwich in a wretched craft, and, after beating about the North Sea in a succession of tempests, arrived on the fourteenth night, when the crew took the boats and hastened ashore, leaving the Benthams till the following midday with no other food but rejected bits of biscuit picked up wherever they could be found.

In England the family settled at Hampstead, whence the father went daily to his offices at the Admiralty and Somerset House, whilst George and his brother pursued their studies. These, then and ever afterwards, were conducted by private tutors, and it was a life-long source of

regret to George that he had never been at school or college. This, in his opinion (and not his alone), accounted for an habitual shyness and reserve that often caused him to be misunderstood, and credited with motives or sentiments that were foreign to his disposition and character. Much of his time was spent at Berry Lodge, a house and property which his father had bought between Gosport and Alverstoke, where the summer months were passed, and which still belongs to the family. It was from here that he was once taken by his father on a visit to Lady Spencer at Ryde, and met at her house John Stuart Mill—then on a visit there—a boy of six, in a scarlet jacket and nankeen trousers buttoned over it, and who was then considered a prodigy. Bentham has described him as wonderfully precocious, a Greek and Latin scholar, historian, and logician, fond of showing off, and discussing with Lady Spencer the relative merits of her ancestor the Duke of Marlborough and the Duke of Wellington, he taking the part of the latter.

The year 1814 opened upon a period of great excitement throughout the Continent; the invasion of Russia by Napoleon and the burning of Moscow were naturally matters of intense interest to the Bentham family. The boy George, then only thirteen, now budded into an author, commencing with his brother and sister the translation of a series of articles from a Russian paper, detailing the operations of the armies, which were contributed to a London magazine of ephemeral duration. He gloried in the reverses and final abdication of Napoleon, and was presented to the Emperor of Russia by his father on the visit of that monarch to the naval establishment at Portsmouth.

Peace being proclaimed, the Bentham family went to France, and prepared for a long residence in that country; they resided first at Tours, then at Saumur and Paris, during the eventful period that extended from the return of Napoleon to his final overthrow. Young Bentham kept full journals of all that passed, interspersed with anecdotes relating to the forced exile of Louis, the defeat of the Emperor, the restoration of the Bourbons, the conduct of the allies, the execution of Ney and Labedoyère, the condition of the city of Paris, and the prominent part taken in the politics of the day by Walter Savage Landor, who was intimate with his family. Moreover, he seems to have been able at this early age to enjoy and even take his part in the society of the eminent men of the time and the *salons* of the leaders in literature and science, the Duc de Richelieu, Talleyrand, the Comte de Damas, Jean Baptiste Say, the aged Mme. Andelan (the daughter of Helvétius), were amongst the intimate friends of the family; as was Baron Humboldt, who took warmly to the lad, encouraging especially his taste for geographical science, giving him introductions to libraries and to individuals who could aid him in the preparation of a work which he had begun on the data of physical geography.

In 1816 Gen. Bentham organised what may be called a caravan tour of France for himself and family, having for its objects partly unceremonious visits to his many friends in the provinces, and partly the leisurely inspection of the great towns and other objects of interest. The *cortège* consisted of a two-horse coach fitted up as a sleeping-apartment, a long, two-wheeled, one-horse spring van for himself and Mrs. Bentham, furnished with a library and piano, and another, also furnished, for his daughters and their governess. The plan followed was to travel by day from one place of interest to another, bivouacking at night by the road, or in the garden of a friend, or in the precincts of the prefectures, to which latter he had credentials from the authorities in the capital. In this way he visited Orleans, Tours, Angoulême, Bordeaux, Toulouse, Montpellier, and finally Montauban, where a lengthened stay was made in a country-house hired for the purpose. From Montauban (the *cortège* having broken down in some way) they proceeded, still by private conveyances, to



Carcassonne, Narbonne, Nîmes, Tarascon, Marseilles, Toulon, and Hyères.

It was during this tour, when at Angoulême, that Bentham's attention was first turned to botany, and it fell out on this wise:—His mother, who was fond of plants, and a great friend of Aiton at Kew, had purchased a copy of De Candolle's "Flore Française," which was then just published. Young Bentham took it up accidentally, and was struck with the analytical tables for the determination of the affinities and names of plants, which exactly fitted in with the methodising, analysing, and tabulating ideas which he had derived from his Uncle Jeremy's works, and had endeavoured to apply to his own geographical tables. He at once went into the back-yard of the house, and, gathering the first plant he saw, he spent the whole morning studying its structure with the aid of the introductory chapter of the "Flore," which treated of elementary botany, and succeeded in referring it to its natural order, genus, and species. The plant, *Salvia pratensis*, was not an easy one for a beginner, owing to the irregularity of the flower and abnormal character of the ovary and stamens. His success led him to pursue the diversion of naming every plant he met with in future.

