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referred to; for his mode of using his influence was so unostentatious, and his desire for a recognition of his services so small, that much of what he did is scarcely known; and the want of specific details in showing how his influence was brought to bear in so many ways is owing to the modesty of his nature. Justice, too, has hardly been done in the foregoing lines to his scientific knowledge and sympathies. In this respect, as in his constant endeavour to promote the wellbeing of his fellowmen, he was so little self-obtrusive that few men knew the extent of his acquirements. He paid, even to within a week of his death, constant attention to scientific progress, and especially to its practical application. Among his notes written but a few weeks before his last illness are details of the composition and mode of action of chloral. It was this union of a scientific spirit with great benevolence of character which, aided by a large experience abroad and at home, made him so excellent a physician.

His position at the Court necessarily occupied much of his time and thoughts; he was unceasing in his attention to the health of the Queen and of her children, and the Royal family owe to him much of that blessing of health which has happily been their lot. He was on most confidential terms with the Prince Consort; and the Prince found in him a congenial adviser on all points connected with education and science. The Queen's trust in him was early and firmly implanted, and was never impaired, and her sympathy and, we can truly say, affection for him were manifested to the last.

Sir James Clark retired from private practice in 1860, and removed to Bagshot Park, which Her Majesty had lent him for his life. He died there on the 29th of June, 1870, in the eighty-second year of his age, retaining almost to the last hour of his life a warm interest in all scientific progress, and a heart-felt sympathy with every step which would promote the improvement and happiness of his fellowmen.

William Allen Miller, Vice-President and Treasurer of the Royal Society, was born at Ipswich, in Suffolk, on the 17th of December, 1817. He was indebted for his early education to his mother, whose memory he cherished with the greatest love and respect, and whose quiet, sagacious nature was reflected in him. Mrs. Miller had a favourite maxim, "Take everything by the smooth handle; and if a thing has not got a smooth handle, make one!" Dr. Miller was actuated through life by the spirit of this axiom; and we have known him, when giving advice to a friend who sought it, introduce the remark, "Take it by the smooth handle."

Miller passed one year in Merchant Taylors' School, and two years at Ackworth, in Yorkshire, in a school belonging to the Society of Friends—the same in which Luke Howard took so great an interest that he purchased the Ackworth Villa estate, and made it his summer residence during some years. Luke Howard's partner, William Allen, F.R.S., the manufacturing chemist, and author, conjointly with Mr. Pepys, of the well-known researches



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on respiration, was the friend after whom Miller was named. Miller's natural simplicity of character probably received its outward expression from this early contact with influential members of the Society of Friends. It was at Ackworth that he first distinctly remembered having acquired a taste for science, and a desire to devote his life to its cultivation; and this was not so much from the chemical lectures, or rather the chemical experiments, which were shown to some of the boys, as from the fact that Miller was occasionally invited to look at the stars through a telescope belonging to one of the masters. These early impressions bore fruit in the chemistry of the stars, with which his name is now associated. At the age of 15 he was apprenticed to his uncle, Mr. Bowyer Vaux, one of the honorary surgeons in the General Hospital at Birmingham, of which, during nearly twenty years, his father, Mr. William Miller, was secretary. After five years he entered the medical department of King's College, London, where his superior knowledge of chemistry over that of the other students attracted the attention of Professor Daniell, who more than once expressed his surprise in the inquiry, "Where did you get your knowledge from?" One of those opportunities that occur in the lives of most people, but are taken advantage of only by superior men, occurred in connexion with the chemistry lectures. Miller had no taste for surgical practice, and preferred, if possible, to get some employment in the laboratory of a manufacturing chemist, rather than become a medical practitioner. Indeed he did perform some analyses for the Messrs. Chance, while in treaty with them for more permanent employment. But the laboratory assistant at King's College having been disabled by illness, Daniell engaged the services of Miller; and when the office of Demonstrator in the laboratory became vacant in 1840, he was appointed to the post. It should be mentioned that in 1839 Miller obtained the Warneford Prize for the encouragement of theological studies among medical students, and in 1840 he passed a few months in Liebig's laboratory at Giessen. In 1841 he became Assistant Lecturer for Professor Daniell, and also took his degree of M.B. in the University of London, proceeding to M.D. the following year. He also assisted Professor Daniell in various scientific inquiries, and conducted the experiments on the electrolysis of saline compounds, his name being associated with that of Daniell in the paper that appeared in the Philosophical Transactions for 1844. In the following year he was elected a Fellow of the Royal Society, and on the death of Professor Daniell succeeded to the vacant chair of Chemistry in King's College. The writer of this notice was engaged in assisting Professor Daniell to bring out the third edition of his well-known work entitled "Meteorological Essays," and on the sudden death of the author he requested Dr. Miller to cooperate with him in completing the work, to which he readily assented. Dr. Miller was engaged about this time in some experiments on Spectrum Analysis. They were conducted in a sort of lumber-room below the seats of the Chemical Theatre, and formed the subject of a paper which was

