THE SCIENTIFIC PUBLICATIONS OF ALEXANDER MARCET

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Supplemental material

Abstract

This paper lists all the publications which can be attributed to Alexander Marcet, a physician, chemist and geologist active during the first two decades of the nineteenth century. The contents of each publication are described and assessed. Marcet was a practicing physician at a time and place when many chemists had medical connections. His chemical work is primarily analytical and it also demonstrates how chemistry might eventually shed light on how the human body deals with the materials it has ingested.

Introduction

Alexander Marcet (1770-1822) and his wife Jane Haldimand Marcet (1769-1858) were active in the circles of natural philosophers in London from about 1800 until well into the nineteenth century. Alexander had been exiled from Geneva in 1794 as a consequence of the French Revolution, and he went to Edinburgh to study medicine under Joseph Black (1728-1799) and his colleagues. After graduation in 1797 he moved to London where he practiced medicine and met Jane Haldimand, whom he married. Later he taught chemistry to medical students at Guy's Hospital. He always retained his interest in the growing science of chemistry, and he built a laboratory in each of two homes in London in which he and his wife lived. In his publications he initially cited his name as Alexander Marcet M.D., adding F.R.S. in 1808 when he was elected to the Royal Society. French was his native language and this enabled him to maintain contacts with French and Swiss researchers, and to act as foreign secretary to, for example, the Geological Society of London. He died in 1822. His scientific activities show how, at the beginning of the nineteenth century, chemistry in Britain was professionally and institutionally intertwined with medicine, even while other chemists were breaking free from it.

Detailed information on Alexander and Jane Marcet is still easily available, and Jane's life, in particular, has been described in considerable detail (1). However, Alexander's professional career has been relatively neglected. This paper is an attempt to illustrate that he was no mere helper to his exceptional wife, but a significant figure in his own right. Indeed, Alexander's interests included not only medicine but chemistry, geology, education, and public health (2).

Once exiled, Marcet decided to study medicine at the School of Medicine of Edinburgh University. At the time this was perhaps the foremost in Europe and it drew students from all over the Continent (3). The Head, Joseph Black being concerned with the nature of heat and fixed air (carbon dioxide), the properties of magnesium compounds (as distinct from those of calcium), and the use of the analytic balance (4), is recognized today by chemists a major figure in the development of chemistry as an independent scientific discipline. Black had been appointed Professor of Chemistry and Medicine at Ed-

inburgh in 1766, and he continued to practice medicine for some time afterward. Modern chemists often do not realize that he continued to be active as a physician while researching and teaching chemistry, and that he became principal physician in Scotland to King George III. Black eventually ceased research because of illness and then devoted himself exclusively to teaching. His teaching was very successful and attendance at his lectures increased from year to year for more than thirty years. He had a powerful effect in popularizing chemistry, through his introduction in his chemistry lectures of new concepts and ideas, and his students spread them and practiced them when they left Edinburgh. In fact, one of those students, John Robison, published Black's lectures on chemistry, based on his notes, after his death (5).

Amongst the medical students whom Marcet had met in Edinburgh, and with whom he continued to interact in London were John Yelloly (1774-1842) and Peter Mark Roget (1779-1869). Roget was the son of a Genevan father and an English mother who was the sister of Sir Samuel Romilly, an eminent politician who paid for Roget's university education. Another of Marcet's London acquaintances was William Hyde Wollaston (1766-1828) who also started studying medicine at Edinburgh, but did not complete his studies there, moving to Cambridge. He also made his reputation as a chemist. Another acquaintance was Smithson Tennant (1761-1815), who had intended to study under Joseph Black, but due to family circumstances finally took a medical degree in Cambridge. Being financially secure, he did not long practice medicine and soon spent his time researching chemistry, identifying the new metals osmium and iridium, for which he is still recognized today. At that time it was generally impossible to study chemistry as an independent discipline in universities in Britain, and where chemistry was taught it was usually within a medical curriculum. Marcet's professional career was a prime example.

Alexander Marcet's Publications

A list of Marcet's publications was published in the *Annual Biography and Obituary* (6). (A copy of the obituary is available as Supplemental Material to this paper.) As was usual at the time, this obituary was published without the writer being identified, but it was certainly Roget, who was a great admirer of Marcet. Nick Rennison, in an account of Roget's life (7) quotes several sentences from an unidentified obituary which Roget wrote of Alexander Marcet. These quotations are to be found word-for-word in the "anonymous" 1823 obituary cited above (6).

