George Bentham was born on the 22nd of September, 1800, at Stoke, near Portsmouth, where his parents happened to be at that time residing, in consequence of the professional occupations of his father, General, afterwards Sir Samuel, Bentham, who then held the important post of Inspector of Naval Works under the Admiralty. His mother, a lady of great ability, was the daughter of Dr. George Fordyce, F.R.S. He was the second son and third child of a family of five, all of whom he survived.

The conditions of young Bentham's early days were hardly favourable to the settled routine of an orthodox scheme of education; for he was trained by private tutors, and never went to school nor college. But although it was a life-long regret to him that he had not been subjected to the associations and discipline of school and college—to which deprivation, no doubt, a certain shyness and reserve that characterised him may be attributed—his was not a mind to run to waste even under the unsettlement of strong contrasts of life and circumstances occasioned by the migration of his father and family to Russia, and afterwards to the South of France, where the administration and control of a large estate belonging to the father were confided to the junior in his early manhood.

As a youth he was an eager student in many branches of knowledge, with a special aptitude however for the acquisition of languages: while yet a lad of six or seven years he was able to converse fluently in French, German, and Russian. Methodical habits and a capacity for close and prolonged application to any favourite study appear to have been ingrained in him from very early days, and, with his retentive memory, laid the sure foundation of his future eminence in the field of Systematic Botany. He was first attracted, as is assumed, to this branch of science by the "Flore Française" of De Candolle, the analytical tables of which, as an aid in the determination of species, appear to have had a special fascination for him—falling in with the "methodising, analysing, and tabulating ideas" which he had derived from previous study of the works of his eminent uncle Jeremy Bentham. The study of other works of De Candolle's on the structure and classification of plants, and the personal friendship and influence of that eminent botanist, strengthened Bentham's bias towards Classificatory Botany. This indeed may, from about

his twenty-fourth year onward, be regarded as his serious life's work, interrupted more or less, however, for some years by legal research with a view to a professional career, and by the services which he rendered in the preparation of his uncle's works for the press.

Mr. Bentham's first botanical work, published in 1826, was his "Catalogue des Plantes Indigènes des Pyrénées et du Bas Languédoc," the result of a careful botanical exploration of the Pyrenees, in company with the late Dr. Arnott (afterwards Professor of Botany in the University of Glasgow). To appreciate rightly this little work of 128 pages, we must compare the botanical science of that date with our present detailed knowledge of Pyrenean Botany, and of the relation of the vegetation of this region to that of other European chains. At that time there was no accurate scientific account of the Botany of the Pyrenees, and the loose practice of the authors of local floras freely allowed, on the most slender indirect evidence, admission into their enumerations of very unlikely species. But Mr. Bentham says, "Pour donner à mon catalogue une utilité plus générale que celle des simples compilations, si faciles à faire et par conséquent si multipliées malgré leur peu d'utilité, je me suis attaché à n'y admettre aucune observation, aucun synonyme que je n'ai pas eu occasion de vérifier par moi-même, ou, si je me suis écarté de cette règle, cela n'a été que très-rarement, et toujours en citant la personne de qui je les tiens." This habit of carefully scrutinizing his data he maintained to the end of his life. Besides an enumeration of Pyrenean plants this catalogue includes critical essays on several peculiarly difficult genera, especially *Cerastium*, *Helianthemum*, *Linum*, *Medicago*, *Myosotis*, and *Orobanche*.

Mr. Bentham's botanical life in England may be regarded as beginning with his association with the late Dr. Wallich in the distribution of the enormous Indian collections of that naturalist, and with his elaboration of the great natural order Labiatæ, and of the Indian Scrophulariaceæ: orders which some years afterwards he revised for the "Prodromus Systematis Naturalis Regni Vegetabilis" of his friend De Candolle. It is in these works that we may first recognise the peculiar qualities which give value to all Mr. Bentham's taxonomic work. They show an insight, of so special a character as to deserve the name of genius, into the relative value of characters for practical systematic work, and, as a consequence of this, a sure sifting of essentials from non-essentials in each respective grade. At the date of these works the broad foundations in classificatory Phanerogamic botany had, we must remember, been already securely laid; and the pressing need, supplied so precisely at the right time by Mr. Bentham, was for a systematist capable of reducing to order the number of genera which in some of the largest natural orders were still simply an unorganised mob.

Mr. Bentham published his "Labiatarum Genera et Species" in 1832–36: his "Scrophularineæ Indicæ" in 1835.

In 1829 Mr. Bentham accepted the onerous duties of Honorary Secretary to the Horticultural Society of London. The Society was, at that time, in very low water; but with his friend Dr. Lindley's assistance he rescued and brought it into "a flourishing condition, financially and scientifically, which it has never since approached." This connexion with the Horticultural Society necessarily determined somewhat the direction of his botanical work, and led him to the publication of the botanical results of the Douglas and Hartweg explorations in North and Central America and in the United States of Columbia.

In 1833 Mr. Bentham married the daughter of the late Right Hon. Sir Harford Brydges, of Boultibrooke, and settled in the following year at his late uncle's house in Queen's Square Place, whence he removed in 1842 to Pontrilas House, in Herefordshire. It was while resident here that he revised the orders Labiatæ, Scrophulariaceæ, and the Eriogoneæ for the "Prodromus," besides continuing his publication of the Guiana plants of Schomburgk, and the botanical collections of the voyage of the "Sulphur" (1844).

In 1836 Mr. Bentham made a tour with the object of visiting the principal herbaria of the Continent, and settled to hard work in Vienna in the autumn of that year. It was here that he prepared his first important work on the Leguminosæ ("Leguminosarum Generibus Commentationes"), published in 1840 in the "Annalen des Wiener Museums." He also described, in conjunction with Dr. Endlicher, the Australian novelties brought home by Baron Hügel, and worked at the Ericeæ for the "Prodromus."

In 1854, finding the maintenance of his herbarium and library too serious a charge, Mr. Bentham contemplated, on his final removal to London, abandoning botanical work and presenting his collections and books to the Royal Gardens, Kew, of which his old and most intimate friend Sir W. J. Hooker was Director. That eminent man, however, by his entreaties and by the offer of the free use of his library and herbarium, prevailed to secure to Systematic Botany the rest of Mr. Bentham's active life. Through his influence the accommodation of a private working room in connexion with the herbaria at Kew was secured for Mr. Bentham, and the course of his future life's work was finally determined by the inauguration of a series of Colonial Floras, of the model of which, the "Flora of the Island of Hong Kong"—so remarkable in the number of forms peculiar, or at that time supposed so to be, to that small island—Mr. Bentham was the author. The "Flora Hongkongensis" was published in 1861. A short time before Mr. Bentham had published, for the use of beginners, an admirable flora of the British Islands, a work in

which the species are described in simple but accurate English, and which possesses an excellent analytical *Clavis*. Here the writer of this short notice may remark upon the perfection of Mr. Bentham's descriptive work, manifest not only in its terseness, aptness, and precision, but especially in the judicious selection of diagnostic marks, and in the instinctive estimate of probable range in variation which long experience and innate genius for such work could alone inspire. In 1863 Mr. Bentham published the first volume of the greatest work of the colonial series yet given to the world, the "Flora Australiensis," based upon the collections at Kew and Melbourne, the latter annotated and transmitted with noble liberality by our Fellow Sir F. Mueller. This work was completed in seven volumes in 1870.

In 1863 Mr. Bentham accepted the Presidency of the Linnean Society, which he retained until 1874, working with head and hand as no President ever did before for the welfare of any learned society. His anniversary addresses are, in their way, masterpieces, embracing wide fields and discussing biological questions with a liberality and breadth of view surprising even to his nearest friends.

While the Australian flora was yet in progress Mr. Bentham, in conjunction with his friend Sir Joseph Hooker, entered upon the crowning work of his life, for which his long experience in systematic work had pre-eminently fitted him, the "Genera Plantarum." This occupied him, with comparatively slight interruption by such serious trifles as the elaboration of the Leguminosæ of Brazil for the great Flora of von Martius and the like, until the spring of 1883. No sooner had he completed this great work, the "Genera Plantarum," than it seemed as though he felt that his life's work had been accomplished. His strength rather suddenly gave way, his daily visits to Kew became intermittent, ceasing at last in April, 1884, and gradually becoming feebler he sank to rest, dying simply of old age, with his mental faculties bright nearly to the last, on the 10th September, 1884, within a fortnight of his 84th birthday.

With Mr. Bentham we lose a master in Systematic Botany. The excellent and interesting biographical notice of him in "Nature" by his most intimate friend Sir Joseph Hooker, of which the present writer has made free use, says "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, again, "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." The compiler of this notice, who had the privilege of association with him in the work of the Kew herbarium for twenty-five years, can most feelingly answer to the truth of this.

A Royal Medal was awarded to Mr. Bentham in 1859: he was elected a Fellow of the Royal Society in 1862. The titles of ninety papers by his own hand, and seven written jointly with other botanists, occupy nearly three pages in the Society's Catalogue of Scientific Papers. He was a Companion of the Order of St. Michael and St. George, and member or associate of almost every society in Europe, America, and Australia, which recognises biological studies.

He left no relative except a grand-niece.

D. O.

THOMAS WATSON was born in Devonshire on the 7th March, 1792, as appears from the register of his birth in the parish church of Kentisbeare, in that county. His early education was begun, during the head mastership of Dr. Malken, at the Grammar School of Bury St. Edmund's, where he was a contemporary of the late Bishop Blomfield, with whom he was always on terms of intimate friendship.

On leaving Bury school he entered as a pensioner at St. John's College, Cambridge. He graduated B.A. in 1815, when he was tenth wrangler, and in the following year was elected Fellow of his College, and became M.A. in 1818. According to a rule which then existed those Fellows of St. John's who were not in holy orders, could retain their Fellowships for a short time only. From this rule, however, certain Fellowships, one of which was set apart for the study of medicine, were exempted, and Mr. Watson held his Fellowship until his marriage in 1825, in which year he took his M.D. degree.

While at Cambridge he taught private pupils, and in 1823–24 he served the office of Junior Proctor. During his seven years' residence as Fellow of St. John's he was occasionally absent for months together; in 1819, he was a student of medicine at St. Bartholomew's under Mr. Abernethy, and in the session of 1820–21, he attended the medical classes in Edinburgh. In 1825 he married the daughter of Edward Jones, Esq., of Brackley, Northamptonshire, and commenced practice in Henrietta Street, Cavendish Square. In 1826 he was elected a Fellow of the College of Physicians, and in the following year physician to the Middlesex Hospital. In 1828, when University College was opened, Dr. Watson was appointed Professor of Clinical Medicine, and gave lectures on cases under his care in the wards of the Middlesex Hospital. This appointment he held until 1831, when, at the opening of King's College, he was appointed Professor of Forensic Medicine in that institution.

