An Omnivorous Curiosity, a Sense of Wonder, and a Taste for the Spectacular

Sir John Meurig Thomas*

1. Introduction

We are what we remember. Novelists, philosophers, and neuroscientists all seem to agree that human beings are the sum total of their memories: this is one of the reasons why each individual is unique. Oliver Sacks' memories of his "chemical boyhood" as a teenager growing up in a large family of Russian-Lithuanian-Jewish descent in a London suburb at the close of the Second World War constitutes one of the most riveting, humane, and lyrical biographies that one is ever likely to encounter.[**] Fascinating, pyrotechnic, kaleidoscopic, it is a joy to read; and an extra pleasure to animadvert on its contents and qualities.

The history of chemistry, which encompasses almost all its ancient and modern subdisciplines, is captured here, and told retrospectively (and perhaps with a touch of post-event rationalization) through the eyes, heart, and voice of a passionate and precocious teenager, but with the lapidary, literary skills of this distinguished neurologist, now almost 70 years old. Analytical chemistry, radiation and radiochemistry, spectroscopy (from the X-ray atomic to the molecular), the rudiments of quantum theory, electrochemistry, kinetics, photography, and the phenomenology of luminescence (embracing fluorescence, phosphorescence, thermoluminescence, and (obliquely) crystalloluminescence) are all introduced in a nontechnical, and effortlessly compelling manner. How very different is the entire texture of Sacks' exposition and the impact of his magical story-telling—which succeeds in smoothly weaving many disparate scientific activities into the fabric of chemistry—from the aridly factual and desiccated historical discourses that professional philosophers of science sometimes produce, discourses which expunge and excise the intrinsic romance and excitement from great and subsidiary scientific discoveries alike. The remarkable communicative gifts of Oliver Sacks bring to life the vitality, exuberance, commitment, and genius of so many of the founders of modern chemistry. We are told in a fresh and vivid fashion of the essence and significance of the contributions, lives, and publications of Boyle, Scheele, Lavoisier, Dalton, Davy, Crookes, Mendeleev, Kirchhoff and Bunsen, the Curies, Moseley, Bohr, Langmuir, as well as several other less-well-known investigators.

2. The Author

Until this wonderful book came my way, I knew of Oliver Sacks—largely from what my wife had told me—only as the author of *The Man Who Mistook His Wife for a Hat*, the story of a musician of distinction who genuinely made that mistake, a story that was even converted into an opera. My wife had also described Sacks' perceptive *A Leg To Stand On*, a neuropsychological odyssey about a damaged leg[1] (Sacks') and the nature of selfhood, in which he exposed (as the author and critic Anthony Burgess put it) "*the damnable rift that subsists between doctor and patient. The book's value lies in its willingness to combine the technical and the demonic, to admit poetry and philosophy and the religious impulse*".

Born in July 1933, Sacks was educated in an English Public (that is, private) school, St. Paul's, London, before proceeding to the University of Oxford and then to California. He practices neurology in New York City, where he is also clinical professor of neurology at the New York University School of Medicine. His Internet Web page tells us that just as Nietsche claimed that "*Bizet makes me a better philosopher*", so Sacks asserts that "*Mozart makes me a better neurologist*". He tells us also that he was much influenced by the writings of Charles Dickens and H. G. Wells.

It is quite astonishing, given that his principal preoccupation is neurology, that he has such an encyclopaedic and penetrating grasp of the origins and applicability of chemistry, of its major theoretical constructs and key turning points, as well as of its creative and destructive power, its "musicality in the sphere of thought" (to borrow a phrase used by Einstein to describe Bohr's theory of the atom), and its poetic dimension. It is dazzling to discover from *Uncle Tungsten* the sheer body of connected fact that he knew—what he had read and what he had experimented with—by the time he was a mere 14-year-old. I doubt whether there are many young professors of chemistry in respectable universities and colleges these days who could rival, let alone surpass, his corpus of fundamental chemical knowledge or his remarkable powers of pedagogy and exposition. As for his ratiocinative skills and perspicacity,

[*] Prof. Sir J. M. Thomas
The Royal Institution, London
and The Master's Lodge
Peterhouse, Cambridge, CB2 1QY (UK)
Fax: (+44) 1223-339-200
E-mail: has22@cam.ac.uk

[**] *Uncle Tungsten: Memories of a Chemical Boyhood* By Oliver Sacks, pp. 396 + viii, Picador, **2001**

 © WILEY-VCH Verlag GmbH, 69451 Weinheim, Germany, 2002 1433-7851/02/4112-2059 $ 20.00+.50/0

consider the following (pp. 202–203) when the young teenager argues as follows (more than a decade before Neil Bartlett's momentous discovery of the reactivity of the noble gases):

"I think I identified at times with the inert gases, and at other times anthropomorphized them, imagining them lonely, cut off, yearning to bond. Was bonding, bonding with other elements, absolutely impossible for them? Might not fluorine, the most active, the most outrageous of the halogens—so eager to combine that it had defeated efforts to isolate it for more than a century—might not fluorine, if given a chance, at least bond with xenon, the heaviest of the inert gases? I pored over tables of physical constants and decided that such a combination was just, in principle, possible."