Alexander Marcet's publications are listed below, in numbered items, exactly as Roget described them in the obituary, though Roget did not number the items. Here Roget's citations are numbered, followed by a full bibliographic citation (including Marcet's by-line, if any), and summarized. Nearly all are available online at Google Books or the Hathi Trust Digital Library. Supplemental material to this paper gives the text of the bibliographic part of Roget's obituary with links to online versions of Marcet's papers.

Item 1: In 1799, he wrote an account of the History and Dissection of a Diabetic Case (published in the London Medical and Physical Journal, vol. ii. p. 209.)

> **"**Case of Diabetes, with an Account of the Appearances after Death, stated in a Letter to Dr. Rollo." By Alexander Marcet, M.D., member of the Royal College of Physicians, London; and Physician to the City Dispensary. *London Medical and Physical Journal*, **1799**, *2*, 209-213.

Marcet came to London in 1797 and worked first at the City Dispensary. The patient discussed here came to the dispensary in March 1798, suffering from diabetes and phthisis pulmonaris (consumption or tuberculosis). Marcet was not aware of the phthisis pulmonaris before he examined the patient. Dissection revealed nothing which had not been observed before in diabetic cases. The patient customarily consumed "seven or eight pounds of beer, or spirits and water in twenty-four hours." Although Marcet studied diabetes in Edinburgh and wrote his graduation thesis on the disease, this account could not have been from his graduation thesis because the case described here came from London. The urine was sweet, and the patient also suffered from mesentery (the attachment of part of the digestive system to the stomach wall.

Item 2: In 1801, a paper on the Medicinal Properties of the Oxyd of Bismuth. (Memoirs of the Medical Society of London, vol. vi. p. 155.) This paper, though read to the Society in 1801, was not published till 1805.

> **"**Observations on the Medical Use of the White Oxyd of Bismuth." By Alex. Marcet, M.D. &c. Sec. M.S., One of the Physicians to Guy's Hospital. *Memoirs of the Medical Society of London*, **1805**, *6*, 155-173.

This paper resulted from a visit to Dr. Odier in Geneva (Louis Odier, 1748-1817). It was read originally in 1801, but Marcet was later asked to publish it. He discovered that Odier was using magistery (oxide) of

bismuth to relieve stomach pains, especially for women used to carrying loads of water on their heads. Bismuth was sold by perfumers, but Marcet describes its preparation and freeing it from a green color, said to be due to oxide of nickel. He includes many back references, some in German and French, and even presents a large chunk of Latin. Marcet describes several of his own cases, mainly women, all with severe stomach pains and sometimes difficulty in holding down food. Most recovered with the bismuth oxide in time, but one required more treatment with mercurial medicines. Many salts had been tried as medicines in such cases, most without success. Marcet cured four cases out of the six described, and later often used the remedy at Guy's.

This was Marcet's first chemistry paper, and it reflects the habit of these early chemists/doctors of trying new compounds on their patients in the hope that they might effect cures. Marcet took pains to describe cases where the oxide of bismuth proved ineffective, and he recommended similar candor in the description of other prospective medicines.

Item 3: On the Hospice de la Maternité at Paris. (Monthly Magazine for May 1801, p. 311.) To this communication he did not affix his name.

"On the Hospice de la Maternité at Paris." *Monthly Magazine*, **1801**, *11*, 311-313.

A footnote to the published paper states that "This valuable and authentic account was communicated to us by a physician, established in London, who had an opportunity last summer of being an eye-witness to all that is mentioned in this report." As a consequence of the French Revolution, hospitals and poorhouses in Paris were funded by the government and never by individuals or charities, unlike normal practice in England. Marcet visited Paris in 1800 and checked that they were as bad as rumored, though recent improvements had been made. He reported that the buildings were good and clean, and the patients were not hungry, cold, or lacking air, but the medical treatment was worse than in England. Patients did not thank their caregivers, as they would do in a charity hospital, such as Guy's Hospital in London, and the caregivers grew discouraged. There were 20,000 distressed persons in 22 hospitals in Paris. The Maternity Hospital delivered 1500 babies per year and accepted any woman in her eighth month. The midwives were female. They received and cared for abandoned children and sent them to "country nurses" to raise them. These children were paid subsistence until the age of 16, when they were told their parents' names and given a birth certificate.