In 1830 he had the terrible sorrow of losing his wife, who died suddenly three days after the birth of their second child. In 1836 Dr. Watson succeeded the late Dr. Francis Hawkins as Professor of Medicine in King's College, and he retained that chair until the spring of 1840, when at the opening of the newly founded King's College Hospital he was called upon to resign either his office of physician to the Middlesex Hospital or his chair at King's College; and he decided to retain the former office. The resignation of his professorship led at once to a result which proved beneficial alike to Dr. Watson, to the profession, and indirectly to the public, namely, the publication of his admirable lectures "On the Principles and Practice of Physic." The lectures appeared first in the weekly numbers of the "Medical Gazette;" the first lecture was published on 20th September, 1840, and the last of the series on 23rd September, 1842. In the following year, 1843, they were collected and published in two volumes. Between that date and 1871, four large editions were called for. The publication of these lectures, admirable as they were by universal consent acknowledged to be, not less for the soundness and wisdom of their teaching than for their lucid, elegant, and scholarly style, greatly increased the reputation of their author, acquired for him the well merited title of the "Cicero of English Medicine," and led to a large and rapid increase of his practice.

In 1862 Dr. Watson, having held most of the minor offices in the College of Physicians, was elected President, an office to which he was unanimously re-elected for four successive years. The College would have gladly elected him for the sixth time, but he declined on the plea of advancing years, and at the annual meeting for the election of President in 1867 he bade the College farewell in the following characteristically graceful terms:—"It only remains that I should attempt to do that which I feel to be well nigh impossible—to embody in any form of words that I can devise the deep and inextinguishable sense of gratitude with which my mind is full for that kindness and trust which have placed me year by year on five successive occasions at the head of the College of Physicians, in other words, at the head of the medical profession in this great country. According to my estimation more than once expressed, there is no nobler position in medicine, whether I look before me and around me to the body of men from whom it comes, or backwards to the splendid list of names of those who have preceded me in the presidential chair—Linacre, Caius, Glisson, Sir William Browne, Pitcairn, Sir George Baker; these, to go no later, are but a few of the eminent men and sound scholars with whom it may well be deemed a proud distinction to have had one's name in any way associated. But besides this great and repeated honour—the greater because so repeated—I have much else to thank you for. I have to acknowledge your indulgence towards

the many shortcomings of which I am but too conscious. I have to express my thanks for your constant support and counsel in all difficulties, for your unvarying courtesy and deference, for the friendships which my official intercourse with you has formed or strengthened, and most especially for that recent and touching evidence of your approbation and esteem shown by your wish to possess within your walls some pictorial remembrance of my unworthy person. Of this high and generous compliment I can never, while life and reason remain to me, be other than most gratefully, and I hope pardonably, proud. Further, I have to rejoice that the happy lustrum during which I have presided over your affairs has been harmonious and peaceful—disturbed by no unseemly quarrels or serious differences among us—stained by no scandal arising within our proper body, and productive through your exertions and self-sacrifices of something, at least, of benefit to the common weal. If I find anything to regret it is that I have not taken larger advantage of the opportunity which you have confided to me of promoting the interests of the College, and of our useful and noble profession. Still, I must cherish the hope that the College has suffered no abatement of its ancient dignity and renown through my occupation of the office which I now respectfully render back into your hands. And so without encroaching further upon your time, and in redemption of the pledge which I gave you last year, I bid you, as your President, one and all a cordial, affectionate, and final farewell."

The "pictorial remembrance" to which he alludes is an admirable likeness by his old friend, George Richmond, which was subscribed for by the Fellows, and which is now among the most cherished treasures of the College. A replica is in the possession of the present baronet, and the picture has been most successfully engraved by the great and venerable artist Samuel Cousins.

Dr. Watson was appointed Physician Extraordinary to the Queen in 1859, and in 1870 one of the Physicians in Ordinary. On the 9th December, 1861, he was summoned to attend the Prince Consort at Windsor in consultation with Sir James Clark, Sir Henry Holland, and Dr. (now Sir William) Jenner, and his attendance continued until the lamented death of the Prince on the 14th December.

In 1866 Dr. Watson was created a baronet, the honour having been conferred upon him, as the then Prime Minister, Lord John Russell, informed him, by the express desire of Her Majesty.

Among other distinctions which were conferred upon him may be mentioned the following. He was elected an Honorary Fellow of his old College at the same time as the late Sir John Herschel. He was made Hon. D.C.L. Oxford, in 1862; Hon. LL.D. Cambridge, in 1864; and Hon. Fellow of the King's and Queen's College of Physicians, Ireland. In 1859 he was elected a Fellow of the Royal

Society. For many years he was a most active and influential member of the Council of King's College, London. During the session 1857–58 he was President of the Pathological Society. In 1868 he became the first President of the Clinical Society, and in his inaugural address he impressed upon the Society, with his customary good sense and grace of style, the supreme importance of an endeavour to obtain "more exactness of knowledge, and therefore more direct and intelligent purpose, and more successful aim in what is really the end and object of all our labours—the application of remedies for the cure and relief of disease."

During the last ten years of his life he had retired from the active practice of his profession, but he continued to take great interest in all its concerns. His three latest essays on Zymotic Diseases, on Hydrophobia, and on Small-pox and Vaccination, were republished in a small volume in 1879, when he was on the verge of his ninetieth year; yet in these latest products of his pen there is no evidence that age had dimmed his intellect or lessened his command of graceful and expressive language.

After Sir Thomas Watson had retired from the Chair of the College of Physicians, he always attended the annual meeting for the election of President. The last occasion on which he appeared was a few months before his death, at the second election of Sir William Jenner to the Presidency. That meeting was rendered memorable from the circumstance that, in the absence of the Senior Censor, Sir Thomas Watson was called upon, as the senior Fellow present, to deliver to the newly elected President the insignia of his office; and when he got up to walk towards the President's chair the whole of the assembled Fellows rose as one man to show their respect and affection for their venerable ex-President. Notwithstanding his great age he enjoyed his usual good health, spending the greater part of the summer and autumn of 1882 with his daughter and his son's family, partly at the sea-side, and partly at his son's house at Reigate. On Sunday, the 22nd October, soon after attending the morning service at Reigate Church, he was seized with slight paralysis of the left side. He calmly remarked to a medical friend who visited him soon after, "this is the beginning of the end," and so it proved. The paralytic symptoms soon increased and confined him to his bed. He retained his consciousness until within the last two days of his life, though his power of speech had latterly become much impaired. At length, on the 11th December, he sank into a slumber, and so, near midnight, came the final rest for which he had longed and prayed.

Thus passed away one of the wisest and best of men, and one who, by universal consent, was regarded as the most complete illustration of the very highest type of a physician. His own lectures

and public addresses afford the best and fullest illustration of his mind and character; and that he taught no less by example than by precept was known and acknowledged by all who had the privilege of his acquaintance. He was, in fact, a living embodiment of the principles which he so eloquently expounded in his lectures.

One of his most remarkable and admirable characteristics was his freedom from prejudice, and the judicial impartiality with which he weighed and considered any facts or arguments which might be adduced in opposition to principles and doctrines which he had adopted and publicly taught. A writer in the "British Medical Journal" says of him: "The opinions which he formed were always provisional—formed upon the best evidence then available, but subject to revision. The last edition of his celebrated lectures testifies to his rare gift of judicial impartiality, and to the admirable candour and philosophic modesty with which he revised and altered the opinions of earlier years, and the unfaltering courage with which he avowed such changes of opinion. Among the most notable instances of such changes were the new doctrines which he accepted with regard to the theory of the change of type of disease and the pathology of cholera. In both instances he had watched with careful study the progress of medical knowledge, and in neither did he hesitate at the close of the controversies to which they gave rise, to declare himself convinced in a sense contrary to his former opinion, and to set forth with the utmost clearness and graceful simplicity the new conclusions to which he had been led."

We have it on the best authority that when one of his medical friends reproached him for having, in the last edition of his lectures, adopted and given his sanction to so many novel doctrines, his reply was, "Although I am advanced in years" (he was then nearly eighty) "I hope I am not too old to learn;" and so to the very last he continued to take a keen interest in the progress of medical science, and the improvement of medical practice.

G. J.

Robert Alfred Cloyne Godwin-Austen was the eldest son of the late Sir Henry E. Austen, of Shalford House, near Guildford, a gentleman who was for some time an officer in the Household of William IV, and received the honour of knighthood. The subject of this notice was born at his father's house on the 17th March, 1808.

Robert A. C. Austen, as he was then called, was sent to a school situated at Midhurst, in Sussex, which at that time had a very high reputation. This school, which was an ancient foundation, had for its head-master Dr. Bayley, an Oxonian of great classical erudition, who had been an assistant-master at Winchester, and conducted the establishment on the plan of the great public schools. It is a remark-

able circumstance that Charles Lyell had some time before been educated in the same school. If we may judge, however, by the amusing sketch given in Lyell's Autobiography ("Life and Letters," 1881) of the rough and almost brutal system adopted in the school, there can have been nothing in the studies, the associations, or the influences of the school at all calculated to foster that love of natural science which became so conspicuous in the after lives of both Lyell and Austen. After spending some time at Midhurst, Robert Austen went to France, and in a semi-military school there laid the foundation of that knowledge of the French language and its literature which proved so useful to him in his subsequent scientific labours.

The career of young Austen at Oxford, where he was next sent, must have commenced somewhat early, for before he had reached the age of twenty-two he had taken his degree and been elected a Fellow of Oriel College. At Oxford he was, like Lyell, a pupil of Buckland's, and under his persuasive influence imbibed that passion for geological study which henceforth became the distinguishing feature of his life.

Destined by fortune for the life of an English country-gentleman, Robert Austen in 1830 became a student of Lincoln's Inn, and the knowledge of law which he there acquired was doubtless of great service to him during after years in the discharge of his duties as a justice of the peace. But it is clear that at this time Austen's studies were not entirely devoted to the law. At Lincoln's Inn he met Lyell, then just returned from his geological explorations in the south of Europe, and engaged in the completion of the first volume of his "Principles of Geology;" Leonard Horner, then Warden of the London University, and Murchison were also resident in London; and on the 19th of March, 1830, Robert Austen, introduced by these three friends, was elected a Fellow of the Geological Society. At that time Sedgwick was President of the Society, and De la Beche, Whewell, Greenough, and the three friends already mentioned were among the most active Members of its Council. In listening to the papers which described the numerous and important geological discoveries of that period, and to the debates, always animated and instructive, often amusing, and sometimes stormy, which followed the reading of those papers, Robert Austen doubtless increased that knowledge of the infant science, the foundation of which had been so well laid by the teachings of Buckland.

In 1833 Robert Austen was married at Teignmouth to Maria Elizabeth, the only daughter, and afterwards the heiress, of the late Major-General Sir Henry Thomas Godwin, K.C.B. This officer at a later date, namely, between the years 1851 and 1853, commanded the Burmese Field Force during the campaigns which resulted in the addition of the Province of Pegu to our Indian possessions. On the

death of General Sir Henry Godwin, in October, 1884, Robert Austen obtained by Royal licence permission to add the name of Godwin to that of Austen.

In 1834 Austen went to reside at Ogwell House, near Newton Abbot, Devonshire. Here he received frequent visits from Sedgwick and his other geological friends. No better centre for study could have been selected by the young geologist. The richly fossiliferous Devonian limestones, the outliers of Cretaceous strata, and the Tertiary deposits of Bovey Tracy, were all within easy reach, and as proof of the good use he made of his opportunities it may be mentioned that De la Beche entrusted to him the construction of portions of the Devonshire map, while Phillips found in the collection of Ogwell House many of the choicest specimens figured in his "Palæozoic Fossils of Cornwall, Devon, and West Somerset." Between the years 1834 and 1840 a number of valuable papers dealing with the district in the West of England, where he had gone to reside, were read by Robert Austen to the Geological Society, and published in their Proceedings and Transactions.