Or, again, his discussions on p. 79:

"But the most mysterious and beautiful of all the blues for me was that produced by dissolving alkali metals in liquid ammonia (Uncle Dave showed me this). The fact that metals could *be dissolved at all was startling at first, but the alkali metals were all soluble in liquid ammonia (some to an astounding degree—cesium would completely dissolve in a third of its weight of ammonia). When the solutions became more concentrated, they suddenly changed character, turning into lustrous bronze-coloured liquids that floated on the blue—and in this state they conducted electricity as well as a liquid metal like mercury. The alkaline earth metals would work as well, and it did not matter whether the solute was sodium or potassium, calcium or barium—the ammoniacal solutions, in every case, were an identical deep blue, suggesting the presence of some substance, some structure, something common to them all. It was like the colour of the azurite in the Geological Museum, the very colour of heaven."*

Such passages not only reveal his depth of knowledge, they celebrate the sheer joy of existence, which, as chemists, we are privileged to experience in a profoundly aesthetic and intellectual way.

The omnivorous Sacks even knew of the relatively obscure Urbain, that pertinacious professor of Mineral Chemistry at the Sorbonne, who "*had done fifteen thousand fractional crystallizations to isolate lutecium*" (p. 295); of the discovery of lithium (p. 217); of the Curies' work on radium and polonium; and of Lockyer's discovery of helium (Figure 1). Of the latter he writes (p. 218):

"The wonder of spectral analysis, analysis at a distance, had literary resonances as well. I had read Our Mutual Friend *(written in 1864 just four years after Bunsen and Kirchhoff had launched spectroscopy) and here Dickens imagined a "moral spectroscopy" whereby the inhabitants of remote galaxies and stars might analyse the light from the Earth to gauge its good and evil, the moral spectrum of its inhabitants."*

The young teenager Sacks started to read some philosophy. Leibnitz, because he spoke of "Divine mathematics", appealed to him for he saw that (p. 308):

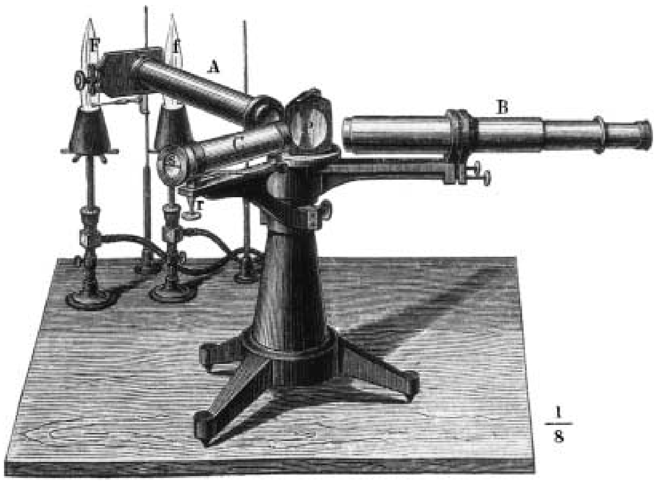


Figure 1. Spectral apparatus designed by R. Bunsen and G. R. Kirchhoff, steel engraving. Photo obtained from the Deutsches Museum, Munich.

"…one could create the richest possible reality by the most economical means, and this, it now seemed to me, was everywhere apparent: in the beautiful economy by which millions of compounds could be made from a few dozen elements, and the hundred-odd elements from hydrogen itself; the economy by which the whole range of atoms was composed from two or three particles; and in the way that their stability and identity were guaranteed by the quantal numbers of the atom itself—all this was beautiful enough to be the work of God."