Item 4: In 1802, Translation of the Report to the Institute of France respecting Paul's Manufactory of Mineral Waters; with a Preface written by himself. This pamphlet was published anonymously.

The Report Made to the National Institute of France, in the Month of December, 1799, by Citizens Portal, Pelletan, Fourcroy, Chaptal, and Vauquelin, Respecting the Artificial Mineral Waters Prepared at Paris by Nicholas Paul and Co. G. Woodfall, London, 1802.

The original was written for a session of the National Institute of Sciences and Arts on 21 Frimaire in Year 8 of the French Republic (December 1799). It lists many sources of mineral waters, apparently duplicated by manufacturing in Paris by Nicholas Paul (who was originally from Geneva). The English text contains no name of a translator, though the document is ascribed to Marcet by Roget. Marcet had a deep interest in the medical uses of mineral waters and their chemical contents, and this may be why he was interested in artificial versions. He was also francophone, so he needed no translator to understand it himself.

Item 5: In 1803, a correspondence appeared between Dr. Marcet and Dr. Jenner, respecting a mode of procuring vaccine fluid, in the London Medical and Physical Journal, vol. ix. p. 462.

London Medical and Physical Journal, **1803**, *9*, 462-466.

This set of correspondence between Marcet and Edward Jenner (1749-1823) concerning methods to safeguard vaccination fluid was published without a title. It comprises a brief introductory letter by Marcet to the editors of the journal, followed by extracts of letters from Jenner to Marcet, Marcet to Jenner, and Jenner to Marcet.

Jenner and Marcet were personal friends, and Marcet was very active in encouraging the wide application of vaccination to treat fevers. There is a discussion of cases where the vaccine for smallpox seems to have caused complications. The vaccine taken from a pustule was originally "stored" on a cotton thread, a lancet or between glass plates, and this sometimes caused other illnesses (!). Marcet recommended glass phials with a ground glass stopper (costing one shilling, £0.05 each). Samples should not be too large and should be kept free of air, but light does not damage the vaccine.

Item 6: In 1805, an Analysis of the Brighton Chalybeate, published in Dr. Saunders's Treatise on Mineral Waters, second edition, p. 331.

"A Chemical Account of the Chalybeate Spring, Near Brighton." In William Saunders, *A Treatise on the*

Chemical History and Medical Powers of Some of the Most Celebrated Mineral Waters…, 2nd ed., Phillips and Pardon, London, 1805, pp 331-402.

This is an extensive account of the analysis of a chalybeate (that is, iron-bearing) spring near the Wick in Brighton. There are no medical uses reported, but his many tests showed that 100 parts of residue dried at 160° (Fahrenheit) contains sulfate of iron 21.2 and sulfate of lime 48.2, muriate of soda 18.0 and muriate of magnesia 8.9, and siliceous earth 1.7, with the remaining 2.0 parts attributed to loss. The water itself contains about 1/13 part of carbonic acid gas by volume. The report refers to much then current work due to Black, Humphry Davy (1778-1829), etc., and shows Marcet's careful chemical analysis. He assumes that salts exist in solution very much as what we would term molecules, so that the various sulfates and muriates (chlorides) were considered to be still present as compounds in solution. The chalybeate spring is probably still present in the area, though not exploited for any medicinal properties, as it apparently once was.

William Saunders (1743-1817) was the first president of the Medical and Chirurgical Society, formed in 1805. Marcet was a founding member and foreign secretary (8). Both Saunders and the Medical and Chirurgical Society figure in a few of Marcet's scientific publications in the next several years.

Item 7: Account of the Case and Dissection of a Blue Girl, in the Edinburgh Medical Journal, vol. i. p. 412.

"Case of a Blue Girl, with Dissection." Communicated by ALEXANDER MARCET, M.D., one of the Physicians to Guy's Hospital. *Edinburgh Medical and Surgical Journal*, **1805,** *1*, 412-416.

Description of the dissection of a young woman maid servant, afflicted in winter with a cough, and shortness of breath. She had worked until 7 weeks previously, then could not proceed, and her menses had stopped. She was blue and obviously very ill. Blisters were applied to no effect. She died and the blue color slowly faded in 24 hours. Her heart was slightly enlarged but not changed otherwise, her lungs adhered everywhere to the inner surface of the chest and the pleural cavities were also shrunken and the insides adhered to themselves. All the blood looked venous.