Returning to his native county in 1838, Robert Austen, after a brief residence at Shalford House, went to live at Gosden House, and subsequently at Merrow House, both situated near Guildford. At a later date, 1846, he removed to Chilworth Manor, in the same county. Here he was within an easy distance from London, and was able to take an active part in the work and management of the Geological Society. Between the years 1841 and 1876 he was frequently a Member of the Council; in 1843–44, and again in 1853–54, he was Secretary, and between 1865 and 1867 he acted as Foreign Secretary of the Society. Although he was frequently nominated Vice-President, it was a subject of regret to all his geological friends that he could not be induced to accept the Presidency. In 1849 he became a Fellow of the Royal Society.

Upon Austen's return to his native county of Surrey, he commenced that series of careful researches on the geology of the South-East of England, the results of which were laid before the Geological Society between the years 1843 and 1853, and did so much to extend our knowledge of the Wealden, the Neocomian, and the Cretaceous systems. During the same decade he spent much time in yachting, always making use of the opportunities afforded for pursuing his favourite studies, and in these he was encouraged and assisted by his friend and frequent companion Edward Forbes. During these excursions he made the observations which were embodied in a series of remarkable and suggestive essays on the valley of the English Channel and the drift of its shores, on the geology of the Channel Islands, the Boulonnais, and other parts of France. Upon Forbes' death in 1854, Austen, acting as his literary executor, completed his two unfinished

works, "The Tertiary Fluvio-Marine Formation of the Isle of Wight," and "The Natural History of the European Seas."

High as the reputation of Godwin-Austen (for so we must henceforth call him) deservedly was as a patient observer, an accurate describer, and a close reasoner, he now began to give proof that his abilities and sympathies were not confined to the narrower sphere in which he had first won distinction. His versatility of mind, his capacity for doing work of a much higher order and for following out the most difficult lines of philosophical investigation, began to be displayed in a series of essays which have justly earned for him the title of the "Physical Geographer of bye-gone periods." The many-sidedness of his mind was exhibited, not only in the circumstance that he was able to complete Forbes' Essay on the Distribution of Marine Forms of Life, but by the fact that in 1840 he read before the Geological Society a remarkable and suggestive palæontological memoir; the views which he at that time enunciated on the zoological position of the extinct forms of Cephalopoda have perhaps not yet received from naturalists the attention which they deserve. At the British-Association meeting at Birmingham in 1849 we find him treating with great ability two difficult questions of Botanical Morphology.

Mr. Godwin-Austen's various studies had led him to consider carefully the conditions under which different geological deposits were formed. Long ago he threw out the suggestion that the Old Red Sandstone and the Poikilitic strata are of lacustrine origin; his interesting essays on the occurrence of blocks of granite and coal embedded in the midst of the chalk exhibit the same prevailing tendency of his speculations. Even before the year 1850 he had undertaken to write the "Geological History of the European Area," and he also contemplated the possibility of preparing an atlas exhibiting the distribution of land and water at different geological periods. It is not difficult to gather from some of his later essays that in the course of time he became convinced of the impossibility of performing such a task in a manner which would have satisfied his accurate and critical mind; but at this time a problem fortunately presented itself to him, which his extensive and minute knowledge of the geology of Southern Britain, Northern France, and Belgium, and his powers of insight and generalisation admirably fitted him to grapple with.

That a ridge of palæozoic, and possibly coal-bearing, rocks extends beneath the Secondary and Tertiary strata lying beneath the Mendip Hills and the Ardennes had been suggested with more or less distinctness by Buckland, Conybeare, and De la Beche in this country, and by De Beaumont, Dufrenoy, and Meugy on the Continent. But in his famous essay "On the Possible Extension of the Coal-measures

beneath the South-Eastern part of England," which was laid before the Geological Society in 1854, Godwin-Austen not only made the subject especially his own, and exhibited his exceptional ability for dealing with geological problems of the greatest intricacy, but he accomplished what was perhaps the highest service to science at that time, by convincing those who had not paid special attention to the subject, that geology was now entitled to take its place in the family of sciences, and was no longer, as the world generally regarded it, a mass of crude theories and baseless speculations. When, in the following year, a deep boring at Kentish Town demonstrated the accuracy of Godwin-Austen's reasonings, and established the truth of his conclusions, it was felt that lustre had been reflected upon the science, no less than upon its able votary.

During his later years, Godwin-Austen was prevented by ill-health from taking so constant and active a part in the management of the Geological Society as formerly. His devotion to science was, however, unabated. Almost every year he accompanied a party of geological friends on some Continental tour; and several of these excursions gave rise to thoughtful and suggestive essays. In 1862 he received from the Geological Society the Wollaston Medal. He also completed the revision of the south-eastern portion of the Greenough Geological Map of England and Wales, for the second edition, which was published in 1865. In 1868, at Norwich, he filled the Chair at the Geological Section of the British Association, dealing in a characteristic address with the geological history of the Basin of the North Sea. At the Brighton meeting in 1872 he occupied the same position, and discoursed upon the history and relations of the Wealden deposits.

In 1872, after the death of his father, Godwin-Austen went to reside at Shalford House. In spite of physical infirmity, he took an active part in the preparation of the Report of the Coal Commission, of which he was a member, and in the movement which resulted in the experimental sub-Wealden boring at Battle. He was almost to the last an energetic and useful member of the magisterial bench and of the county-boards of his native district. On the 25th November, 1884, he passed away, after a protracted illness, his death occurring in the house of his birth, the place where he had spent the earliest and latest years of his active and useful life.

Among his numerous family several sons have distinguished themselves in the military profession, and his eldest son, Lieutenant-Colonel Godwin-Austen, F.R.S., availing himself of opportunities of scientific study during many years of work upon the Topographical Survey of India, has made large contributions to our knowledge of the geology and zoology of that country.

J. W. J.

JOHN GWYN JEFFREYS was born on the 18th of January, 1809, at Swansea, where his great grandfather, his grandfather, and his father had successively practised as solicitors. His father, who had occupied a leading position in the town, died in 1815, leaving four young children, of whom the subject of this notice was the eldest. He received the chief part of his education at the Swansea Grammar School, in which he finally attained the place of "head boy," after a long competition with his rival. Having early begun to collect shells on the shore of Swansea Bay, and having been encouraged in the study of Conchology by Mr. Griffiths (Master of the Grammar School), Mr. Dillwyn, and other friends, he thenceforth made it a regular pursuit, at first as a recreation, and in later years as his chief occupation. Articled at the age of seventeen to one of the principal solicitors of his native town, he laboured diligently at his law studies, but devoted his autumnal holidays to dredging along the coast. In 1829, when only nineteen years of age, he presented to the Linnæan Society a "Synopsis of the Pulmonobranchous Mollusca of Great Britain," which was published in its Transactions; and in the following year he was elected a Fellow. In 1836 he attended the meeting of the British Association at Bristol;* and there first met Edward Forbes, with whom he afterwards formed an intimate friendship, which became valuable to both. For while Gwyn Jeffreys made many important contributions to Forbes and Hanley's classical work on the British Mollusca, his own scientific horizon was enlarged by intercourse with the most philosophic and far-seeing British naturalist of his time. Gwyn Jeffreys continued for many years to be one of the most constant attendants at the Annual Meetings of the Association; serving as Local Treasurer at its first meeting at Swansea in 1848, as President of the Biological Section at its Plymouth meeting in 1877, and as Vice-President of the Association at its second meeting at Swansea in 1880. He was elected a Fellow of the Royal Society in 1840, and served on its Council in the years 1869—1871.

Having entered into an advantageous partnership as a solicitor in Swansea, and married a daughter of R. J. Nevill, Esq., of Llangennech Park, Carmarthenshire, he applied himself assiduously to the business of his profession; but still carried on his conchological researches by systematic dredging during his vacations, at first in a row-boat, but afterwards in a yacht, which he purchased for the purpose of extending his explorations to the northern part of the British seas,

* This Bristol meeting was also the first attended by the writer of this notice, who believes that he is now the only scientific representative of the large gathering there assembled. In that gathering his old fellow-student, Edward Forbes, was always personally conspicuous, the question being continually asked, "Who is the philosopher with the long hair?"

and of working down to greater depths. His inquiries early led him to suspect that the marine Molluscan Fauna of the present time is the direct continuation of that of the later Crag period; and this idea received strong confirmation from his finding many Crag shells, supposed to have become extinct, still living in the seas around Shetland and the Hebrides.

After having published, from time to time, numerous short papers on the results of his explorations, Gwyn Jeffreys determined to bring out a systematic treatise on British Conchology, not in rivalry with the elaborate work of Forbes and Hanley, but on a less costly scale, generic types only (instead of specific) being illustrated. The first volume of this treatise appeared in 1862, and the fifth and last in 1869. He had previously removed from Swansea to London; having been called to the Bar in 1856, with the view of practising in the Court of Chancery and before Parliamentary Committees. In 1866, however, he retired altogether from legal practice, with the view of devoting his whole time to scientific work, and soon afterwards transferred his residence to Ware Priory, Herts. There, whilst taking an active interest in the business of the county (of which he became J.P., then D.L., and in 1877 High Sheriff), he continued his conchological studies; and, with his estimable and accomplished wife, gave a hospitable reception to his numerous scientific friends of all countries.

Gwyn Jeffreys's dredgings, having been hitherto prosecuted on what is now regarded as the submerged portion of the Continental platform, had not been carried deeper than 200 fathoms. But the feasibility of exploring much greater depths having been demonstrated in the experimental cruise of the "Lightning" in 1868 (when a successful haul was brought up from 650 fathoms), the "Porcupine" Expedition was next year fitted out expressly for the prosecution of still deeper explorations. As both Dr. Carpenter and Professor Wyville Thomson—who had been the joint promoters of this research—were precluded by their official duties from taking charge of the work during the earlier part of the season, they were very glad to avail themselves of Gwyn Jeffreys's offer to superintend it; and the results proved in every way satisfactory. During the first cruise the dredge was successfully worked at the then unapproached depth of 1476 fathoms, thus preparing the way for the great exploit of the expedition, the 2435 fathoms' dredging in the second cruise. Gwyn Jeffreys's Report of the First Cruise ("Proc. Roy. Soc.," Nov. 18, 1869, vol. 18, pp. 415—423) mentions, among the most remarkable novelties of his deepest dredgings, the singular Clypeastroid, now known as *Pourtalesia Jeffreysi*,* and the beautiful little *Orbitolite*

* When this was first brought up, it was supposed to be an entirely new form. On the return of the Expedition, however, Professor Wyville Thomson learned that

disk, to which (on account of its extreme tenuity) Dr. Carpenter has designated *O. tenuissima*. Both these types have recently been made the subject of special monographs; the former by Professor Lovén,* who characterises it as "the most extraordinary Echinoid hitherto known;" and the latter by Dr. Carpenter,† who finds in it the complete key to the pedigree of the Orbitoline type, and makes it the basis of a Study in the Theory of Descent. The total number of additions made by this expedition to British shells (partly of species previously known, but new to British seas,—partly of species previously known only as fossils,—and partly of species altogether new to science) was so great, that Gwyn Jeffreys spoke of them as requiring for their description an additional volume of his Conchology. This, however, he never brought out; but communicated to the Zoological Society his descriptions of new types.