At Montauban, near Tours, where the family resided for many months, Bentham spent what he always regarded as the happiest period of his life; he was entered as a student of the Faculté de Théologie, at Tours, followed with ardour the courses of mathematics, Hebrew, and comparative philology (the latter a favourite study in after-life), and at home occupied his time with music, Spanish, drawing, and botany, whilst, during the holidays, dancing was his delight; it was a favourite boast that at Montauban he attended thirty-four balls between Twelfth-night and Mardi-gras, of which thirteen were consecutive, and lasted from nine at night to the same hour on the following day.

The appearance of the "Dictionnaire d'Histoire Naturelle," a course of lectures under Benedict Prevost, and De Candolle's general works on the structure and classification of plants, first opened his mind to scientific botany, and induced him to take up the study of exotic plants, to which he devoted himself till 1820, when he took to the amusement of shooting and stuffing birds. At this period, too, John Stuart Mill resided in his father's family for seven or eight months, and it was probably due to this that Bentham was diverted to the study of philosophy, and at the age of twenty began a translation into French of his uncle's "Chrestomathia," which was published in Paris some years afterwards. Here, too, he began the study of Lamarck's works, with the "Système analytique des Connaissances positives de l'Homme," only to give it up in disgust on reading "Dieu créa d'abord la matière," followed by the statement that nature was the second thing created, and this produced everything else. Sliding down from great things to small, a fit of entomology supervened, and he commenced tabulating observations on insect life as he had his geographical and philosophical facts and ideas.

The next phase of Bentham's Protean life was that of a practical estate-manager and farmer, his father having bought a property of 2000 acres, that of Restinalières, near Montpellier, and given over the management of it to his now only son, for he had lost his eldest through an accident some years before. Into this work Bentham threw himself with ardour, and now his methodical habits, close application, and familiarity with French country life stood him in good stead. The farms and vineyards rapidly improved, and were very profitable. Still he found time for his favourite pursuits, his holidays were spent in botanical excursions to the Pyrenees and Cevennes, and his spare hours at home in logic and the preparation of a French edition of his uncle's essay on Nomenclature and Classification. Here, too, he wrote his own first work of importance, "Essai sur la Nomenclature et Classification

des Arts et Sciences," which was published in Paris, and established his position in France as an acute analyser, clear expositor, and cautious reasoner.

In 1823 Bentham was sent to England for the purpose of purchasing agricultural implements and obtaining information as to improved methods of farming that might be introduced into the Montpellier estate. On arriving in London he was asked by his uncle to visit him, bringing his translation of the "Chrestomathia." This invitation, the attractions of English scientific and literary society, and the fact that provincial jealousies threw every obstacle in the way of the introduction of improvements into the Restinalières estate, led ultimately to the abandonment by his father of the latter (in 1826), and the return of the Bentham family to England.

On his arrival in London he was at once received into the best literary and scientific society; he attended the breakfasts and receptions of Sir Joseph Banks, and studied in his library and herbarium, and that of the Linnean and Horticultural Societies, and formed life-long friendships with Brown, Lambert, Don, Sabine, Menzies, &c. During a tour through England and Scotland, taking with him letters of introduction to the leading botanists there, he became acquainted with Sir James Smith, Dawson Turner, Graham, Greville, Hooker, and many others. It was during this tour that he formed a friendship with the late Dr. Arnott (subsequently Professor of Botany in Glasgow), with whom he made, in 1824, an extended journey into the Pyrenees, which resulted in his first botanical work, "Catalogue des Plantes indigènes des Pyrénées et de Bas-Languedoc, avec des Notes et Observations" (Paris, 1826).

On the settlement of the family in London a new career was opened to Bentham, his uncle Jeremy having invited him to devote much of his time to aiding him in the arrangement and preparation of his MSS. for the press, accompanying the invitation with assurances that he would provide for him at his death. The proposal of aiding his uncle was congenial to him, but not the accompanying one, for he was now desirous of seeking a serious profession that would lead to independence; and after many embarrassing interviews on the subject with his uncle it was arranged that he should enter Lincoln's Inn and study law, whilst devoting some morning hours to his uncle, besides dining with him twice a week and writing for him afterwards from 8 to 11 p.m. In one shape or another this arrangement of working with and for his uncle lasted till the death of the latter in 1832; when, owing to the many foolish and fruitless speculations of the great jurist, the extravagant sums spent by his executors on the posthumous publication of his works, and some irregularity in his will, Bentham found himself in possession of the house in Queen Square Place, but with less property than he should have received. His father's death, however, in the previous year, had rendered him in a measure independent.