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read before the British Association and published in 1845 in the Philosophical Magazine (Series 3, vol. xxvii. p. 81). He thus became interested at an early period in the subject of spectrum investigation.

Miller continued during some years to use as his text-book Professor Daniell's 'Introduction to the study of Chemical Philosophy,' supplemented at a later period by Fownes's 'Manual of Chemistry.' The writer of this notice repeatedly urged Dr. Miller to bring out a work of his own, which should be better suited to the wants of his pupils; but he hesitated in doing so lest he should at all interfere with his predecessor's work. "I must prepare the book," he said, "from my lecture-notes, and you are not aware how much of Daniell I have in them." For some time his idea was to accede to a proposal of the publisher of Daniell's work to bring out a third edition, making such additions thereto as the progress of science required, and to maintain it in its old position as the text-book. But on looking over Daniell with this view, he found that so many additions and alterations would be required as greatly to supersede the author's peculiar touches; so that he finally decided to produce a new work, and the first volume accordingly appeared in 1855. In the preface to this volume, which was devoted to "Chemical Physics," the author stated that "he had decided to leave untouched the work of his late master, as the true exponent of his views, upon some of those branches of science which his researches had contributed to advance and adorn." The two subsequent volumes on "Inorganic" and "Organic Chemistry," which appeared, the one in 1856 and the other in 1857, were written from Miller's lecture-notes, as was also the case with the "Chemical Physics," the notes being so amplified as to form continuous reading, a process which led to so many insertions and alterations as to make the manuscript difficult to read. But the effect of this mode of treatment was so far advantageous that when the books were introduced to the students, they, so far from having to conform to any new method, seemed to recognize in the new text-books the very lectures they had heard.

The three volumes of Miller's 'Elements of Chemistry' passed through several editions, and were reprinted in the United States of America. While not professing to set forth any marked original views, the work affords a clear and comprehensive exposition of the science, and soon became deservedly popular. In the later editions Miller adopted the new method of notation in chemistry. His conservative principles led him to resist this change as long as it was possible to do so. Moreover, having been, during so many years, accustomed to the old notation, he never took kindly to the new. Indeed it was part of Miller's character to grasp a new idea with a certain amount of mental slowness; but when once fairly appreciated, it was held tenaciously and not given up without a severe struggle. But he was so conscientious that he would sacrifice every thing to what he held to be the truth. The writer has known him to refuse to hold any further intercourse with a foreign man of science whom he had received into his



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house and assisted in various ways, on hearing the expression of a doubt as to the benevolence of the Almighty for permitting him to undergo so much trouble. Soon after he became Professor, he was on one occasion giving evidence in a court of law on some scientific point connected with a patent, when, during the cross examination, the Judge made a remark which had the effect of questioning the veracity of the witness. Miller felt this so keenly that he fainted, and had to be carried out of court. After a short interval the Judge sent to inquire how he was. Miller said, "I shall be better when his Lordship does me justice." On his return, the counsel for the cross examination was proceeding to put questions in the spirit of the objection, when the Judge stopped him, stating that he had misunderstood the witness, and explained how.