In the following year (1870) Gwyn Jeffreys again undertook the charge of the earlier part of the "Porcupine" deep-sea explorations; which, it was arranged, should extend from Falmouth to the Straits of Gibraltar, along the eastern border of the Atlantic basin. Although his dredgings were not carried on at as great depths in this cruise as they had been in the previous year, yet their results were not less interesting. Thus, in one haul, at 994 fathoms off the coast of Portugal, no fewer than 186 species of shells were brought up, of which 71 were undescribed, whilst 24 were only known as fossil, less than half having been previously described as existing species. In another day's dredging in the same neighbourhood, at from 600 to 1095 fathoms' depth, several rare Siliceous Sponges and Echinoderms were found; but the great prize was a beautiful new species of *Pentacrinus* —the first of that type ever met with in temperate seas—of which a full account has recently been given by Dr. P. H. Carpenter,‡ under the specific designation *Wyville-Thomsoni*, assigned to it by its discoverer.

The prevalence of northern forms in this deep-sea Fauna confirmed Gwyn Jeffreys's previous views as to the southward extension of that Fauna into the Mediterranean; and perceiving the improbability that in the existing condition of the Strait of Gibraltar any immigration of bottom crawlers could take place, he threw out the suggestion in

a similar generic type had been obtained in the previous year in the dredgings carried on by Count Pourtales in the Gulf Stream, and had been named by Professor Alexander Agassiz *Pourtalesia miranda*. As the "Porcupine" type proved specifically different, Professor W. Thomson designated it *P. Jeffreysi*.

* "Kongl. Svenska Vetenskaps Academiens Handlingar," 1883.

† "Phil. Trans.," vol. 174, p. 551.

‡ "Report on the *Crinoidea* collected during the Voyage of H.M.S. 'Challenger,'" Part I, pp. 313–321.

his report of this cruise ("Proc. Roy. Soc.," Dec. 8, 1870, vol. 19, pp. 152—161), of a former communication between the Bay of Biscay and the Gulf of Lyons, probably in the later Tertiary epoch; nearly in the line of the Languedoc Canal.* On giving over the charge of the Mediterranean cruise to Dr. Carpenter, Gwyn Jeffreys proceeded to Sicily *viâ* Malta, for the purpose of examining the shells found in the later Tertiaries of Sicily and Italy, preserved in the collections at Catania, Messina, Palermo, and Naples; and of comparing these with his deep-sea types.

In 1871 he visited the United States, and, through the kindness of Professor Spencer Baird, was enabled to take part in a dredging cruise off the coast of New England. When the last Arctic expedition was fitted out in 1875, and an additional ship, the "Valorous," was provided for the conveyance of stores as far as Disco Island in Baffin's Bay, Gwyn Jeffreys undertook the superintendence of the deep-sea explorations, for which provision was made on her return voyage. His report on this cruise ("Proc. Roy. Soc.," June 15, 1876, vol. 24, pp. 623–636, and vol. 25, p. 92), which includes contributions from the Rev. A. M. Norman, Dr. Macintosh, Dr. Carpenter and Professor Dickie, shows that although (in consequence of an accident to the ship) the work done was less complete than had been hoped, results of great interest, especially in regard to geographical distribution, were obtained.

In 1880, on the invitation of Professor Milne-Edwards, Gwyn Jeffreys joined the Expedition fitted out for the deep-sea exploration by the French Government, the work of which was prosecuted in the Bay of Biscay and the neighbouring portion of the Atlantic basin. After that date, though constantly occupied in the prosecution of his Conchological studies, he did not again engage in marine research.

On the death of his wife in 1881, Gwyn Jeffreys removed from Ware Priory to Kensington, where he passed the last years of his life. His health continued good, and the advance of years seemed but little to impair his usual vigour. On the evening of January 23, having just completed his 76th year, he attended a lecture given at the Royal Institution by his son-in-law, Professor Moseley, of Oxford; but on the following morning was struck down by apoplexy, and died a few hours afterwards.

While possessing an excellent general acquaintance with Marine Invertebrate Zoology, Gwyn Jeffreys's scientific position rested on the thoroughness of his knowledge of Conchology, in which department he came to hold a highly distinguished rank. He had a keen

* In considering this suggestion, however, it should be borne in mind that all marine Mollusca have free-swimming larvæ; and that, as these live near the surface, they would be liable to be carried into the Mediterranean by the Gibraltar current.

eye for minute distinctions, a methodical habit of mind, scrupulous exactness, and an excellent memory. He spared no pains to clear up a doubtful point, and never satisfied himself with imperfect knowledge, where there was more to be acquired. Continuing to believe in the permanence of species, and opposing the doctrine of evolution, he nevertheless fully recognised the frequency of a wide range of variation; and his collection, instead of being restricted to type-forms, contained many interesting series of varietal modifications. How important is the careful and systematic study of Shells, in relation to the existing geographical distribution of Molluscan species (both terrestrial and marine), and, through this, to the elucidation of the past history of the globe, would not need to be here pointed out, if it were not that among the present generation of naturalists such study finds comparatively little appreciation. It should never be forgotten that (to go no further back in the history of Geology) it was entirely upon the Conchological comparisons of Deshayes, that Lyell founded his division of Tertiary formations into Eocene, Miocene, and Pliocene —a division which has stood the test of fifty years' thorough scrutiny. And it will not be for the advantage of Science, if Conchology should ever cease to attract competent workers. No better model could be set forth of what Conchological work should be, than that which is presented in Gwyn Jeffreys's life-long labours, whose results are contained in the fifty-five years' series of papers (considerably exceeding 100 in number) which he communicated to the Societies of which he was a Fellow, and to the pages of scientific Journals.

It should not be left unmentioned that Gwyn Jeffreys's excellent business-habits caused his financial services to be sought by the Linnæan and Geological Societies, the treasurership of both of which he held for several years; and that as treasurer also of the Royal Society Club, his social qualities did much to promote its prosperity.

W. B. C.

John Christopher Augustus Voelcker was born on September 24th, 1822, at Frankfort-on-the-Maine. He was the fifth son, in a family of seven sons and one daughter, of Frederick Adolphus Voelcker, a merchant of that city, who died when his fifth son was only eleven years old. During his years of boyhood, Augustus suffered from very delicate health, which greatly retarded his early education. This he obtained at a private school in the town. About the age of twenty-two he went to the University of Göttingen, chiefly for the purpose of studying chemistry under, and of working in the laboratory of, Professor Wöhler.

At Göttingen he took the degree of Doctor of Philosophy, in 1846, the subject of his inaugural dissertation being the composition of tortoiseshell.

He also appears to have devoted his attention to the investigation of some of the compounds of manganese, and of some other metals, on which, in 1846, he published papers. In the same year he also published a paper on the occurrence of mannite in the roots of *Triticum repens;* and one on the analysis of poppy-oil.

It was also whilst he was still at Göttingen, that Professor Mulder, the distinguished Dutch chemist, paid a visit to Wöhler at that place; and, on Wöhler's recommendation, Mulder engaged Voelcker as his principal assistant, who accordingly returned with him to Utrecht, where he remained for some time. Dr. Voelcker assisted Mulder in his various investigations, and it was doubtless this work, and the connexions into which it led him, that gave a direction to his future studies and labours.

At Utrecht, Dr. Voelcker commenced the investigation of some of the albuminous compounds, and he continued the inquiry from time to time for some years afterwards; but the only record of this work which has come under my notice is in papers read at the meetings of the British Association for the Advancement of Science: in 1855—"On Caseine, and a Method of Determining Sulphur and Phosphorus in Organic Compounds in one Operation;" and in 1857—"On the Proportion of Organic Phosphorus in Legumine."

During Dr. Voelcker's stay at Utrecht, Professor James F. W. Johnston, of Edinburgh, who was Chemist to the Agricultural Chemistry Association of Scotland, afterwards incorporated with the Highland and Agricultural Society of Scotland, paid a visit to Mulder, and he induced Dr. Voelcker to go to Edinburgh to take charge of the laboratory of that Association. He went to Edinburgh in February, 1847, and remained there until August, 1849; excepting that from November, 1848, to February, 1849, he spent at Durham, at the University of which place Johnston was Professor of Chemistry, and for whom he lectured and worked in the laboratory there.

At Edinburgh the whole responsibility of the position, both as analyst and consulting chemist, frequently devolved upon him, Professor Johnston spending much of his time at Durham, or being otherwise engaged. It was under these circumstances that he first gained experience in the requirements of practical agriculture; for it was here that for the first time he found himself constantly in communication with practical farmers, learning from them their wants, and investigating and advising on the problems they brought before him for his solution. Trained in analysis in the best schools of the time, himself an acute observer, and having an eminently practical turn of mind, the responsibility of his position greatly tended to develop his powers, and to give him that self-reliance which was his characteristic through life, and which, thoroughly sustained by knowledge, industry, and conscientiousness, contributed in no small degree

to his success as a teacher, a scientific adviser to the practical farmer, and in his profession as a Consulting Chemist generally.

In August, 1849, after spending about two and a half years at Edinburgh, Dr. Voelcker was appointed Professor of Chemistry at the Royal Agricultural College, Cirencester; and from this time began a still more active life of lecturing, writing, and experimenting. His income at the College was small, but he supplemented it by writing, and by analytical work. The articles on chemical subjects in "Morton's Cyclopædia of Agriculture," from the letter M to the end, were contributed by him.

It was about, or soon after this time, that he contributed papers on various subjects of investigation to some Scotch scientific and agricultural journals. For example, to the "Edinburgh New Philosophical Journal," "Analysis of the Anthracite of the Calton Hill, Edinburgh;" to the "Annals and Magazine of Natural History," "On the Chemical Composition of the Fluid in the Ascidia of Nepenthes;" "On the Composition of the Ash of *Armeria maritima* growing in Different Localities, with Remarks on the Geological Distribution of that Plant, and on the Presence of Fluorine in Plants;" "On the Watery Secretion of the Leaves and Stems of the Ice Plant." To the "Transactions of the Highland and Agricultural Society of Scotland," "The Chemical Composition of the Seed of *Chenopodium quinoa;*" "Composition of House Coal Soot;" "On Artificial Manures in General and Bone Manure in Particular;" "The Effects of Burnt Clay as a Manure;" "On the Comparative Value of White Scottish and Black English Oats;" and "On the Composition of Rice Meal."

In 1852 Dr. Voelcker went to Frankfort to be married, and he returned to Cirencester with his wife. Mrs. Voelcker, four sons and one daughter, survive to mourn his loss.

In 1855 Professor Voelcker was appointed Consulting Chemist to the Bath and West of England Agricultural Society, and he held the office up to the time of his death, a period of nearly thirty years. In this capacity he gave lectures at various places from time to time, instituted field and other experiments, conducted much laboratory investigation, and contributed papers to the Journal of the Society.

In 1852 his first paper in the "Journal of the Royal Agricultural Society of England" appeared. He also contributed one in 1855, one in 1856, and one in 1857. In that year, 1857, he was appointed Consulting Chemist to the Society; and from that time to the date of his death, about twenty-seven years, he contributed one or more papers to every half-yearly number of the Society's Journal.