From 1826 to 1832 Bentham's life was one of incessant activity. Besides his irksome labours for his uncle, in whose ideas he did not at all participate, and many of whose acts he regretted, he had the editing and often rewriting of his father's (now Sir Samuel Bentham's) voluminous papers on the management of the navy and the administration of the dockyards. His legal studies were sacrificed to logic and jurisprudence; the fruits of the former being the publication of his "Outlines of a New System of Logic, with a Criticism of Dr. Whateley's Elements of Logic" (London, 1827), in which the doctrine of the quantification of the predicate is for the first time clearly set forth. This remarkable work fell still-born from the press; only sixty copies were sold, when the publishers became bankrupt, and the stock was seized and went for waste paper. It was not till 1850 that the fact of its containing a discovery was recognised (*Athenæum*, December 31, 1850); this led to a sharp dispute as to Sir



William Hamilton's claims to the same, and which was ended by a verdict of Herbert Spencer's in the *Contemporary Review* (May 1873) in favour of Bentham.

In jurisprudence two subjects deeply engaged his attention—one was codification, in which he entirely disagreed with his uncle, and his paper on which attracted the attention of Brougham, Hume, and O'Connell; the other was the laws affecting larceny, his suggestions on which he submitted to Sir Robert Peel, *apropos* of his Bill for the consolidation of the criminal law. Of this Peel thought so highly that he wrote a complimentary letter to its author, informing him that his remarks should be fully considered and submitted to Sir John Richardson, to whom the Bill was referred. Brougham also (to whom his uncle showed the paper) wrote a letter of eighteen pages of remarks on it. These and a pamphlet on the "Law of Real Property" are Bentham's chief contributions in his adopted profession. Of practice he had very little; he got his first brief in 1832, and, as junior counsel, bewigged and begowned, followed his leader when called for; but, being overcome with nervousness, he cut short his argument, and had the mortification of hearing the counsel for the opposite side say that "a more preposterous speech it had not been his fortune to hear during a long course of practice."

In botany Bentham was more at home than in the courts. In 1828 his herbarium arrived from France, and in the same year he was elected a Fellow of the Linnean Society, and joined with delight its reunions, attending its meetings punctually, its anniversary dinners, and those of its club. The return of Wallich from India with the enormous collections of the East India Company which first made known the flora of the Himalayas, Burmah, and many other parts of that vast empire, gave him occupation in the study and publication of various intricate genera and natural orders of plants. Of these writings, his "Labiatarum, Genera and Species" was the most important; this large family having been in a state of utter chaos before Bentham brought his remarkable powers of generalisation and description to bear upon it.

In 1829 Bentham finally gave up the law for botany, and amongst other labours accepted the honorary secretaryship of the Horticultural Society, which was in a perilous condition of debt and dissension. From these he extricated it with perfect success, and, aided by his friend Lindley, the assistant secretary, raised it to a flourishing condition financially and scientifically, and which it has never since approached.

In 1833 he married the daughter of the late Right Hon. Sir Harford Brydges of Boultonbrook, formerly Ambassador at the Court of Persia, and in 1834 removed to his late uncle's house in Queen Square Place, the site of which is now occupied by the "Bentham wing" of the "Queen Anne's Mansions." There he resided till 1842, when, with the view of providing better accommodation for his now extensive herbarium and library, and devoting himself more exclusively to science, he removed to Pontillas House in Herefordshire, where he revised the *Labiatae*, and elaborated the great families of *Scrophularineae*, *Polygoneae*, and others for his friend Alphonse de Candolle's continuation of the "Prodromus Systematis Naturalis Regni Vegetabilis."

In 1854, finding that the expenses of his collections and books were exceeding his means, he determined on presenting the whole to the Royal Gardens at Kew (they were valued at 6000*l.*), and returning to London; at the same time he entertained the idea of abandoning botany, with characteristic modesty regarding himself as an amateur who had hitherto pursued the science rather as an intellectual exercise in systematising, than as a scientific botanist, who, in his opinion, should unite a competent knowledge of anatomy, physiology, and of Cryptogamic plants, to skill as a classifier and

describer of Phanerogams. He yielded, however, to the entreaties of his friends, the late Sir W. Hooker and Dr. Lindley, coupled with the offer from the former of access to his own private library and herbarium, and a room in Kew where his own was placed, backed by the request that he would inaugurate the series of colonial floras that was planned at Kew, by elaborating that of Hong Kong. Consequently, in 1855 he again took up his residence in London, first at Victoria Street, and latterly at 25, Wilton Place, and for the remainder of his life, till disabled by age, he almost daily throughout the year, except during autumn excursions to the Continent or visits to friends in Herefordshire, repaired to Kew and occupied himself exclusively with descriptive botany from 10 a.m. till 4 p.m.