These philosophical thoughts, and the echoes they carry of Pythagorean and Galilean views of the cosmos, contrast with Sacks' earlier religious feelings (p. 179):

"…I myself, traumatized at Braefield,[2] *had lost touch with, lost interest in, the religion of my childhood. I regret that I was to lose it so early and as abruptly as I did, and this feeling of sadness or nostalgia was strangely admixed with a raging atheism, a sort of fury with God for not existing, not taking care, not preventing the war, but allowing it, and all its horrors, to occur."*

3. A Concatenation of Influential Circumstances

How come that this youngest of teenagers knew such a wealth of facts and ruminated so deeply on their significance? First, he was a member of a large and gifted family and an even larger extended family: his maternal grandparents (the Landaus) had 18 children, most of whom were imbued with an unquenchable thirst for knowledge that characterizes so many of the families who attended synagogues and yeshivas in that era. His parents—both doctors who met at the Ibsen Society—were bookish people who read extensively and experimented freely. The home library contained many of the books that the juvenile Sacks felt impelled to read (such as his mother's copy of Eve Curie's biography of her mother, Marie,

 © WILEY-VCH Verlag GmbH, 69451 Weinheim, Germany, 2002 1433-7851/02/4112-2060 $ 20.00+.50/0

given to the boy when he was just ten); and he early formed the habit of taking advantage of his local municipal library.

As a result of his irrepressible sense of wonder and a self-confessed taste for the spectacular, he readily persuaded his parents to convert one of the rooms in their large house into a chemical laboratory, equipped with a fume cupboard. (His parents were comfortably off, financially; there were two Bechstein pianos in their large detached home, and, when very young, Sacks was taken out by a resident nanny to play with other children.) Above all, however, his uncles and aunts were exceptionally gifted intellectually, and many were resourceful entrepreneurs. Each member of the family, it seemed, was animated by the desire to learn the causes of things (Vergil's famous dictum springs to mind: *Felix, qui potuit rerum cognoscere causas*.[*]

They had voracious appetites for all manner of human endeavours; but two of his uncles, in particular, were extraordinarily scholarly and gifted practical scientists with an eye for the commercial exploitation of their knowledge. They had their own laboratories, workshops (one, even an observatory), and a factory dripping with the kind of equipment that captured Oliver's imagination—a spinthariscope, vacuum pumps, induction coils, ultraviolet and infrared lamps, photometers, photoelectric cells, telescopes, microscopes, pocket spectroscopes, an array of inorganic phosphors, radioactive and fluorescent minerals. Moreover, his uncle Abe (15 years his mother's senior), the more physically and mathematically oriented of the two, had a repository of exotic chemicals such as pitch blende, radium bromide, polonium, as well as old X-ray and Crookes' tubes in his possession. Uncle Dave (the "Uncle Tungsten" of the title) was six years his brother Abe's junior, and was Oliver's chemical and mineralogical uncle. He greatly inspired Oliver because he saw all science as a wholly human, no less than an intellectual and technological, enterprise. There was also his Auntie Len, an admirable lady with a social conscience,[3] who delighted in showing her nephew all sorts of botanical, astronomical, and mathematical pleasures. She showed him as an eight-year-old the spiral patterns on the faces of sunflowers in the garden, and suggested that he count the florets in them. As he did so, she pointed out that they were arranged according to a series: 1, 1, 2, 3, 5, 8, 13, 21…, each number being the sum of the two that preceded it, thereby revealing to him the famous Fibonacci series[4] and all its proliferating charm.

His father's family were also exceptionally talented; indeed Alida, his father's sister, a gifted linguist, worked with Chaim Weizmann (a leader of the Zionistic movement in England) and was responsible for translating the famous Balfour Declaration[5] of 1917 into French and Russian. Her son Aubrey later became (as Abba Eban) the first Israeli Ambassador to the U.N., which is further proof of the remarkable pool of genes from which he emerged.

However, there were two other factors over and above these familial and filial relationships that seemed to have influenced greatly the young and growing Oliver. First, his visits to London's National Museums, especially the Science and Geological ones. These were initiated by his mother when he was about six years of age. From the moment she showed him the Landau lamp (a variant of Humphry Davy's miners' safety lamp), invented in the 1870s by her father, he immediately identified Davy in his mind *"as an ancestor of sorts, almost part of the family"*. Davy was and remains one of Oliver Sacks' heroes. Second, his parents, uncles, and aunts drew to his attention and portrayed the trajectory of the lives of many famous scientists, and the magnanimity of the attitudes and pursuits of many of them. Take, for example, what Uncle (Tungsten) Dave told young Oliver about the great Swedish chemist Carl Wilhelm Scheele (Figure 2), after whom the mineral scheelite, $CaWO_4$, is named (p. 44):

Figure 2. Carl Wilhelm Scheele (1742–1786), statue by Börjeson. Photo obtained from the Deutsches Museum, Munich.