For about six years after his appointment as Consulting Chemist to the Society, he still retained his Professorship at Cirencester; and he availed himself of the opportunities which the College farm

afforded for carrying out various experiments at the homestead and in the field, which were supplemented by collateral laboratory investigations. He had already commenced an investigation into the composition of farmyard manure, and as to the changes it undergoes under various circumstances, such as in contact with different soils.

From the results obtained in these inquiries, he was led to investigate the absorptive powers of different soils of known composition; and he showed that the most important soluble constituents of manures are rendered less soluble, but not quite insoluble, when applied to the soil.

In the course of his inquiries, he instituted numerous field experiments with different manures, on different crops, on the College farm; and he also endeavoured to enlist the co-operation of intelligent practical farmers in different localities in the conduct of field experiments.

In 1878, he became responsible for the conduct of the systematic series of field experiments which, in the previous year, had been commenced at Woburn, on behalf of the Royal Agricultural Society, at the instance, and at the cost, of His Grace the Duke of Bedford. To the last he took the deepest interest in the management and in the results of these experiments.

Very soon after he had devoted himself to agricultural chemistry, Dr. Voelcker commenced to pay attention to the various aspects of the subject of the feeding of animals. He had not the same facilities, either for conducting feeding experiments himself, or for arranging with others to conduct them, that he had in case of field experiments with manures. He, however, not only wrote and lectured on the chemistry of the feeding process, but he analysed a very large number of food stuffs, both home-grown and imported. He determined the composition, in much detail, of most of the crops grown on the farm as food, of new plants proposed to be grown as food-crops, of hay, of various descriptions of straw, of certain refuse matters, and so on; discussing at length their actual and comparative feeding value, as deduced from the results of his laboratory investigations.

But perhaps the most essential service he rendered, in connexion with the composition and value of food-stuffs, was by his most elaborate investigations, microscopic and chemical, of the various matters entering into the composition of feeding-cakes, by his numerous analyses of the various cakes themselves, and by his fearless and persistent exposure of what he considered injurious, or against the feeder's interest, in the manufacture or composition of such articles, whether resulting from carelessness, ignorance, or fraud.

The subject of Milk and the Dairy, which is one of rapidly growing importance to the British farmer, was early taken up by Dr. Voelcker,

his first paper on the subject appearing in 1861. In connexion with this subject he has executed a great amount of analytical work, made many experiments in dairy management, given several lectures, and published not a few papers recording existing knowledge, and the numerous results of his own investigations.

In all his work and publications, the thorough manner in which he sought to elucidate the connexion between practice and science is conspicuous. Many other questions of agricultural interest than those which have been referred to, engaged his attention, such as—the properties of soils in other aspects than those which have been mentioned; the composition and value of town sewage, and also of earth-closet manure; the chemistry of sugar-beet; and the chemistry of drinking-waters.

From time to time Dr. Voelcker contributed papers to the Chemical Society, and in some cases he gave the same results in less technical form in the "Journal of the Royal Agricultural Society." Of those communicated to both journals, the one involving by far the largest amount of laboratory investigation, and leading to the most important conclusions, both practical and scientific, related to the composition of the waters of land-drainage, and to the loss of plant-food thereby.

He was elected a member of the Chemical Society in 1849; was several times a member of the Council of the Society; and was one of its Vice-Presidents at the time of his death. He was elected a Fellow of the Royal Society in 1870. He was one of the founders, and one of the first Vice-Presidents, of the Institute of Chemistry of Great Britain and Ireland, established in 1877.

On coming to London in 1863, in addition to his duties as Consulting Chemist to the Royal Agricultural Society, Dr. Voelcker commenced private practice as a Consulting Chemist, and very soon acquired considerable repute in this capacity, and gained a very extensive practice, not only in connexion with agriculture, but with many other industries, being frequently called upon to give evidence before Parliamentary Committees or Royal Commissions.

There can be little doubt that his life was shortened by overwork. On Sunday, December 23, 1883, he had an attack of paralysis, not severe, but such as to indicate that absolute rest was essential for some considerable time; the Council of the Royal Agricultural Society accordingly requested him to devote six months to the restoration of his health. As soon, however, as he felt some recovery of strength, it was impossible to restrain him from returning more or less to his active duties. He had no return of paralysis, but in August, 1884, symptoms of heart disease, with other complications, supervened. From this time he never really rallied, and he died on the morning of December 5. For some weeks he had suffered intensely; and not

many days before his death, his sufferings were indeed very painful to witness. His mind was, however, perfectly clear; he fully recognised his position, and was entirely resigned to it. He passed away quietly, and without any pain towards the last.—J. H. G.

Charles Adolphe Wurtz was born at Wolfisheim, a village near Strasburg, on the 26th November, 1817.

His father, Jean Jacques Wurtz, the Protestant minister at Wolfisheim, was a man of considerable literary culture, but of a somewhat gloomy disposition. His mother, Sophie Kreiss, was singularly cheerful and sweet-tempered, had a sound clear head, and was most conscientious in the discharge of her duties in life. She was the intimate friend and confidant of her son until her death, which took place quite recently, namely in 1878.

Young Adolphe spent his early childhood at Wolfisheim, and he probably owed to his country life as a child the robust health which he enjoyed in after life.

As Wolfisheim was not many miles from Strasburg, the Wurtz family, although living in the country, were by no means isolated, and had frequent opportunities of enjoying the society of their various friends and relations. Besides other friends, Madame Wurtz's two brothers, Théodore and Adolphe Kreiss, would often come out to spend Sunday at the parsonage, and the intelligent conversation of these two distinguished men probably contributed in no small measure to the moral and intellectual development of young Wurtz.

In the year 1826 Jean Jacques Wurtz was appointed to the church of St. Pierre-le-Jeune, in Strasburg, and Adolphe now joined the classes of the Gymnase Protestant, a school of secondary instruction, founded by Jean Sturm at the period of the Reformation.

As a schoolboy Adolphe Wurtz did not specially distinguish himself. During the eight years he attended the Gymnasium he obtained several prizes for diligence, one for geography, one for memory and elocution, besides mentions for history and geography, for Latin and Greek translation, mathematics, and French verse. He appears to have worked industriously and steadily at the various subjects taught him, but not to have particularly distinguished himself in any one. Hence it is not surprising that his father, with his morose disposition, should on more than one occasion have told the boy that he would never do anything remarkable in life.

A free course of botany was open to the pupils of the Gymnase Protestant, and in 1828 young Wurtz attended this course, which doubtless contributed to the development of his faculties of observation, and to give him his taste for natural history. Years afterwards, when fully entered upon his career as a chemist, he still took a pleasure in reading the works of the naturalist Oken.

Although, owing to his father's poor circumstances, and more especially to his gloomy disposition, Adolphe Wurtz's home was by no means a cheerful one, the young people spent many pleasant hours at the house of their grandfather, M. Kreiss. Besides this kind and excellent man, there were the two uncles, Théodore and Adolphe, the former of whom became to them as a second father, on the death of his brother-in-law. M. Théodore Kreiss always took the warmest interest in their studies, and was amply rewarded in after years by their gratitude and affection, and by their success in life.

The young people usually passed their holidays at the house of a great aunt at Rothau, in the Ban de la Roche. The excursions made on these occasions amongst the mountains and woods of the neighbourhood, and also to various factories, and to the mines and ironworks of Armont, were amongst Wurtz's pleasantest recollections in after life.

Adolphe Wurtz left the Gymnase in 1834, after taking the degree of Bachélier ès Lettres. It was his father's earnest wish that he should now attend a course of instruction as a preparation for theology, but the youth had already contracted a love of science. For some time past he had been making chemical and physical experiments in the laundry attached to his father's house. His mother made no objection to this, but his father looked upon such pursuits as both a waste of time and of money, and occasionally even went so far as actually to demolish the little brick furnaces which the future chemist had the ingenuity to build up.

Wurtz's strong inclination for chemistry was no doubt fostered by his intercourse with Emil Kopp—afterwards the distinguished chemist, who in later years was one of his fellow workers at the Dictionnaire de Chimie.

The youth at last announced that he wished to make chemistry his profession, but his father refused his permission, insisting on his son taking up either theology or medicine. The youth decided on the latter, and this selection of medicine was probably influenced by the opportunity it would afford him of pursuing his favourite study, as he would have to attend a course of chemistry, and would have access to a laboratory.

Wurtz soon became (in 1835) second and before long full assistant in the chemical and pharmaceutical department. At a competitive examination in 1839, he was appointed Chef des Travaux Chimiques de la Faculté, on which occasion he wrote an essay: "Histoire Chimique de la bile à l'état sain et à l'état pathologique." He fulfilled the duties of this new post under the direction of M. Caillot until he left Strasburg.

It was thus that whilst regularly and quietly pursuing his medical studies and passing the necessary examinations, Wurtz became a

chemist. All this earnest and arduous work did not, however, prevent him from joining in the various amusements going on in his family. He had a good voice and was fond of singing, and in such a musical city as Strasburg there was plenty of scope for this accomplishment. In the year 1843 he took the degree of Doctor of Medicine, and on this occasion he read a thesis "Essai sur l'albumine et la fibrine," which gained him a medal from the Faculté. He now obtained the permission of his family to go for a year to Giessen, where Liebig had opened the first laboratory for students. At Giessen he became acquainted with Dr. A. W. Hofmann, with whom he maintained a friendly intercourse through life. Here also he became intimate with Strecker, with Hermann Kopp, and others. Liebig received him in the most friendly manner, and entrusted him with the translation of some of his papers into French. These translations, which were sent to Paris for insertion in the "Annales de Chemie et de Physique," were the means of bringing Wurtz into contact with some of the leading French men of science, and in particular with Dumas.

It was in Liebig's laboratory that Wurtz began his investigation of hypo-phosphorous acid.

On leaving Giessen he made a rapid trip to Vienna before returning to Strasburg. In 1844 he left Strasburg for good, and went to Paris with letters of introduction from Liebig. There he worked for a short time in Balard's laboratory, but very soon removed to the laboratory of Dumas, in the Rue Cuvier, where were also working Messrs. Cahours, Mellens, Lewy, Leblanc and Bouis.

In 1845 he became assistant to Dumas at the École de Médecine, and it was whilst assisting Dumas that he made his great discovery of the compound ammonias, which had such an important influence on the progress of chemistry, and which gave the clue to the constitution of the vegetable alkaloids. It was also in Dumas' laboratory that he completed the beautiful investigation which he had begun at Giessen of the constitution of the hypophosphites.

About this time he gave some instruction to M. Eugène Caventou, who became one of his most intimate friends. The father of this young man, M. Caventou, the discoverer of quinine, was not slow to perceive the merits of young Wurtz, used frequently to invite him to his house, and did his best to support him by his influence on various occasions.

From 1845 to 1850, Wurtz held the appointment of Chef de Travaux Chimiques of the 3rd and 4th year students at the École Centrale des Arts et Manufactures.

In the year 1847, Wurtz distinguished himself greatly at the competition for the Agrégation de Chimie. One *leçon* which he gave on this occasion, "Sur les Corps Pyrogénés," earned high praise.

In 1845 he was employed in his capacity of Agrégé to give Dumas' course of lectures on Organic Chemistry, Dumas being prevented by his political and administrative occupations from attending to his professional duties.