The Hong Kong flora finished, Bentham took up that of Australia, and, aided by the observations, collections, and numerous discoveries of his active and able correspondent, Baron Mueller, of Victoria, he, single-handed, completed it in 1867 in seven octavo volumes, containing about 7000 species, the most extensive exotic flora ever brought to a conclusion. Meanwhile, the plan of a general work on Phanerogamic plants had been on various occasions discussed by Dr. Hooker and himself; at first it was proposed to confine it to carpology, but it finally assumed shape in a critical study and description of the genera of plants, founded on all available characters, for which his herbarium and the Hookerian offered unrivalled resources. This work, entitled "*Genera Plantarum ad Exemplaria, imprimis in Herbariis Kewensibus servata, definita*," was commenced in 1862 and concluded in 1883, the greater portion of it being the product of Bentham's indefatigable industry.

The only material break in Bentham's work at Kew was his acceptance of the presidency of the Linnean Society, which he held from 1863 to 1874, and to the duties and interests of which he devoted his time, his energies, and his purse, with characteristic singleness of purpose. He combined with the duties of President those of Secretary, Treasurer, and Editor of the botanical parts of the *Transactions* and *Journals*, spending a part or the whole of one day a week in the Society's rooms during the eleven years of his presidency. On the final transference of the Society's collections, library, and portraits from the rooms in old Burlington House to those they now occupy, he arranged the whole himself, classifying the books, and literally with his own hands placing them on the shelves they now occupy. His presidential addresses were remarkable for their grasp and wide range, and those who knew him only as a systematist and descriptive writer were surprised to find the great powers of analysis and the sound judgment he displayed in discussing evolution and its bearings, the writings of Haeckel, geographical distribution, the condition and prospects of fossil botany, deep-sea life, abiogenesis, methods of biological study, and the histories and labours of the Natural History Societies and their journals, and the scientific periodicals of every civilised quarter of the globe.

On the conclusion of the "*Genera Plantarum*" in the spring of 1883, his strength, which had for some years shown signs of diminution, suddenly gave way, and, after several ineffectual attempts to resume his studies, his visits to Kew ended, and, lingering on under increasing debility, he died of old age on September 10 last, when within a few days of his eighty-fifth year, leaving no family, and directions that his funeral was to be a strictly private one.

The above sketch conveys no idea of the prodigious amount of systematic and descriptive work in Phanerogamic botany that Bentham accomplished. In the "*Genera Plantarum*" there is hardly an order of any importance that he did not more or less remodel. His labours on the *Compositae*, *Gramineae*, *Cyperaceae*, and *Orchideae* are especially noticeable, and he contributed



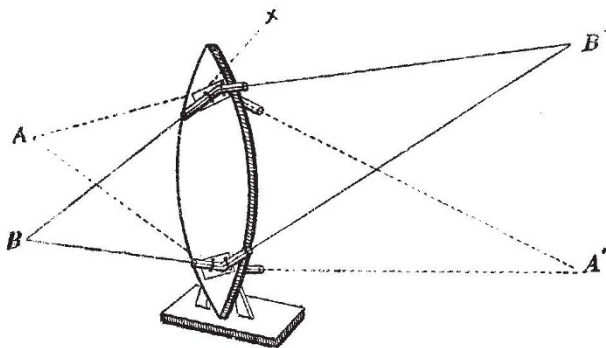
masterly essays upon these and others to the Linnean Society. His treatises on the Leguminosæ are no less exhaustive and valuable; and there is not a temperate or tropical region of the globe whose floras have not been largely elucidated by him. It may safely be affirmed that for variety and extent of good work of the kind he had no superior. The distinctive qualities of his descriptions are—scientific accuracy, good arrangement, precision of language, lucidity, and the discarding of what is superfluous. In these respects he has had no superior since the days of Linnæus and Robert Brown, and he has left no equal except Asa Gray.

Of his amiable disposition, and his sterling qualities of head and heart, it is impossible to speak too highly: though cold in manner and excessively shy in disposition, he was the kindest of helpmates and most disinterested of labourers for others.