Item 8: In 1807, an Analysis of the Waters of the Dead Sea, and of the River Jordan. (Philosophical Transactions for 1807.)

"An Analysis of the Waters of the Dead Sea and of the River Jordan." By Alexander Marcet, M.D., one of the Physicians to Guy's Hospital. Communicated by Smithson Tennant, Esq. F.R.S., *Phil. Trans. Roy. Soc. London*, **1807**, *97*, 296-314.

Marcet persuaded friends and acquaintances who travelled abroad to collect suitable water samples for him. He did not travel so widely himself. Small samples were collected and held in corked bottles. The paper describes properties of the Dead Sea, noting its earlier English name of Lake Asphaltite. Its water contains muriates of lime and magnesia, and soda, also selenite. Muriate was analyzed by precipitation of luna cornea (silver nitrate). Analyses were checked against standard solutions he had prepared. He checked analyses by two different methods. Sea water contains 25% salts by dry weight. Water from the River Jordan contains only about 1/300 of the dissolved solids as the Sea water, but the same kinds of salt. The same paper was published in *Nicholson's Journal of Natural Philosophy, Chemistry, and the Arts*, **1808**, *20*, 25-40.

Item 9: In 1809, an Account of the Effects produced by a large quantity of Laudanum, taken internally, and of the means used to counteract those effects. (Medico-Chirurgical Transactions, vol. i. p. 77.)

"Account of the Effects Produced by a Large Quantity of Laudanum, Taken Internally, and of the Means Used to Counteract those Effects." By ALEXANDER MARCET, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Medico-Chirurgical Transactions*, **1809**, *1*, 77-82.

An 18 year old man had taken six ounces of laudanum and was very ill. Copper sulfate solution made him vomit, and he was kept on his feet and active for 24 hours, and fed with various materials, especially perfumes which aid breathing (musk, assa foetida, etc.). After several days the patient recovered completely.

Item 10: A Case of Hydrophobia, with an Account of the Appearances after Death. (Medico-Chirurgical Transactions, vol. i. p. 132.)

"A Case of Hydrophobia, with an Account of Appearances after Death." By ALEXANDER MARCET, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Medico-Chirurgical Transactions*, **1809**, *1*, 132-156.

This was the result of a dog bite some days earlier. The patient was treated with opium and iron sulfate and then potassium arsenite (Fowler's solution). He had paroxysms and fits of anger, as is usual with rabies, and died after six days. Dissection showed few abnormalities in the organs.

Item 11: In 1811, a Chemical Account of an Aluminous Chalybeate Spring in the Isle of Wight. (Geological Transactions, vol. i. p. 213.)

> "A Chemical Account of an Aluminous Chalybeate Spring in the Isle of Wight." By ALEXANDER MARCET, M.D. F.R.S., one of the Physicians to Guy's Hospital, and member of the Geological Society. *Transactions of the Geological of London*, **1811**, *1*, 213-248.

This work was undertaken at the suggestion of Saunders, who says that geologists are not interested in medical or chemical properties, but this spring is exceptionally strong in iron sulfate and aluminum sulfate. The environment and the rocks and their general obvious content (iron, little calcium, etc.) are described using notes of a Dr. Berger. Marcet reports specific gravities (*ca*. 1007.5), apparent acidity to litmus, the production of reddish flakes by air, a blue color with potassium "prussiat," a green precipitate with alkali, and white precipitate with silver nitrate, barium nitrate and chloride. Marble was unaffected by being boiled in it, and the residue after drying and redissolving gave an acid solution. Marcet claimed to identify iron, calcium, and aluminum sulfates and maybe magnesium sulfate, also sulfuric and muriatic acids. These are all considered as compounds present in solution, though he states all the muriatic acid exists in the form of muriate of soda. Then comes an extensive discussion of seven ways to analyze such mineral water samples, followed by a detailed account of the identification and quantification of the various sulfates. Silica was also identified. The quantities involved, which included dissolved gas, are greater than in any other chalybeate spring yet recorded. The medicinal properties of the water should be considerable, but maybe it should be diluted with other water before drinking.