Wurtz was at this time working in a dark and inconvenient laboratory, situated in the Practical School of the Faculté de Médecine in the Musée Dupuytren. On taking possession of it he found it in such a state that the first thing he did was to go with his assistant, M. A. Rigout, and buy a pot of colour and some brushes, with which he himself painted the black and dirty walls. He was not only particular about neatness and exactness in his work, but attached importance to having a light, cheerful, well-kept laboratory.

Desirous of getting more suitable conditions for work, Wurtz joined in 1850 with two young chemists, Messrs. Charles Dolfus and Verdeil, just returned from a course of practical chemistry under Liebig—to open a laboratory in the Rue Garancière. The three friends were each to carry on their separate experiments and to take a few pupils, Charles Dolfus contributing the money needed for the undertaking. Wurtz was the real scientific director of the enterprise, and this was practically the beginning of the laboratory in which he accomplished such great work, and in which so many chemists have been trained. Amongst those who worked under his direction in the Rue Garancière, we may mention Mr. Marcet, well-known for his labours in the department of Biological Science, M. E. Risler, who was already working at the applications of Agricultural Chemistry, and who afterwards became Director of the Institut National Agronomique, and Adolphe Perrot, afterwards Wurtz's assistant at the Faculté de Médecine.

But though this enterprise of the three young chemists was undertaken to supply a real want—it was not successful; unfortunately the young men were not long able to keep possession of their laboratory, for the house was very soon sold to a printer; and they were obliged to quit, and to sell off the fittings, &c., which had been a considerable expense to them.

It was at about this period that Wurtz became more or less intimately acquainted with various men afterwards distinguished in science or literature. Most of these were members of the Société Philomathque, sometimes called the Ante-Chamber of the Institute. Some of these friends were in the habit of meeting after dinner at the Café Procope before going to the meetings of the Society in the Rue Anjou-Dauphine. Occasionally it would happen that the conversation was so interesting that they prolonged their sitting at the café, and did not go at all to the meeting of the Society; but this was no loss to science when the party consisted of such men as

Wurtz, Foucault, Verdet and Brégnet, Himly, Regnault, Robin and Serret.

When the Institut Agronomique was founded at Versailles in 1850, Wurtz was appointed Professor of Chemistry in it. His appointment, however, was not of long duration, for the new institution was suppressed in 1852 by the Prince President. He lost his appointment just as he was about to marry, and it was 25 years before this institution, so much needed for the promotion of agricultural science, was re-established.

Wurtz was ere long amply compensated for this disappointment by his election as Professor at the Faculté de Médecine in 1853. Dumas had resigned his chair, and Orfila, who had been Professor of Mineral and Toxicological Chemistry, was dead. The two chairs were now united and Wurtz appointed to the post. It might seem a difficult task to replace two men of such talent and reputation, but Wurtz was equal to the emergency, and for 30 years his lecture room was crowded by students who flocked to hear him, attracted by his lucidity and masterly exposition. Whilst lecturing, he would go from the table where his experiments were made, to the black board, all the time speaking with eloquence and vivacity, talking of chemical combinations with as much enthusiasm as though his subject had been the welfare of a State. He always prepared his lectures carefully beforehand, and more and more carefully as years went on.

The principal laboratory where Wurtz worked surrounded by his students had been taken in from the little lecture room of the Faculté. It was lofty, with a vaulted roof, and very light, and held about a dozen students besides the Professor. The balances, which were placed on a little stand in the amphitheatre itself, were not accessible while the lectures were going on. Several adjoining rooms, which were at first used for special experiments on a large scale, such as combustions, &c., had afterwards to be given up for the ordinary work for the additional students who came to Wurtz's laboratory.

Wurtz had only a very moderate sum allowed him for the expense of his course, yet he managed with this and the help of some subscriptions from his pupils not only to buy apparatus and substances, but to defray the expenses of various alterations and improvements. His attempts to get a larger allowance for these purposes never succeeded until years afterwards, when as Dean he obtained a rather larger salary, and first one, then a second assistant.

In the year 1862, being then in London, on the occasion of the Universal Exhibition, Wurtz gave an address to the Chemical Society, "Sur l'Oxyde d'Éthylène considéré comme un lien entre la Chimie Organique et la Chimie Minérale."

In 1864, he being then in his 47th year, he was elected a Foreign Member of the Royal Society.

In 1866 he accepted the post of Dean at the Faculté de Médecine. In thus consenting to sacrifice a part of his valuable time to administrative occupations, it was in the hope of promoting the development of scientific instruction in the Faculté. He succeeded, in fact, in reorganising it, got all the practical work placed on a new footing, especially that of chemistry, obtained a laboratory of Biological Chemistry for his pupil, M. Gautier, and that laboratories should be put at the disposal of the clinical professors in the hospitals. He was an active advocate for the admission of women on an equal footing with men to the classes and examinations. He likewise took a considerable part in the planning and execution of the new buildings of the Faculté, and of the École Pratique. His high-minded courage enabled him to pull happily through a period of trouble, and to retain the office of Dean until a period of tranquillity ensued.

On two different occasions, in 1868 and in 1878, Wurtz visited the principal German and Austrian University centres, bringing back with him numerous documents, by the help of which he drew up two elaborate reports on Foreign Chemical, Physiological, Anatomical, and Pathological Anatomical Laboratories.

Wurtz had held his professorship at the École de Médecine for twenty-five years, when in 1874 he was appointed to the new Chair of Organic Chemistry, at the Sorbonne. He then resigned the office of Dean at the École de Médecine. He was named Honorary Dean, a distinction well earned by his many and long services, especially by the courage he had shown during the disastrous time of the Commune, never quitting his post until summoned to Versailles.

Wurtz had long wished for the opportunity of teaching the higher theories of chemistry, which he of course could not do to a class consisting chiefly of medical students, who for the most part took no interest in the subject, except in as far as it was necessary for passing their examination.

At the Sorbonne, Wurtz had no laboratory, and his experiments had to be prepared in his old laboratory at the École de Médecine, and all the substances and apparatus to be carried to and fro for each lecture. Thanks to the energy of the Professor, and to the efficiency of his able assistants, Messrs. Salet and Œchsner de Coninck, the course did not suffer from this unusual arrangement. It was only in the last months of 1881, after the death of Henri Sainte-Claire Deville, that a small laboratory was given to Wurtz for preparing his lecture experiments. A new and more suitable laboratory was being built for him in the Avenue de l'Observatoire, according to plans drawn up by himself, pending the completion of which Wurtz and his students remained at the École de Médecine, and he was looking forward during the last few months of his life to occupying the new buildings at the commencement of the following session.

During the siege of Paris Wurtz took an active interest in the fate of the inhabitants of Alsace-Lorraine, who had crowded to Paris. He was one of those who took part in the establishment of the Société de Protection des Alsaciens-Lorrains, which has been the means of relieving so much suffering, and of founding in Algiers three prosperous villages, peopled by refugees from those two provinces. He was also one of the first shareholders in the École Alsacienne, in which school the principles of instruction of the Gymnase Protestant of Strasburg have been adopted with much success. He was an active member of the committees of several charitable and other societies. He frequently spoke at the public meetings of the Société Protestant de Prévoyance et de Secours Mutuels, of which he was Vice-President, M. Léon Say being President.

In the year 1880 he went to Bordeaux to take part as a member of the Committee at the annual meeting of the Colonial Agricole de Sainte-Foy. At this meeting he delivered a most eloquent address, giving an account of the life of Felix Vernes, and of his services to his country during the siege and to French Protestantism.

Wurtz himself had worked most actively during the siege, both in the ambulances and on the field of battle. After the battle of Buzenval, the Société Française de Secours aux Blessés, of which he was on the Council, entrusted him with the painful task of finding the body of Henry Regnault. On the 23rd of January he reported to the Académie des Sciences his failure to find the remains of the son of his illustrious colleague. As we now know, it was in the cemetery of Père la Chaise that the body was at last recognised, amongst a crowd of others, on the 24th January.

Wurtz remained to the end of his life firmly attached to the religious belief in which he had been brought up. He was assiduous in his attendance at the meetings of the Consistory and the Synods. He contributed greatly to the reorganisation in Paris of the Strasburg Faculté de Théologie Protestante, in which he continued to take an active interest, and he also accepted the presidency of a society which was founded for the encouragement of theological study.

He was of course a member of all the principal learned and scientific societies, both in France and abroad. He became Vice-President of the Académie des Sciences in 1880, and presided at the sittings during the following year. His numerous brilliant and scientific labours were appreciated abroad at least as fully as in France, and certainly sooner. He became a Foreign Member of the Royal Society before he was admitted to the Institute. True it is that between the election of Balard to the Académie des Sciences, in 1844, and that of Wurtz in place of Pelouze, in 1867, there was only one other election, that of 1857, when Frémy was chosen in pre-

ference to Henri Sainte-Claire Deville, Wurtz, Berthelot, and Cahours The Académie had already, however, given Wurtz every other distinction it had to bestow. In 1859 it had awarded to him and his friend Cahours jointly the Jecker Prize; in 1864 it had again conferred on him the Jecker Prize; and in 1865 the great Biennial Prize of 20,000 francs was voted to him by the Institute.

In 1881, the Copley Medal was awarded to him by the Royal Society.

During the siege of Paris he punctually attended the daily meetings of the Comité Supérieure de Hygiène. At these meetings had to be considered the question of supplying food to the city, of the best means of resisting epidemics, and of diminishing as far as possible the immense mortality caused by the investment. Among the members of this committee were H. Sainte-Claire Deville, Gubler, Behier, &c. Wurtz became President in 1879.

He was also an active member of the Commission des Hôpitaux Civils et Militaires.

He had been a member of the Académie de Médecine since 1856. In 1871 he was chosen President, and during the whole of that gloomy year he regularly took the chair at the meetings, with one exception, that of the 23rd of May, during the disastrous period of the Commune. He took an important part in the discussions which were held in 1871, on vinage; in 1874, on the water of Paris; on the phenomenon of fermentation in cells; on the products of cinchonine, &c.

In 1877, during the rebuilding of the Faculté de Médecine, Wurtz moved into a provisional laboratory, which was arranged for him in the old houses facing the Rue des Écoles and the Rue Hautefeuille. This new laboratory was more commodious and better arranged than the old one, and as there were more rooms, a better distribution of the work could be made. Wurtz now had his own private laboratory, and he had also the gratification of being able to give a place in the laboratory to his former teacher, Professor Caillot, who had left Strasburg when the Germans took possession of Alsace.

It was here that Wurtz worked during the remaining years of his life, amidst a larger number of students than ever, and a little group of disciples who had gathered around him.

About the year 1856 there existed in Paris a society of young chemists, who used to meet for mutual instruction. In 1858 Wurtz conceived the happy idea of transforming this association into a learned society. He succeeded in obtaining the concurrence of Dumas, Balard, Sainte-Claire Deville, Berthelot, Thénard, Pasteur, Cahours, and others in this object. He organised the "Bulletin," a periodical in which are published the papers read before the Society, and also the "Répertoire de Chimie Pure," which gives *résumés* of chemical

work published both in France and abroad. To this was added a "Répertoire de Chimie Appliquée," under the direction of M. Barreswil. From the time of its foundation the Société Chimique de Paris took a high rank amongst scientific societies. Wurtz himself gave several lectures at the Society: one in 1860, "L'Histoire Générale des Glycols;" three in 1863, "Sur quelques points de Philosophie Chimiques;" and one in 1883, on "Aldol," with his usual vivacity and enthusiasm. He had been chosen Secretary of the Society at the time of its foundation, and he several times filled the office of President. He was a frequent attendant at the meetings of the Society, and often gave there his most interesting papers.