"Scheele was one of Uncle Dave's great heroes. Not only had he discovered tungstic acid and molybdic acid (from which the new element molybdenum was made), but hydrofluoric acid, hydrogen sulfide, arsine, and prussic acid, and a dozen organic acids, too. All this, Uncle Dave said, he did by himself, with no assistants, no funds, no university position or salary, but working alone, trying to make ends meet as an apothecary in a small provincial Swedish town. He had discovered oxygen, not by a fluke, but by making it in several different ways; he had discovered chlorine; and he had

[*] Happy is he who is able to understand the cause of things

 © WILEY-VCH Verlag GmbH, 69451 Weinheim, Germany, 2002 1433-7851/02/4112-2061 $ 20.00+.50/0

pointed the way to the discovery of manganese, of barium, of a dozen other things.

Scheele, Uncle Dave would say, was wholly dedicated to his work, caring nothing for fame or money and sharing his knowledge, whatever he had, with anyone and everyone. I was impressed by Scheele's generosity, no less than his resourcefulness, by the way in which (in effect) he gave the actual discovery of elements to his students and friends—the discovery of manganese to Johan Gahn, the discovery of molybdenum to Peter Hjelm, and the discovery of tungsten itself to the d'Elhuyar brothers.

Scheele, it was said, never forgot anything if it had to do with chemistry. He never forgot the look, the feel, the smell of a substance, or the way it was transformed in chemical reactions, never forgot anything he read, or was told, about the phenomena of chemistry. He seemed indifferent, or inattentive, to most things else, being wholly dedicated to his single passion, chemistry. It was this pure and passionate absorption in phenomena—noticing everything, forgetting nothing—that constituted Scheele's special strength.

Scheele epitomized for me the romance of science. There seemed to me an integrity, an essential goodness, about a life in science, a lifelong love affair. I had never given much thought to what I might be when I was "grown up"—growing up was hardly imaginable—but now I knew: I wanted to be a chemist. A chemist like Scheele, an eighteenth-century chemist coming fresh to the field, looking at the whole undiscovered world of natural substances and minerals, analyzing them, plumbing their secrets, finding the wonder of unknown and new metals."

Sacks' remark about the essential goodness of a life in science, was exactly the sentiment that the young Michael Faraday had expressed after listening to the brilliant lecture-demonstrations of Humphry Davy in 1812.[6]

In retrospect, we see that young Oliver was the beneficiary of a concatenation of fortunate circumstances, not the least important of which was the guidance by precept and example, using the life and work of the Curies, Roentgen, Davy, and others, which uncle Dave and uncle Abe provided.

4. The Success and Uniqueness of the Book

Why is this such an inspiring book, commendable to nonscientists and scientists alike? The reasons are many. Apart from the fact that Sacks is a supremely skilful raconteur, brimming with human sympathy, psychological insight, and emotional commitment, he is also the master of introducing the apt aside, usually contained in his teeming footnotes—which, for example, offer a retrospective medical analysis of Henry Cavendish (p. 121) that concludes that he was a unique autistic genius; or that Eve Curie came to one of his lectures, and he got her to sign the copy of her book on Madame Curie acquired by him fifty years earlier; or the unbearable vividness with which, whenever he now hears Schubert's *Nachtgesang*, he recalls the childhood memory of his mother's figure and voice as she leaned over the piano and sang. In his story-telling gifts he combines the qualities of Primo Levi with the vivid recollections of childhood and adolescent thought reminiscent of the poet Dylan Thomas.[7]

Other keys to Sacks' success here lie in his ingenious way of weaving an enchanting story about a specific technique, instrument, or individual, such as his chapters on (photographic) images, a pocket spectroscope, or Mendeleev and Davy, and his brilliant choice of truly memorable quotations (very few of which, unfortunately, carry a reference to source).

Of dramatic still photographs, Sacks said that they *"confirmed—or did they suggest?—my own very early memories!"*. It seemed to him *"wonderful that photographs could capture actual moments, clean cross sections, as it were, of time fixed forever in silver"*. Photographs *"seemed to me like an extension of my own memory and identity, helped to moor me, anchor me in space and time, as an English boy born in the 1930s, born into a London similar to that in which my parents had grown up, a London which would have been recognizable to Wells, Dickens or Conan Doyle…If photography was a metaphor for perception and memory and identity, it was equally a model, a microcosm, of science at work—and a particularly sweet science, since it brought chemistry and optics and perception together into a single, indivisible unity"*.