Item 12: An Account of a severe Case of Erythema, not brought on by Mercury. (Medico-Chirurgical Transactions, vol. ii. p. 73.)

> "An Account of a Severe Case of Erythema Unconnected with Mercurial Action." By ALEXANDER MARCET, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Medico-Chirurgical Transactions*, **1811**, *2*, 73-84.

A detailed account of a patient who had recurring attacks of erythema (a reddish inflammation of the skin) over some years. He was treated with saline antimonial mixture. The patient had been treated earlier for gonorrhea with mercury, and this was often the treatment at the time. Most authorities had linked erythema to mercury, and often called it erythema mercurial or even hydrargyria, but Marcet could find no reason to connect this patient's disease to mercury. He quoted another patient with a similar history, but he also found many cases where mercury was not involved at all. Perhaps mercury potentiates a patient for the condition, but clearly it is not necessary.

Item 13: Experiments on the Appearance, in the Urine, of certain Substances taken into the Stomach, in a letter to Dr. Wollaston. (Philosophical Transactions, for 1811, p. 106.)

> "Reply of Dr. Marcet on the Same Subject." ALEX. MARCET. *Phil. Trans. Roy. Soc. London*, **1811,** *101*, 106-109.

This is actually a reply to, and in part, a section of the paper that immediately precedes it: "On the Non-existence of Sugar in the Blood of Persons Labouring under Diabetes Mellitus." In a Letter to Alexander Marcet, M. D. F. R. S. from William Hyde Wollaston, M. D. Sec. R. S., *Phil. Trans. Roy. Soc. London*, **1811,** *101*, 96-109.

This discussion originated in about 1800 when Wollaston gave up medicine, but it was widely believed that sugar could be detected in diabetic blood. In 1797, Marcet had also accepted this. However, Wollaston and Marcet had independently searched for sugar in blood and urine, and had communicated together around 1800, but had never concluded their discussion. The paper relates their various experiments on blood and urine. Sugar could not be found, but they did trace iron through the system of various patients, which included subjecting then to doses of prussiate of potash, apparently without harming them. Mercury salts were also imbibed by some patients, without harm. That some chemicals, after a dosage, could reach the bladder without passing through the blood was not, at that time, recognized.

Item 14: A Chemical Account of Various Dropsical Fluids with Remarks of the Nature of Alkaline Fluids Contained in these Fluids, and on the Serum of the Blood. (Medico-Chirurgical Transactions, vol.ii. p. 340)**.**

> "A Chemical Account of Various Dropsical Fluids with Remarks of the Nature of Alkaline Fluids Contained in these Fluids, and on the Serum of the Blood." By ALEXANDER MARCET, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Medico-Chirurgical Transactions*, **1811**, *2*, 342-384.

Marcet examined samples taken from different sources in bodies afflicted with cases of spina bifida, hydrocephalus or several kinds of dropsy. He tried a range of chemical tests, many quantitative, employing reagents such as alcohol, lead acetate, silver nitrate,

barium chloride, oxymuriate of platina (sic). Among the "animal matter" he found albumen in highly variable proportions but not gelatine. The ionic nature of salts in solution had not been recognized in 1811, and analytical efforts were directed to identifying the individual species of salts in solution. He also found potassium in small amounts, but always rationalized in terms of compounds such as muriate of potash. He used specific gravity as a measure of the fluids, but noted that the specific gravity of serum varies with the patient and also with time in a single patient. His results differed from those of Dr. George Pearson (1751-1828), M.D. F.R.S., physician to the Duke of York and his household.

In a footnote (p 356), Marcet pays tribute to the growing power and diminishing discomfort of chemical analysis: "The large dismal, subterraneous laboratory of the old chemists is now changed for the fire-side of a comfortable study; and a new school is arising under his [Wollaston's] auspices, and of those of two or three other British chemists, which promises to give a most essential impulse to the progress of analytical chemistry."

This paper of Marcet's prompted a rejoinder by Pearson, published both in *Philosophical Magazine* and in *Nicholson's Journal* (9). Pearson's letters led in turn to responses by Marcet, summarized under Item 15. Pearson had published papers in 1809 and 1810 on Expectorated Matter and Purulent Fluids, which discussed their alkaline content, and in which some results differed from those reported by Marcet. In particular, Pearson had reported that phlegm and pus contain potash and not the soda which Marcet had found in his biological materials. He promised a few more words on the subject for the next issue of the journals. Pearson was evidently classically educated, and apart from quoting Lord Bacon in Latin also expressed his respect for both Marcet and for his putative collaborator Wollaston.