Wurtz also organised in his laboratory a set of conferences, which usually took place on Saturday afternoons, where sometimes he or his students, or occasionally distinguished chemists of France and other countries, gave an account of recent researches, and showed the more important experiments.

In 1872 he took an active part in the formation of an Association for the Advancement of Science, similar to our British Association, which has done so much for Great Britain. This new French Association held its first Congress at Bordeaux, in 1872. Wurtz continued to watch assiduously over its welfare. In 1874 he presided at the meeting at Lille, and on this occasion he gave the Association an important and interesting discourse on "La Théorie des Atomes dans la Conception Générale du Monde."

In 1875 Wurtz had been persuaded to accept the office of Maire of the VII^{e} Arrondissement of Paris. He fulfilled the duties of this post with his usual zeal and devotion, until 1881, when he was proposed for election to the Senate by the Centre Gauche, and elected without opposition. On the occasion of his nomination to the Senate his numerous pupils, both French and foreign, took occasion to offer him a testimonial of gratitude and affection. They presented him with a copy in bronze of Barrias' statue of Bernard Pallissy, on the pedestal of which was engraved a dedication, with the names of 111 present and former pupils, amongst which we note Ch. Friedel, Lecoq de Boisbaudran, J. M. Crafts, Ladenburg, &c., &c.

During the short time that he was a member of the Senate, Wurtz appears to have spoken only once, namely, at the discussion of the law for permitting the importation into France of the American salted meats. He drew up for the Senate on this occasion an exhaustive report on the Trichini, collecting together for the first time all the experience of France on the subject.

In 1878 Wurtz gave the Faraday Lecture to the London Chemical Society. He selected for his subject "La Constitution de la Matière à l'état Gazeux," dwelling especially on the beautiful researches of Faraday on the liquefaction of gases. He was warmly welcomed by

his scientific friends in London, and returned to Paris well pleased with his reception.

Wurtz had married in 1852 a lady of some fortune, with whom he had been on terms of friendship since childhood. He had four children. His daughters are both married, Marie, the eldest, being the wife of her father's friend and assistant, M. Œchsner de Coninck, and he had during his last years the happiness of seeing grandchildren around him.

Of his two sons, the elder, Robert, is studying medicine, and the second has passed through the École Polytechnique, with a view to a military career.

Wurtz's family circle did not however stop here. On the death of her sister, Madame Oppermann, Madame Adolphe Wurtz undertook the superintendence of the education of her four nieces, and when these young ladies afterwards lost their father, the three who were unmarried became inmates of Wurtz's house until their marriage.

Wurtz's mother, Madame Jean Jacques Wurtz, had remained for many years in Strasburg with her brother, Professor Théodore Kreiss, but, after her brother's death, she came to reside in Paris with her distinguished son. Amiable and cheerful in spite of her deafness, the only infirmity of her old age, she was thoroughly happy in the midst of the charming family circle, of which her son was the chief ornament. Wurtz's brother, Théodore, had also come, with his wife and children, to live in Paris, and with the exception of his sister, Madame Grüner, all the family were now together.

Wurtz took great delight in receiving his friends at his home, and besides his numerous friends and colleagues, his pupils often visited him either in Paris or at the country places the family inhabited during the summer months. A few years ago, he bought a charming place called Fromenteau, near Juvisy in the Seine Valley, where he thoroughly enjoyed receiving his friends, and sharing with them the pleasures of a country life.

Wurtz had, with few exceptions, enjoyed excellent health, but in 1867, owing to the fatigue of the work he had undertaken in connexion with the exhibition, he had fallen ill. The repose of the vacation however soon restored him to his usual health. He had always kept up his habit of taking plenty of exercise, whether by long walks, fishing, swimming, shooting, or gymnastics. Like most chemists, he had not escaped laboratory accidents. On one occasion a violent explosion caused an injury to one eye, which resulted in the formation of a cataract. After some years, however, his sight was restored by an operation.

Towards the end of 1883-84, his friends remarked that he showed signs of fatigue. Still he was as active as ever. In March, 1884, before resuming his course of lectures at the Sorbonne, he went for a

few days to stay with one of his daughters at Cannes. There he had the pleasure of seeing once more his friend Dumas, who was apparently in good health. Very shortly after his return, he heard of Dumas' death. He had just then business at Liège. He hurried through this as early as possible, for the sake of attending the funeral of his old master, and was imprudent enough to pass two consecutive nights in railway trains. On reaching home, he got a notice that he was expected to give an address over the grave of Dumas, on behalf of the Faculté des Sciences et Médecine. He set to work at once to compose the eloquent discourse which he delivered on this occasion. But the strain on his powers was too great, and his friends noticed with pain his altered appearance. Still he went on with his work, and resumed his lectures, though with visible effort. He gave his last lecture on the 27th April with his usual animation, but at the end was in a fainting state. He was now obliged to give up, and, as he himself remarked with some pride, it was the first time during a professorship of thirty years that he had put up a notice announcing that his state of health prevented his lecturing. Still his condition was not considered serious, and he himself did not appear to have any misgivings about his health. He was full of the idea of replacing his illustrious master, Dumas, as Secrétaire Perpetuel of the Académie des Sciences. He consulted some of his friends on this subject. They seeing that he was overdone by his work, yet feeling how desirable it was that he should hold this appointment, urged him to apply; but at the same time to give up more than an equivalent part of his other work. This he promised to do, and they still hoped to see him at the head of the Académie. But disease was making rapid progress, and he expired on the 12th of May, after a few days' illness, and only one month after paying his last tribute to the memory of Dumas.

He was followed from his home in the Boulevard St. Germain to his grave in Père-la-Chaise by an immense procession, consisting of official deputations from the Sénat, the Institut, and various learned institutions with which he was connected, and of hundreds of students principally from the École de Médecine and the Faculté des Sciences.

The labours of Wurtz have exerted a powerful influence on the development of chemistry. Among his most important discoveries may be mentioned those of the compound ammonias and the glycols, by which two extensive and fertile provinces were opened up in organic chemistry. His researches on the mixed alcohol radicals threw great light on the constitution of hydrocarbons, which had been the subject of a long controversy. He also made important experiments on dissociation. He discovered butylic alcohol. Other important investigations were his synthesis of glycerine, and of neurine, his elaborate investigation of lactic acid, his researches on the poly-

basic acids, and on the production of aldol and its beautiful derivatives.

The classical investigations with which Wurtz enriched science form but a small part of his work. He was one of the few French chemists who founded a school, and the greater number of the present generation of French chemists were his students.

It might well be supposed that the labours of this great investigator and teacher who had, in addition to his professional work, much official business and a considerable social position, would have left him neither energy nor leisure for other work. But he found time for much else. Besides being a brilliant lecturer and laboratory teacher, he excelled as a writer. The ease and rapidity with which he wrote induced him to undertake various literary works. He brought out his "Dictionnaire de Chimie" in a marvellously short time, with the aid of friends and pupils. The elegantly written little book "La Théorie Atomique" has long since been translated into all the chief modern languages. The "Leçons Élémentaires de Chimie Moderne" is a model of lucid exposition.

The fundamental feature of Wurtz's character was a love of truth. With this love of truth was combined a modest estimate of his own merits, accompanied by the most heartfelt and generous appreciation of the labours of others.

A. W. W.

William Spottiswoode was born in London on January 11th, 1825. He was descended from an old and distinguished Scottish family, of whom, perhaps, the most notable character was John Spotiswood, the Archbishop of St. Andrew's, who crowned Charles I at Holyrood, and was the author of "A History of the Church of Scotland." Andrew Spottiswoode, the father of William, was himself a man of no ordinary attainments; he represented Colchester for some time in Parliament, and in 1831 was admitted into partnership with George Eyre as one of Her Majesty's printers. His wife, William's mother, was of the Longman family, well known from its connexion with the celebrated publishing firm.

Of the early days of William Spottiswoode there is but little to tell. His school life began at Laleham under a brother of Dean Buckland. From Laleham he went to Eton, but his stay there was short, as the first recorded development of his scientific tastes resulted in an explosion which, though effecting no damage to his moral reputation, was deemed inconsistent with sound discipline. He was accordingly moved to Harrow, then under Dr. Wordsworth, and was there placed in the upper "shell." After continuing three years at Harrow, where he had the reputation for being studious and thoughtful, he in 1842 obtained a Lyon Scholarship and went to Balliol College, Oxford.

His mathematical tutors there were Dr. Temple, the present Bishop of London, and afterwards the Rev. Bartholomew Price, who had the highest opinion of his industry and power of work. His range of reading is said to have been very extensive. In 1845 he took his B.A. degree as a first-class in mathematics, and in 1846–7 gained successively the Senior University and the Johnson's Mathematical Scholarships.

In 1846 Mr. Spottiswoode left Oxford to take his father's place as Queen's printer, but he kept up his connexion with the University, delivering a course of lectures at his college on solid geometry, and acting in 1857–8 as Examiner in the Mathematical Schools.

The business of the Queen's Printing Office continued to occupy his close attention until his death. The great powers which he possessed as an organiser and master of detail ensured the advancement and complete commercial success of this great establishment, and rendered of real efficiency his unceasing efforts to promote the physical and moral welfare of his workpeople.

Mr. Spottiswoode began to communicate to the world the results of his mathematical researches in 1847, when he issued a series of five pamphlets, which he entitled "Meditationes Analyticæ." These contained thirteen essays on a variety of mathematical topics, including the curvature of surfaces, virtual velocities, infinitesimal analysis, physical astronomy, and the calculus of variations. After a pause of three years, he in 1850 sent three brief papers to the "Philosophical Magazine" on quaternions, and from that time forward his communications to the leading English and foreign mathematical societies and journals were poured out in an almost continuous stream. In a list of his publications which is before the writer, four years only of his subsequent life, viz., 1858, 1867, 1869, and 1878, appear without some record of mathematical work committed to the press. Much of this no doubt was of a slight and fugitive character, consisting merely of new proofs by elegant methods of known theorems, or notes of ideas suggested by the papers of others which the wide range of his college reading enabled him to follow without difficulty, so that but few were allowed to escape his attention. But of important and original work there was an abundance. The interesting series of communications on the contact of curves and surfaces which are contained in the "Philosophical Transactions" of 1862 and subsequent years, would alone account for the high rank he obtained as a mathematician. It would not be possible to discuss in any detail the various mathematical writings which have established the reputation of Mr. Spottiswoode without the use of complex symbolical expressions quite inconsistent with the objects of a brief obituary notice. In truth, the mastery which he had obtained over the mathematical symbols was so complete that he never shrank from the use of

expressions, however complicated, nay, the more complicated they were the more he seemed to revel in them, provided they did not sin against the ruling spirit of all his work—symmetry.