As a lecturer Miller was more successful in style and expression than as a writer, for his written composition had some tendency to become involved. One of the best specimens of his lectures is that on Spectrum Analysis, given before the British Association at Manchester in 1861, at the time when Kirchhoff's researches had made the subject more than usually popular. One part of this lecture was devoted to an historical review of that remarkable branch of chemico-physical research; and so little attention had been paid to this part of the subject that when a large audience were collected to hear, as they supposed, an account of Kirchhoff's discoveries, they were not a little surprised to find Kirchhoff occupying the end of a long series of illustrious names, from Newton in 1701 to Wollaston in 1802 and Fraunhofer in 1815; while the various other names were arranged after the fashion of a genealogical tree, under the four heads of (1) Cosmical lines, (2) Absorption-bands, (3) Bright lines produced by the electric spark, and (4) by coloured flames, the four branches uniting in the names of Kirchhoff and Bunsen, 1860. On the morning of the day appointed for that lecture, successful and brilliant as it was, Dr. Miller was seized with one of those bilious attacks to which he was subject, and was so prostrated that he had to keep his bed nearly up to the time of the lecture, and return to it immediately after its close. This gave occasion to a little incident which deserves to be noted as illustrative of the cautious habit of forethought of the man. In moving to the front of the crowded platform with a bottle containing red nitrous fumes in his hand, in his weak state he stumbled and fell, breaking the bottle in pieces. Immediately he sprang to his feet, exclaiming "I have another!" on which a round of applause caused him to remark, as if to himself, "I am too old a lecturer to rely upon one bottle."

This lecture was repeated before the Pharmaceutical Society of London on the evening of the 15th January, 1862, and printed in the Society's Journal for February of that year. The historical details given in it have been largely used by subsequent writers, presenting, as they do, in a very clear manner, the results obtained by the earlier workers on the Spectrum. It was on returning from this lecture to his house at Tulse Hill, with his

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friend and neighbour Mr. (now Dr.) Huggins, that Miller assented to a proposal made by Mr. Huggins that they should unite in carrying on a series of experiments on the spectra of the heavenly bodies. Miller was at this time engaged in an elaborate series of experiments which formed the subject of a paper read before the Royal Society, 19th June, 1862, "On the Photographic Transparency of various bodies, and on the Photographic effects of metallic and other Spectra obtained by means of the Electric Spark." This paper is inserted in the Philosophical Transactions for 1862.

The joint labours of Miller and Huggins were continued during about two years; and as the observations could only be made at night, they must have told on the energies of a man who was so actively employed as Miller in brain-work at College and elsewhere during the day. The first results of their observations are given in a note on the lines in the spectra of some of the fixed stars, dated February 1863*, from which it appears that a considerable time was devoted to the construction of apparatus suited to this delicate branch of inquiry; but they had at length "succeeded in contriving an arrangement which has enabled them to view the lines in the stellar spectra in much greater detail than has been figured or described by any previous observer." They further add that, "during the past twelve months, they have examined the spectra of the Moon, Jupiter, and Mars, as well as of between thirty and forty stars, including those of Arcturus, Castor, $\alpha$ Lyræ, Capella, and Procyon, some of the principal lines of which they have measured approximatively. They have also observed $\beta$ and $\gamma$ Andromedæ, $\alpha$, $\beta$, $\epsilon$, and $\eta$ Pegasi, Rigel, $\eta$ Orionis, $\beta$ Aurigæ, Pollux, $\gamma$ Geminorum, $\alpha$, $\gamma$, and $\epsilon$ Cygni, $\alpha$ Trianguli, $\epsilon$, $\zeta$, and $\eta$ Ursæ Majoris, $\alpha$, $\beta$, $\gamma$, $\epsilon$, and $\eta$ Cassiopeiæ, and some others." When their labours were sufficiently advanced, they embodied their results in a memoir entitled "On the Spectra of some of the Fixed Stars," which was published in the Philosophical Transactions for 1864. At a somewhat later period there is a joint note on the spectrum of the variable star Alpha Orionis, contained in the 'Monthly Notices of the Royal Astronomical Society,' vol. xxvi.; and another joint note on the spectrum of a new star in Corona borealis, in the 'Proceedings of the Royal Society,' vol. xv., dated May 17, 1866.