Items 15: In 1812, he was engaged in a controversy with Dr. Pearson, respecting the nature of the Alkali existing in the Blood. (See Nicholson's Journal, vol. xxxii. p. 37; and Philosophical Magazine, vol. xxxix.)

Together with a correspondence with Dr. Bostock on the same subject. (Nicholson's Journal, vol. xxxiii. p. 148. and 285.)

15a: "An Answer to the Observations of Dr. Pearson (see our last Number) on Certain Statements Respecting the Alkaline Matter Contained in Dropsical Fluids, and in the Serum of the Blood." By Alex. Marcet, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Philosophical Magazine*, **1812**, *39*, 122-127. The same letter also appeared in *Nicholson's Journal of Natural Philosophy, Chemistry, and the Arts,* **1812**, *31*, 230-236.

Marcet professes a disinclination to engage in public philosophical controversy. Nevertheless, he stands by his finding that the only uncombined alkali he found in his fluids was soda and not potash. He had isolated by various procedures subcarbonate of soda, some muriate of soda and a small quantity of muriate of potash, but never any carbonate of potash. He confirmed that there had been a source of potassium present by testing with oxymuriat of platina and with tartaric acid; these reagents yield precipitates with potash but not with soda. But the uncombined alkali he identified as soda on the basis of the crystals formed on combination with nitric acid. He wonders whether Pearson was worried by Marcet working on very small quantities of material, rather than with the large quantities Pearson had used. Even the esteemed Joseph Black used small quantities to analyze Iceland springs. Microscopic examination of crystals, which Marcet had used, and small-scale analysis have enabled the identification of five kinds of urinary calculi, four new metals in the ore of platina, the similarities of meteoric stones, the identity of metallic bases of alkalis, and the bases of crystallography. Repetition of these works on a larger scale has simply confirmed the earlier small-scale results. He also accuses Pearson of misquoting his statements and attributing to Marcet and Wollaston (whom Marcet admires greatly) findings which were Marcet's alone. His work may contain errors, but none which Pearson has claimed to identify.

Pearson, having been prevented by "a severe accident" from writing the further comments he had wished to make on Marcet's paper on dropsical fluids (Item 14) found that he now had an additional letter by Marcet to which he must respond. He did so, again in both *Philosophical Magazine* and *Nicholson's Journal* (10). Pearson does not wish to enter a polemical discussion either, but feels it necessary in the cause of science to write further, in the hope that others may be stimulated to take part in a learned controversy. Nevertheless, his writing is sometimes ironic. There is an argument about the advantages and disadvantages of working on small amounts of test material, which Marcet preferred, but Pearson refers to some lessons he had learned from his teacher, the redoubtable Professor Joseph Black, and claims that results obtained from large samples are more reliable. Pearson hopes that this discussion is now concluded.

15b: "A Correspondence between Dr. Bostock and Dr. Marcet, on the Subject of Uncombined Alkali in Animal Fluids." J. Bostock and Alexander Marcet.

Philosophical Magazine, **1812**, *40*, 176-179. The same letter also appeared in *Nicholson's Journal of Natural Philosophy, Chemistry & the Arts*, **1812**, *33*, 147-151.

This correspondence is essentially a letter from Marcet to John Bostock (1773-1846) introduced by Bostock and forwarded (with Marcet's permission) to the editors of the journals in which the controversy had already appeared. Concerning the Marcet-Pearson discussion, Bostock had originally believed Pearson that the uncombined alkali in blood is potash, but after correspondence with Marcet and repeated experiments Bostock is now convinced that the alkali is soda, as a letter from Marcet shows. (By potash and soda, the researchers were referring to KOH and NaOH respectively.) Marcet repeated his experiments to show that the uncombined material identified by Bostock as potash was, in fact, muriate of potash. Conclusion: "… that the potash which exists in the animal fluids, is in the state of muriat, and that the whole of the uncombined alkali is soda."