To a mind imbued with the love of mathematical symmetry the study of determinants had naturally every attraction. In 1851 Mr. Spottiswoode published, in the form of a pamphlet, an account of some elementary theorems on the subject. This having fallen out of print, permission was sought by the editor of "Crelle" to reproduce it in the pages of that journal. Mr. Spottiswoode granted the request, and undertook to revise his work. "The subject had, however, been so extensively developed in the interim, that it proved necessary not merely to revise it, but entirely to rewrite the work," which became a memoir of 116 pages. To this, the first elementary treatise on determinants, much of the rapid development of the subject is due. The effect of the study on Mr. Spottiswoode's own methods was most pronounced; there is scarcely a page of his mathematical writings that does not bristle with determinants.

Two communications made by Mr. Spottiswoode in 1860 and 1863 to the Royal Asiatic Society upon mathematical subjects, should be specially referred to. In a brief note in the Journal of that Society (vol. xvii, pp. 221—222) he discusses the claims of Bhóskaráchary, an Indian astronomer, to the discovery of the principle of the differential calculus; and in a more lengthy article in vol. xx, pp. 345—370, of the same publication, he translates into modern symbols the formulæ made use of by the Hindoos in calculating eclipses, contained in the "Súrya Siddhánta." The acquaintance which he had with this work was formed by reading it in the original tongue, for among his varied acquirements he possessed a remarkable knowledge of several European and Oriental languages.

Mr. Spottiswoode was not a traveller in the usual extensive meaning of the term, but he has left us an interesting record of a journey which he made in 1856 through Eastern Russia, entitled "A Tarantasse Journey through Eastern Russia in the Autumn of 1856;" and in 1860, in company with his brother and a sister, he accomplished an expedition through Croatia and Hungary.

In 1861 Mr. Spottiswoode was married to the eldest daughter of the late William Urquhart Arbuthnot, a distinguished member of the Indian Council.

In 1871 Mr. Spottiswoode turned his attention to experimental physical science. The resources at his command enabled him to furnish his laboratory on a scale which rendered it in some respects unique. The gain to the scientific world was not due merely to his own experiments, as, with characteristic generosity, he was always ready to advance the discoveries of others by the loan of the costly and beautiful apparatus with which he had surrounded himself, and

in the perfecting of which he had spent much care and ingenuity. His earliest researches bore on the phenomena of the polarisation of light, upon which he wrote an admirable little handbook, published in the "Nature Series." At a later period he made a number of communications to the "Proceedings of the Royal Society" on the electric discharge in rarefied gases. In 1879 he was joined in his researches on this subject by Mr. J. F. Moulton, and in conjunction with him entered upon an investigation of the sensitive state of the discharge. An important paper in the "Philosophical Transactions" of 1879 (pp. 165—229), and some shorter notes subsequently published in the Society's "Proceedings," give in detail the singular and elegant results which were arrived at.

The great beauty of the experiments involved in Mr. Spottiswoode's physical researches led to demands from his friends that they should be laid before the public in a popular form. The lectures which he delivered to crowded audiences at the Royal Institution and elsewhere were characterised by a remarkable clearness of exposition, and by a depth of poetic feeling which excited much surprise among those who knew of him only as an abstruse mathematician. Perhaps the most interesting example of his powers as a lecturer is to be found in a discourse on "Sunlight, Sea, and Sky," delivered to working men at the British Association Meeting in Brighton in 1872 ("Nature," vol. vi, pp. 333—336). The reputation he acquired in these essays excited high expectations with regard to the address which, as President of the British Association, he had to deliver in Dublin in 1878. These expectations were fully justified by the result. The stores of a mind imbued with the spirit of a philosopher, a mathematician, a physicist, and a poet, were drawn upon with no niggard hand, and matters usually regarded as beyond the ken of others than experts were explained to the unversed in language as interesting as it was simple, clear, and precise. The judgment of his fellow-workers could now be unhesitatingly approved by others.

The honours which were bestowed on Mr. Spottiswoode were many. He was LL.D. of Cambridge, Dublin, and Edinburgh, and D.C.L. of Oxford. He was elected correspondent of the Institute (Académie des Sciences) for the Geometrical Section, after a sharp contest with M. Borchardt. He was Fellow of the Royal Society of Edinburgh, the Royal Astronomical Society, the Royal Asiatic Society, the Royal Geographical Society, the Society of Antiquaries, and the Ethnological Society. He occupied the Presidential Chair of Section A of the British Association in 1865, of the London Mathematical Society in 1870–2, of the British Association in 1878, of which latter body he acted as Treasurer from 1861 to 1874. Of the Royal Institution he was Treasurer from 1865 to 1873, and Secretary from 1871 up to his death. He was also a Trustee of the British Museum.

The Fellowship of the Royal Society was conferred upon him in 1853. After having served several times upon the Council, he in 1871 became Treasurer, a position which he held up to 1878, in November of which year he succeeded to Sir J. Hooker as President. One more fully qualified to occupy this important post it would be difficult to find. To a manner in which sweetness and dignity were singularly blended, he added an unfeigned interest in the work of others, in whatever field it lay, and a rare quickness of appreciation of its merits; while his love of society and liberal hospitality had surrounded him with a wide circle of distinguished friends both English and foreign.

Death overtook Mr. Spottiswoode while he was yet in the prime of life and in the full vigour of his intellect. A serious tricycle accident some months before had lowered his strength so that he was unable to resist an attack of Roman fever, complicated by congestion of the lungs; and thus he passed away on the morning of June 27, 1883.

His remains rest in Westminster Abbey. If further words are needed to justify the claims of William Spottiswoode, President of the Royal Society, to such an honour, none better or more eloquent could be selected than those uttered over his scarcely closed grave by the Dean of Westminster, words which supply that reference to the beauty of his character, without which this brief sketch of him would be indeed imperfect. "Those to whom his memory is dear need not blush to think that he lies near those whose thoughts have enriched, whose examples have guided, or whose lives have served mankind; that he rests there not as a thinker only, not as a student only, but as a citizen of England, as a gifted worker in the fair domain of knowledge, as a busy worker in the manifold range of active life, and that he carried into each sphere the same minute and careful and constant and untiring industry, the same rare powers, the same high aim of serving truth, of serving man, and of serving God. . . . He was emphatically by nature and by choice a man of science. His own special and more cherished studies lay in those high and abstract regions which are traversed only by the few. He moved with ease, we are told, on heights where others can scarcely draw their breath. He did not devote himself to those great fields of knowledge, success in which at once appeals to the imagination of us who stand outside the circle of the true students of science. We can point to no marked and tangible result of his labours such as comes at once to the mind of the passing visitor, or may be brought home to the comprehension of even the least instructed stranger, as he stands on the grave of a Newton, or a Herschel, or a Lyell, or a Darwin. Yet he was, in the truest sense of the words, a man of science. Devout in soul and unperplexed in faith, he never, we are told, cared for one single moment to speak of science in the sense implied in the often misused

As illustrating the activity and energy with which railway enterprise was carried on at the time, it may be mentioned that the Tunbridge Wells Branch, which forms the first portion of the Tunbridge and Hastings line, was carried into execution by consent of the landowners and occupiers before the Act of Parliament which authorised its construction was obtained.

In 1858 Mr. Barlow investigated in great detail the construction of bridges of large span, especially with the view of stiffening the roadways of suspension bridges, and in pursuance of those studies he went to Niagara, in order to examine personally the great railway and road bridge erected there by Roebling.

Mr. Barlow's latest public engineering works were the Lambeth Bridge, which has since been purchased by the Metropolitan Board of Works, and the Tower Subway, the latter work having attracted much attention from the originality of its conception and the cheapness and rapidity of its construction. This subway is formed of cylindrical rings of cast iron, and by forcing forward a cylindrical shield, it was constructed from the north to the south side of the river (900 feet) in fourteen weeks. Although of small dimensions, and only adapted for foot passengers, it is extensively used by the working classes, who were formerly entirely dependent on the ferry.

After the completion of these public works, he erected an iron bridge on the River Lea, and had surveys made for a tunnel under the harbour of Rio de Janeiro for the Brazilian Government.

In 1881 he suffered under an attack of cataract, which entirely deprived him of sight for several months. A successful operation restored the use of one of his eyes sufficiently to enable him to read. He was, however, no longer able to pursue his professional career with the zeal and energy which characterised the earlier part of his life.

Mr. Barlow was the author of several scientific papers, among which the following may be mentioned:—

"An Investigation of the Laws which govern the Motion of Steam Vessels," "Phil. Trans.," 1834.

"On the Strains to which Lock Gates are subjected," "Civ. Eng. Inst. Trans.," 1836.

"Investigation of the Power consumed in overcoming the Inertia of Railway Trains," "Proc. Roy. Soc.," 1846.

"On some Peculiar Features of the Water-bearing Strata of the London Basin," "Civ. Eng. Inst. Proc.," 1854.

"On the Mechanical Effect of combining Girders and Suspension Chains," "Brit. Assoc. Rep.," 1857.

"Observations on the Niagara Bridge," "Frank. Inst. Jour.," 1861.

He became a Fellow of the Royal Society in 1845. He joined the Institution of Civil Engineers in 1827, and at the time of his death was the oldest Member of that Institution. W. H. B.

phrase as 'the handmaid of religion.' He looked on the study of science as, I might even say, part of his religion, as the pursuit of truth, truth only, truth for her own sake; a pursuit to be followed up independently, fearlessly, faithfully, to whatever results patient and enlightened, but impartial and honest, investigation should lead the inquirer. He shrank from all attempts to divert, or to confuse, or to limit the aim of the student by putting before him any other one consideration than that of the pressing forwards to what was clear, true, and demonstrable within his own department. . . . And to all who followed truth in the same spirit he turned with an instinctive and cordial sympathy. He won men's hearts, we hear, by an unassuming and unselfish gentleness. But he did more. The variety of mental powers which enabled him to hold the threads of the many branching lines of the ever expanding studies of his age, which touched with poetry his treatment of the most abstruse themes, and gave a rigorous accuracy to his management of the smallest detail of his business, was united to an attractiveness and transparency of character, and a spotless integrity and uprightness which secured men's confidence. . . . And if he lies not far from those whose genius—very different to his own—has enlarged the bounds of human thought, and embodied sometimes in immortal clothing the various chords of human feeling and emotion, it is something to feel that rarely beneath this roof has been laid one of a purer or more spotless life."

A. B. K.

Peter William Barlow, whose death occurred on May 19th, 1885, was the eldest son of the late Professor Barlow.

He was educated at private schools, and having at an early age selected civil engineering as his profession, became a pupil of the late Mr. Henry Palmer, Member of the Institute of Civil Engineers, under whom he was engaged on the Liverpool and Birmingham Canal and the then New London Docks.

The active demand for railways which followed the opening of the Liverpool and Manchester Railway, caused him to be employed in the preliminary surveys and studies of the county of Kent, with reference to a railway to Dover, and in 1836 he acted as resident engineer under the late Sir William Cubitt, on the central division of the London and Dover Railway, which formed the nucleus of the present South Eastern system. He subsequently became resident engineer of the whole line, and afterwards the engineer-in-chief, during which period he constructed the North Kent, the Tunbridge and Hastings, and many other lines in connexion with the South Eastern system. He also constructed the Londonderry and Enniskillen, and the Londonderry and Coleraine, and other railways.