For his tenth birthday Auntie Len gave Oliver a copy of Sir James Jeans's book *The Stars in their Courses*, in which he read that the sun contained platinum, silver, lead, and most of the elements we have on earth. When he told his Uncle Abe this, he was given a copy of J. Norman Lockyer's *The Spectroscope*, published in 1878; his uncle also gave him a small pocket spectroscope. Very shortly, young Sacks was grappling with the dark lines Fraunhofer had reported in 1814. Did they, he wondered, have any relation to the bright spectral lines, visible in his spectroscope, of flamed elements? Soon he was reading about the brilliant collaborative efforts of Gustav Kirchhoff and Robert Bunsen (Figure 3). These two

Figure 3. Right: Robert Bunsen (1811–1899) and left: Gustav Robert Kirchhoff (1824–1887). Photo obtained from the Deutsches Museum, Munich.

pioneers and others (notably Lockyer and Huggins,[8] who is surprisingly not mentioned in the book) went on to identify 20 other terrestrial elements in the sun, and soon the Fraunhofer mystery—the hundreds of black lines in the solar system—could be rationalized as the absorption spectra of the elements in the outermost layers of the sun. Exciting accounts are given by Sacks of how Bunsen discovered caesium spectroscopically after concentrating some 44 tons of mineral water rich in sodium and potassium down to a few liters. All this prompted the young Sacks to explore, with his pocket spectroscope, the absorption spectra of blood, leaves, urine, and wine. *"I was fascinated to discover how characteristic the spectrum of blood was even when dried and how small a quantity was needed to analyse in this fashion—one could identify a faint blood-stain more than fifty years old and distinguish it from a rust stain."* (One wonders whether his erudite uncles ever told him that the seminal work of the Nobel Prizewinner, Gowland Hopkins (discoverer of vitamins, Figure 4), who had studied the pigments in butterflies' wings and other chemical physiological problems, was greatly

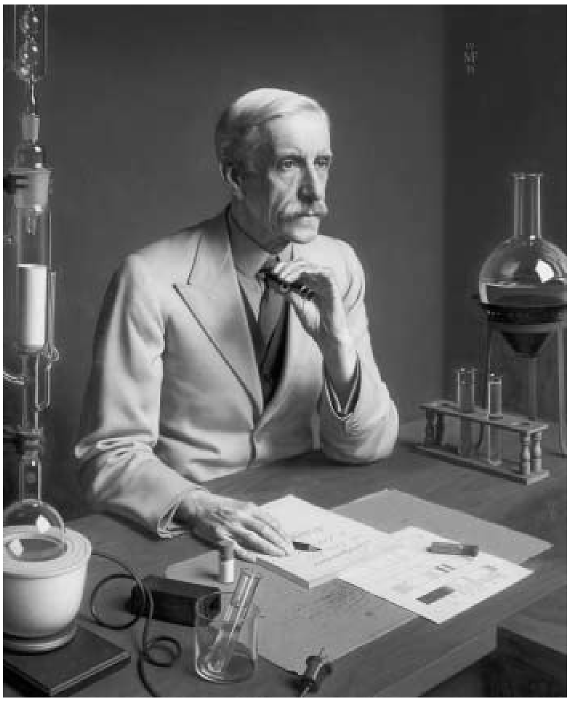
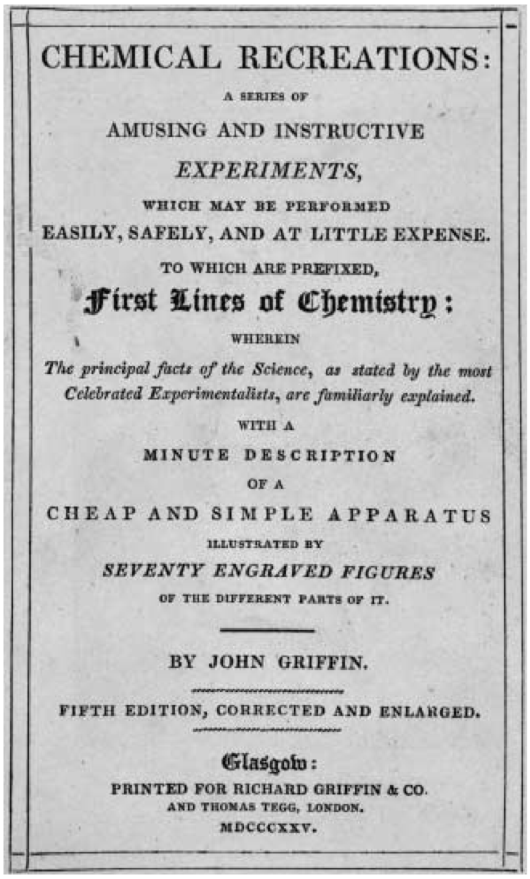