Pearson was not convinced, though, as he wrote in both journals (11). He states that Marcet should have produced new facts, not conclusions supported by authority. He questions Marcet's interpretation of his results at considerable length. He also states that he "never contemplated potash as existing in an uncombined state in the animal fluids, but in reality in combination with a destructible acid, or with animal oxide." He believed that the acid was malic acid, and after talking with Berzelius (then in London visiting Marcet!) discovered that Berzelius thought the acid might be lactic acid. He finishes with a note that Marcet should not be offended by his jocular style of writing. No offence was intended. "... a public-spirited man will always make sacrifices for the benefit of the republic." Pearson hopes that if the disagreement continues, then utmost politeness would be observed.

This whole correspondence represents a problem which current science would not recognize as such.

Item 16: In 1813, a paper on Sulphuret of Carbon, written conjointly with Professor Berzelius. (Philosophical Transactions for 1813, p. 171.)

"Experiments on the Alcohol of Sulphur, or Sulphuret of Carbon." J. Berzelius, M.D. F.R.S. Professor of Chemistry at Stockholm and Alexander Marcet, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Phil. Trans. Roy. Soc. London*, **1813**, *103*, 171-188. An appendix due to Berzelius alone follows on pp 188-199.

Jöns Jacob Berzelius (1779-1848) visited the Marcets in the summer of 1812 and worked in Marcet's laboratory. This paper and appendix seem to be the products of this collaboration. The oil treated in the paper was first described in 1796 and shown by Clement (Nicolas Clément, 1779-1841) and Desormes (Charles Bernard Desormes, 1777-1862) to be formed from sulfur and charcoal. Others thought it might contain hydrogen, and perhaps no carbon. The quantitative work reported is due to Berzelius. The paper describes the preparation from sulfur and carbon at red heat, and then distilled. They measured its specific weight, refractive power, vapor pressure ("expansive power"), and boiling point (110-115°F). It does not congeal above –60°F. It is highly flammable. They investigated its chemical properties, including the reaction with oxymuriatic acid gas (which Davy had recently renamed chlorine). Combustion yielded sulphureous acid gas, carbonic acid gas and carbonic oxide gas. They failed to detect combined hydrogen reacting with metal oxides, but they proved presence of carbon by generating carbonate of barytes. Analyses for carbon and sulfur using Mr. Dalton's "particle weights" and Davy's analytical data give C:S as 1:2 and no other element present. (That is, the compound was what would later be named carbon disulfide.) The Appendix contains the experimental data, all weights in grammes rather than grains and consistent with the law of determinate proportions. Berzelius noted that different sulfurets contain different proportions of sulfur S, which they cannot explain, but sulphureous acid gas is S:O as 1:2. Berzelius prepared carbosulfurets by reaction with various "alkalis" (bases including ammonia, lime, barytes, strontian, caustic potash and soda). Aqua regia produces an acid substance which Berzelius calls *acidum muriaticum sulphuroso-carbonicum* and whose analysis he interprets in terms of Daltonian atoms as a combination of one carbonic acid, one sulfureous acid, and two muriatic acid. Berzelius was interested in chemical nomenclature, which was still rather unsystematic in 1816, and in the particle theory of John Dalton (1766-1844), which dates from 1803 (12), and his law of partial pressures which was even slightly earlier (13).

Item 17: On the intense Cold produced by the Evaporation of Sulphuret of Carbon. (Philosophical Transactions for 1813, p. 252.)

"Experiments on the Production of Cold by the Evaporation of the Sulphuret of Carbon." By Alexander Marcet, M.D. F.R.S., one of the Physicians to Guy's Hospital. *Phil. Trans. Roy. Soc. Lond.,* **1813**, *103*, 252-255.

Marcet showed that the compound characterized in the previous item (i.e., carbon disulfide) is so volatile

that it can produce severe cooling on evaporation and he also used a vacuum pump to magnify the effect. He measured the "elastic force" (pressure) of its vapor and found it comparable to that of ether as reported (14) by Dalton. Evaporation of a few drops of the liquid into a Torricellian vacuum at room temperature reduced the temperature to 10°F, lower than with alcohol or ether. A thermometer bulb wrapped in a cloth soaked in the liquid can be brought to –81°F with the aid of a good vacuum pump.

Item 18: On the Congelation of Mercury by means of Ether and the Air-pump. (Nicholson's Journal, vol. xxxiv. p. 119.)

> An Account of some Experiments on the Congelation of Mercury, by Means of Ether. By Alexander Marcet, M.D. F.R.S., *Nicholson's Journal of Natural Philosophy, Chemistry & the Arts*, **1813**, *34*, 119-121.