Messrs. Miller and Huggins, for their "conjoint discoveries in Astronomical Physics," received each the Gold Medal of the Royal Astronomical Society; and on the occasion of presenting these medals, the President, the Rev. C. Pritchard, M.A., F.R.S., after referring to a former inquiry as to "What is a sun?" remarked that the progress of science had led to the further query, "What is a star?" "For the first dawning of a distinct and intelligent reply to this question we are indebted to Messrs. Huggins and Miller." * * * We find them associated "in the examination of the spectra of stars by means of an admirable and newly contrived apparatus which had required much thought and labour to construct. With this

* Proceedings of the Royal Society, vol. xii. p. 444.

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instrument attached to the telescope it was possible not only readily to divide the sodium line D into its two compartments, but to exhibit also the nickel line which Kirchhoff had observed between them. The spectra of the stars were now, in the first instance, compared approximately with the superposed atmospheric spectrum already alluded to, for the purpose of suggesting what metallic lines probably existed in the star under observation, and then were compared directly, by actual juxtaposition, with the actual spectra of those metallic vapours which had been already suggested. It seems impossible to conceive any process more rigidly or conscientiously exact than that which Messrs. Huggins and Miller thus skilfully adopted; and here I may be excused for repeating that the attainment of the ultimate object of the research depended, not on any approximation, however close, of the stellar with the metallic spectra, but on the certainty of their absolute coincidence. In this way, during the space of two years and a quarter, many of the midnight hours of these gentlemen were passed in the scrupulous examination and measurement of the spectra of upwards of fifty stars; but in several instances the number of the fine dark lines, the inevitable indices (be it remembered) of the material constitution of these distant worlds, were so numerous, that to measure and map them all the labour of months would barely suffice. The physical result of all this scrupulous and conscientious care was to discover the fact, or it may be to confirm the suspicion, that those mysterious lights with which the firmament is spangled are in strict reality worlds fashioned, in their material constitution at least, not altogether differently from the fashion of the little orb on which we live; beyond the question of a doubt they are proved, by the investigations of our medallists, to contain at least the hydrogen, the sodium, the magnesium, the iron with which all terrestrial creatures are so familiar."

On Tuesday, May 14th, 1867, Miller commenced at the Royal Institution a course of four lectures on "Spectrum Analysis, with its applications to Astronomy." These lectures were reported in the 'Chemical News,' under the revision of the author. Again, at the Meeting of the British Association at Exeter in 1869, he gave a lecture on Spectrum Analysis to working men. This lecture was afterwards published in the 'Popular Science Review' for October 1869.

Miller was interested in the subject of water analysis, and, in conjunction with Professors Graham and Hofmann, prepared a Report for the Government "On the Chemical quality of the Supply of Water to the Metropolis." This was printed in 1851. At a later period he undertook an investigation "On the combined Action of Air and Water on Lead," and in 1865 gave a lecture before the Chemical Society "On some points in the Analysis of Potable Waters."

Quitting the subject of Miller's original work, we pass on to a brief notice of the various services rendered by him to Science. He was on the Council of the Royal Society during the years 1848–50 and 1855–57,

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and being elected Treasurer on the 30th of November, 1861, he served on the Council in an official capacity till the time of his death. His methodical and punctual habits, his knowledge of affairs, and his excellent judgment, with the earnest and lively interest he took in the welfare of the Society, rendered his special services as Treasurer of the utmost value; whilst the same high qualities, combined with his accomplishment in science, singularly well fitted him for the various duties he had to perform as Member of the Council and a chief Officer of the Society. The date of his election to the Fellowship is 1845.