Of recognition by foreign Academies Bentham had his full share, including that of Corresponding Member of the Institute of France. His election into the Royal Society was not till late (1862). It should have been in 1829, when he was proposed by R. Brown, and at his recommendation withdrawn, along with other scientific candidates, who thus showed their dissatisfaction at the Society's election of a Royal Duke to the President's chair. He, however, received the Royal Medal of the Society, and in 1878, on the completion of the Australian flora, the Secretary of State for the Colonies, unsolicited, recommended him to Her Majesty for the Companionship of the Order of St. Michael and St. George.

#### A MODEL LENS FOR USE IN CLASS DEMONSTRATIONS

IN using diagrams or models as aids in teaching, this question constantly arises—How far may we represent Nature diagrammatically without producing in the mind of a student one-sided and false impressions? I have myself endeavoured to follow this rule: that, if a complicated object or phenomenon is to be studied, we may simplify this, and bring out many salient features, with a diagrammatic representation; this must, however, only be looked upon as a stepping-stone to a more complete study of the object or phenomenon itself. The



model of a lens to be described I have found of much service in lecturing, antecedent to a demonstration of the passage of luminous rays through actual lenses.

This model may be constructed out of the simplest materials, and should cost but two or three shillings. It consists of a piece of deal board cut in the shape of the cross-section of a biconvex lens, and fixed to a stand of wood (see diagram). Four small squares of board, *x*, are fixed in the positions indicated, two on either side of the lens. Glass tubes bent at obtuse angles are fixed to these by staples, and can rotate with them on the screws by means of which the squares are fixed to the lens. Two pieces of string to represent visual rays are then passed through the tubes *A A'* and *B B'*. The theory of the use of

this model will be at once apparent. A ray of light passing through a lens of a given curvature and density will practically (this is not absolutely true) be bent at a given angle, whatever be the direction of the ray, so long as it passes through the same part of the lens. In the model this constant degree of bending is given to the string—representing the ray of light—by the bent tubes. These, rotating on the lens, allow one diagrammatically to represent the rays passing through it in any desired direction.

Taking the string *B B'*, for example, and holding it at these two points in the two hands, and keeping the string taut, it will be found that in shifting the point *B*—representing a luminous point—in any direction, *B'* will shift until it occupies the position of the corresponding focus. By shifting the string it is possible to demonstrate the focal points of parallel, diverging, and converging rays, either parallel to the axis of the lens, or on secondary axes. Then, by using at the same time the string fixed to the other side of the lens *A A'*, the formation of an image may be shown. Grasping with the two hands *A* and *B*, an assistant holding *A'* and *B'*, it will be seen how by this lens an inverted image is produced. Bring the points *A* and *B* nearer the lens, keeping them, however, at the same distance apart, and the points *A'* and *B'* will recede from the lens and from each other, showing how the image of the nearer object is formed farther away from the lens, and is larger in size. On the other hand, if *A* and *B* be pulled away from the lens, *A'* and *B'* approximate to it and to one another.

In working the model the squares should rotate easily, and the strings must always be held taut. For lecture-room purposes the lens should be about two feet high, and the strings may be coloured. On the same principle I have constructed models of other lenses or lens combinations.

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#### THE ELECTRICAL EXHIBITION AT PHILADELPHIA

[FROM A CORRESPONDENT]

TO one who has visited the various electrical exhibitions held in recent years in the chief European cities, the Exhibition now open in the city of Philadelphia might seem a little disappointing from the absence of novelty in the exhibits, though replete with objects of interest for all to whom this class of show is not familiar. As might be expected, the strong point of the Philadelphia show is electric lighting; and the building—a temporary structure erected close to the depot of the Pennsylvania Railroad Company on the west bank of the Schuylkill—presents both interiorly and exteriorly a blaze of light. The array of dynamo-machines is remarkably complete. Edison leads the way with a variety of machines, including one "Jumbo," of the same type as, but rather smaller than, the pair of machines in use at the Holborn Viaduct lighting station. There are also a large number of Weston's machines, and a very valuable exhibit by the Thomson-Houston Company. The machines of the latter company are quite unique amongst dynamos; one of them can maintain sixty arc lights on one circuit, though there are but three coils on its armature. Other dynamos are shown by Ball, Hockhausen, Van Depoele, and McTighe. There are several excellent arc lamps, possessing novelty, however, in matters of detail only. A great show of incandescent lamps is made by the Edison Company, and also by the Weston Company. The latter has some remarkable lamps with filaments sixteen inches in length prepared from a new parchment-like substance, of which samples are shown. These lamps are from 100 to 200 reputed candle power.

Electric motors are exhibited by several inventors.