Figure 4. Sir F. Gowland Hopkins (1861–1947) with a pocket spectroscope. Photo obtained from The Royal Society.

aided by a pocket spectroscope.) Sacks recalls going to Piccadilly Circus and Leicester Square, at the heart of neon-lit London, with his pocket spectroscope, and looking at the new sodium lights that were used for street lighting, at the scarlet neon advertisements, and at the other gas-discharge tubes that turned the center of the metropolis into *"a glory of coloured lights after the long blackout of the war"*.

In a marvellously evocative chapter entitled "Chemical Recreations" (Figure 5), Sacks writes:



CHEMICAL RECREATIONS:
A SERIES OF
AMUSING AND INSTRUCTIVE
EXPERIMENTS,
WHICH MAY BE PERFORMED
EASILY, SAFELY, AND AT LITTLE EXPENSE.
TO WHICH ARE PREFIXED,
First Lines of Chemistry:
WHEREIN
The principal facts of the Science, as stated by the most Celebrated Experimentalists, are familiarly explained.
WITH A
MINUTE DESCRIPTION
OF A
CHEAP AND SIMPLE APPARATUS
ILLUSTRATED BY
SEVENTY ENGRAVED FIGURES
OF THE DIFFERENT PARTS OF IT.

BY JOHN GRIFFIN.

FIFTH EDITION, CORRECTED AND ENLARGED.

Glasgow:
PRINTED FOR RICHARD GRIFFIN & CO.
AND THOMAS TEGG, LONDON.
MDCCCXXV.

Figure 5. Chemical Recreations of J. J. Griffin (1825). Reprinted with permission from Cambridge University Library.

"My first taste was for the spectacular—the frothings, the incandescences, the stinks and the bangs, which almost defined a first entry into chemistry. One of my guides was J. J. Griffin's Chemical Recreations, *an 1850ish book I had found in a second-hand bookshop. Griffin had an easy, practical, and above all playful style; chemistry was clearly fun for him, and he made it fun for his readers, readers who must often have been, I decided, boys like myself, for he had sections like "Chemistry for the Holidays"—this included the "Volatile Plum Pudding" ("When the cover is removed … it leaves its dish and rises to the ceiling"), "A Fountain of Fire" (using phosphorus—"the operator must take care not to burn himself"), and "Brilliant Deflagration" (here, too, one was warned to "remove your hand instantly"). I was amused by the mention of a special formula (sodium tungstate) to render ladies' dresses and curtains incombustible—were fires that common in Victorian times?—and used it to fire-proof a handkerchief for myself.*

Griffin suggested experiments with bleaching—here I used my mother's bleaching powder in place of the chlorine water he suggested, and with this I bleached litmus paper, cabbage juice, and a red handkerchief of my father's. Griffin also suggested holding a red ose over burning sulfur, so that the sulfur dioxide produced would bleach it. Dipping it into water, miraculously, restored its colour."

Griffin was himself a remarkable individual: an educator as well as a purveyor of chemical apparatus used throughout Europe. His firm, Griffin & Tatlock[9] was a major supplier to universities until very recently. His skill in capturing a potential audience (and customers) is reflected in the compact and compelling descriptions contained in the cover page of *Chemical Recreations*, fifth edition, Glasgow 1825.

Rhapsodic delight is what the reader senses on reading how Mendeleev's (Figure 6) Periodic Table impressed itself upon Sacks' mind and imagination. Almost every scientist I have ever met admits to succumbing to unqualified admiration and awe when they first encounter the Periodic Table—the exhilarations experienced by C. P. Snow and Freeman Dyson are quoted here—but few, not even Primo Levi, have written

Figure 6. Dimitri Mendeleev (1834–1907). Photo obtained from Bridgeman Art Library.

so eloquently and passionately about Mendeleev's achievement than Oliver Sacks. On seeing it for the first time, the Periodic Table gave him "*for the first time, a sense of the transcendent power of the human mind, and the fact that it might be equipped to discover or decipher secrets of nature, to read the mind of God.*

There was a photograph of Mendeleev next to the periodic table in the museum; he looked like a cross between Fagin and Svengali,[10] *with a huge mass of hair and beard and piercing, hypnotic eyes. A wild, extravagant, barbaric Figure—but as romantic, in his way, as the Byronic Humphry Davy. I needed to know more of him, and to read his famous* Principles, *in which he had first published his periodic table.*

His book, his life, did not disappoint me. He was a man of encyclopaedic interests. He was also a music lover and a close friend of Borodin (who was also a chemist). And he was the author of the most delightful and vivid chemistry text ever published, The Principles of Chemistry.