Mr. Gassiot, who knew Miller intimately, referring to his merits as Treasurer, writes, "a more straightforward officer, or one more devoted to upholding the dignity and promoting the usefulness of the Royal Society, I do not know; and there is probably no one with whom Dr. Miller communicated on the subject so freely as myself." Mr. White, the Assistant-Secretary, who habitually had to transact business with him, adds, "My own experience of Dr. Miller was, that on walking down to King's College I could tell beforehand the mood in which I should find him—always uniform and considerate. His decision on questions brought before him was generally quick and sound, and he was ready in detecting the weak points of an argument. In the whole period that he was Treasurer I never had a single disagreeable word with him."

In 1866 Dr. Miller was nominated a Member of the Committee then appointed for the purpose of superintending the Meteorological Observations made by direction of the Board of Trade, and served on it till the time of his death; he was also an active Member of the Committee of the British Association for superintending the Kew Observatory, and devoted much time to that work. The definition of the arrears to be executed under the superintendence of Mr. Balfour Stewart, as entered on the Minutes of the Committee, 9th March, 1870, was written by and inserted at Dr. Miller's particular request, in order specially to define the important work that has yet to be completed by the time when the connexion of the Observatory with the British Association shall cease.

It may here be mentioned that whilst a Member of the Committee appointed to advise on the scientific arrangements for the marine researches carried on during the voyage of the 'Porcupine' in 1869, Dr. Miller was happy enough to contrive a thermometer adapted for taking deep-sea temperatures, which has been found admirably to fulfil its purpose*.

Miller was one of the original founders of the Chemical Society, and frequently presided over its meetings, as well as occupied a place at its Council Board. Along with his other various occupations, Dr. Miller was a Member of the Senate of the University of London, to which he was appointed, on the recommendation of Convocation, early in 1865; and his sound judgment and knowledge generally, as well as his accomplishment in chemical and physical science and his experience as a teacher, gave

* Proceedings of the Royal Society, vol. xviii. p. 408.

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great weight to his opinion in the deliberations of that body, and caused his loss to be severely felt.

In addition to the various honours which rewarded Miller's position as a scientific man, it should be mentioned that he received the degree of LL.D. at the University of Edinburgh, on the occasion of the installation of Lord Brougham as the first Chancellor, that of D.C.L. at the University of Oxford in June 1868, and that of LL.D. at the University of Cambridge in May 1869, after giving the Reade Lecture, which on this occasion was on the Coal-tar Colours.

Perhaps the most marked feature in Miller's character was sagacity combined with a deep sense of religion. His religious views may be gathered, although imperfectly, from an address entitled "The Bible and Science," delivered at the Church Congress in Wolverhampton, October 3rd, 1867; also from his "Introductory Lecture," on the opening of the Medical Session at King's College, October 1st, 1859, published under the title, "Hints to the Student on commencing his Medical Studies."

In conclusion, the writer may be allowed to repeat what he said in a short notice at the period of Miller's death, drawn up at the request of the editor of the 'Chemical News':—"During a quarter of a century Miller continued to lecture with unceasing activity, and to take part in the management of King's College, every one, from the Principal and Professors to the youngest student, being anxious to obtain his advice and assistance. It was impossible to come in contact with him without feeling one's self in the presence of a man of pure nature, of spotless integrity, of sound and sagacious judgment, and of true gentlemanly feeling. His loss will be deeply felt, especially in King's College, in the Royal Society, in the Mint, and the Bank of England, where he was one of the Assayers. He will be missed in the Courts of Law, where his clear perception of patented processes, and his strong sense of justice, made him respected alike by judge and counsel. He will be missed by the manufacturers who sought his advice; but, above all, he will be missed by his own family, and by the few friends who had his confidence."

There had been symptoms of an overwrought brain for some months previous to his last illness, which took place on the journey to Liverpool, 13th September, 1870, at the time of the British Association gathering, which, however, he was unable to attend, his illness culminating in apoplexy on the 30th of the same month. His remains were brought from Liverpool and interred in the cemetery at Norwood, by the side of those of his wife, whom he survived one year. He died on the anniversary of her burial, and at the comparatively early age of 53. He married, in 1842, Eliza, eldest daughter of the late Mr. Edward Forrest, of Birmingham, by whom he leaves issue, two daughters and one son.—C. T.

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