In his very first footnote, in the preface, Mendeleev spoke of "how contented, free and joyous is life in the realm of science"—and one could see, in every sentence, how true this was for him. The Principles grew like a living thing in Mendeleev's lifetime, each edition larger, fuller, more mature than its predecessors, each filled with exuberating and spreading footnotes (footnotes which became so enormous that in the last editions they filled more pages than the text; indeed, some occupied nine-tenths of the page—I think my own love of footnotes, the excursions they allow, was partly determined by reading the Principles."

An outstanding feature of this book is the rich and appositely chosen quotations that the author incorporates into his text. Almost all of them are worthy of repetition here, but I shall restrict myself to a mere few. Ever since I studied Sir William Crookes's comments on Faraday,[11] I have been aware of the almost hypnotic use of words of which he was capable. Sacks provides (p. 208) an excellent example of Crookes's skills when he quotes the latter's thoughts on the bewildering properties of the rare earth elements:

> *"The rare earths perplex us in our researches, baffle us in our speculations, and haunt us in our very dreams. They stretch like an unknown sea before us, mocking, mystifying, and murmuring strange revelations and possibilities."*

When he describes (p. 266) Madame Curie's (Figure 7) *"outrageous thought (in 1898) that radioactivity might come from the disintegration of atoms"*, he recalls the beautiful words of Clerk Maxwell:

Figure 7. Marie Curie (1867–1934). Photo obtained from the Deutsches Museum, Munich.

> *"Though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the [atoms] out of which these systems are built—the foundation stones of the material universe—remain unbroken and unworn. They continue to this day as they were created—perfect in number and measure and weight".*

Interestingly, we are reminded that, after her bold thoughts about atomic disintegration, Marie Curie withdrew from the idea and finally concluded, with poetic resonance, "*the cause*

 © WILEY-VCH Verlag GmbH, 69451 Weinheim, Germany, 2002 1433-7851/02/4112-2064 $ 20.00+.50/0

of this spontaneous radiation remains a mystery…a profound and wonderful enigma."

5. Envoi

Is this book completely without fault? Not quite; there are a few relatively minor errors of fact. It is not correct to say (p. 127) that Davy was the first scientist to be knighted since Sir Isaac Newton: his immediate predecessor as President of the Royal Society, Sir Joseph Banks, was one, and Newton's successor in the same presidency, Sir Hans Sloane, was another. So also was Sir Benjamin Thompson (Count Rumford), who was the first to offer Davy a Professorship, at the Royal Institution, where, incidentally, Davy first experimented with and invented the electric arc (not at Thomas Beddoes' Pneumatic Institute in Bristol, pp. 119–122).

It is also incorrect to say (p. 266) that J. J. Thomson was one of the founders of the British Psychical Society. He certainly showed an interest in such phenomena, but he was always an arch sceptic.[12] It is also not true to assert (p. 167) that before Maxwell's work in the early 1860s *"no-one had suspected any relationship between magnetism and light"*. Michael Faraday, in 1845, discovered what has since become known as the Faraday effect, the rotation of the plane of polarization of light by a magnetic field—effectively the birth of magneto-optics. In nonstoichiometric compounds (p. 148) such as Fe_7S_8 and Fe_8S_9 there is no substitution of iron by sulphur; and the phenomenon of catalysis (p. 130) was not discovered by Davy, the Arabs knew about it as early as the 8th Century.

But even to recite these minor infelicities seems churlish. This is one of the most enjoyable, stimulating, and rewarding books that I have ever read. It is so replete with poetic insight and expression that I wish I had chanced upon it before addressing a joint symposium of the Akademia Leopoldina and the French Academy at Gottingen on "Poetic Suggestion in Chemical Science" in October 2001. The examples that I cited[13] on that occasion would have been enriched by many splendid ones contained in this memorable tome.

---

[1] When I consulted "A Leg to Stand On", Sacks endeared himself to me by the epigraph of that book taken from Mortaigne's Essays: "*Plato therefore was right in saying that to become a true doctor, a man must have experienced all the illnesses he hopes to cure and all the accidents and circumstances he is to diagnose… Such a man I would trust. For the rest guide us like the person who paints seas, rocks and harbours while sitting at his table and sails his model of a ship in perfect safety. Throw him into the real thing, and he does not know where to begin*."

[2] Braefield is the name of the village in England to which the seven-year-old Oliver was sent as an evacuee from London to the reconstituted preparatory school. His four years there were a misery.

[3] Aunt Len had founded in Cheshire the Jewish Fresh Air School for "delicate children", children from working-class families in Manchester.

[4] Fibonacci, otherwise known as Leonardo of Pisa (ca. 1170–1240) was the most distinguished mathematician of the Middle Ages. He studied calculation with an Arab master while his father was serving as a Consul in Algeria. His best know work is *Liber Abaci* (The Book of the Abacus, published in 1202). In it he made the Arabic numeral system generally available in Europe. The Fibonacci series is said to have arisen from the following problem: A certain man put a pair of rabbits in a place surrounded on all sides by a wall. How many pairs of rabbits can be produced from the pair in a year. If it is supposed that every month each pair begets a new pair which from the second month on becomes productive? The answer is 1, 1, 2, 3, 5, 8, 13… (Fibonacci himself omitted the first term).

[5] The Balfour Declaration (1917), named after A J. Balfour, the British Foreign Secretary in Lloyd George's Government pledged British support for a Jewish national home in Palestine.

[6] John Meurig Thomas in "*Michael Faraday and the Royal Institution: The Genius of Man and Place*", Institute of Physics, Bristol, **1991**. Michael Faraday, while still an apprentice bookbinder aged 21, wrote (in 1812): "*My desire to escape from trade, which I thought vicious and selfish, and to enter into the services of Science, which I imagined made its pursuers amiable and liberal, induced me at last to take the bold and simple step of writing to Sir H. Davy expressing my wishes and a hope that, if an opportunity came in his way, he would favour my views: at the same time I sent the notes I had taken of his lectures."* Faraday began work as Davy's assistant at the Royal Institution on 1 March, 1813.

[7] Some of Sacks' lyrical passages made me think of "*Fern Hill*", the poem written by Dylan Thomas when he was 18 years old: "*And as I was green and carefree, famous among the barns / About the happy yard and singing as the farm was home, / In the sun that is young once only / Time let me play and be / Golden in the mercy of his means…"*

[8] Sir William Huggins (1824–1910), who was President of the Royal Society, 1900–1905, on learning about Kirchhoff's exciting discovery of the chemical composition of the sun from the study of the Fraunhofer line-spectrum, he immediately foresaw that this constituted the key to a novel method of astronomical research to which the remainder of his life was dedicated. One application of stellar spectroscopy to which he turned his attention was that of determining the radial velocity of a star from the displacement of its spectral lines to the red or blue. In a dramatic Friday Evening Discourse[5] given at the Royal Institution on 19 May, 1865, entitled "*On the Physical and Chemical Composition of the Fixed Stars and Nebulal*", Huggins presented spectroscopic proof that the star "Aldebaran" contained hydrogen, sodium, magnesium, calcium, iron, bismuth, tellurium, antimony, and mercury. (W. Huggins, *Proc. R. Inst. G.B.* **1862–1865**, *IV*, 441–449.)

[9] The company is now (and has for some time been) named Griffin & George. The parent company was established in Glasgow in 1826, but it is now part of Fisher Scientific, the world's largest supplier of scientific equipment to industry, education, and governmental contractors in 145 countries.

[10] Fagin is a character in Charles Dickens' novel *Oliver Twist* (1870). The word is now used to denote an adult who instructs others (especially children) in theft and other crimes. Svengali is someone who attempts, usually with sinister motives, to mould another to his will. The name comes from that of a sinister hypnotist in the novel *Trilby* by George Du Maurier (1896).

[11] See Ref. [6], pp. 65–69. An example of Crookes's literary skills is contained on p. 195 of this book on Faraday, in the charming manner in which he wrote the Preface to *The Chemical History of a Candle*: "From the primitive pine torch to the paraffin candle, how wide an interval! Between them how vast a contrast! The means adopted by man to illuminate his home at night, stamp at once his position in the scale of civilization…".

[12] See J. J. Thomson, *Recollections and Reflections*, Chap V, G. Bell & Sons, London, **1936**.

[13] "Proceedings of Leopoldina Symposium on Chemistry and Mathematics: Two Scientific Languages of the 21st Century", edited by H. W. Roesky, G. Ourisson, *Nova Acta Leopold.* **2002**, in press.

 © WILEY-VCH Verlag GmbH, 69451 Weinheim, Germany, 2002 1433-7851/02/4112-2065 $ 20.00+.50/0