Marcet was fascinated by attempts to produce low temperatures and demonstrated to family and friends how they could be achieved using ether. This paper mentions an experiment of John Leslie (1766-1832) freezing water by evaporation of water using an air pump, but Marcet could not repeat Leslie's experiment of similarly congealing mercury in the bulb of a thermometer. However, this can be easily achieved using ether rather than water in an arrangement similar to that employed in Item 17. He reached –45°F from a room temperature of above 50°F. The method also works with mercury in an open tube, and so the solid may be examined. In addition he used Wollaston's ingenious cryophorus, which had been described in print in 1813. He also reported seeing what we would now term super-cooling of water.

Item 19: Observations on Klaproth's Analysis of the Waters of the Dead Sea. (Thompson's Annals of Philosophy, vol. i. p. 132.)

> "Observations on Mr. Klaproth's Analysis of the Water of the Dead Sea." By Alex. Marcet, M.D. F.R.S., one of the Physicians to Guy's Hospital. *Thomson's Annals of Philosophy,* **1813**, *1,* 132-135.

The results published by Martin Klaproth (1743-1817) differed from the ones Marcet had published earlier in *Phil. Trans*. (Item 8). Marcet made up standard solutions and analyzed them to check the accuracy of his analytical methods, and then repeated and confirmed his Dead Sea analyses as published. The Dead Sea contains muriates of magnesia and lime, muriate of soda, and sulfate of lime. Marcet attributed the discrepancy between his results and those of Klaproth to "desiccation." Today we would probably ascribe the differences to loss of water of hydration or of crystallization.

Item 20: An easy Method of procuring an intense Heat. (Ibid. vol. ii. p. 99.)

> "On an Easy Method of procuring a very intense Heat. By A. Marcet, M.D. F.R.S. Physician to Guy's Hospital. *Thomson's Annals of Philosophy,* **1814**, *2*, 99-100.

The method simply involves introducing oxygen gas into a lamp flame of burning spirit of wine. This enables higher temperatures to be exerted on larger volumes than hitherto. This enables diamond to be burned and platinum metal to be drawn into wire (as demonstrated by Wollaston).

Items 21: In 1814, the articles Potassium and Platina, in Rees's Cyclopedia.

> "Platina" (in Vol. 27) and "Potassium" (in Vol. 28). In *The Cyclopaedia or Universal Dictionary of Arts, Sciences and Literature*. Abraham Rees … with the Assistance of Eminent Professional Gentlemen. Longman, Hurst, Rees, Orme, & Brown, London, 1819.

The *Cyclopaedia* edited by Abraham Rees (1743-1825) appeared serially over the period 1802-1820. When it was published as a set of 39 bound volumes, each volume carried the date 1819. The volumes containing "Platina" and "Potassium" appeared in 1814 (15). No authors are named in the text, but Marcet is listed in the editor's preface among the contributors on chemistry, along with such luminaries as Dalton and Davy (16). Roget ascribes these particular articles to Marcet (6). Page numbers are not printed. Counting the first page on which an article appears as p 1, the entry "Platina" falls on pp 678-681 (of Vol. 27) and "Potassium" on pp 303-304 (of Vol. 28).

Platina (also called platinum by some recent writers) is a noble metal, unaffected by air and moisture. The ores originate mainly from South America, but now also from Estramadura (Extremadura) in Spain. Ores contain up to 80% pure metal, but also no less than four new metals, iridium, osmium, rhodium and palladium as well as more common metal-based impurities. Marcet describes methods of platinum metal recovery from the ores and ascribes the new metals to Tennant (1804) and also iridium and osmium to Wollaston (1805). Platinum metal utensils were rare but becoming more common, though still expensive. They are useful for experimental chemistry. Wollaston used platinum to make fine wires for electrical experiments, and Marcet copied him in this. There follows an account of the chemistry of platinum and of some of its derivatives. Large platinum vessels

are used in the manufacture and distillation of vitriolic (sulfuric) acid in batches of more than 300 pounds.

Potassium, the basis of potash, arose from early experiments on electrolysis, often in Britain and above all by Davy, an example of "British genius." There follows an account of the chemical properties of potassium. Marcet notes that Davy objects to the name muriate of potash because the compound contains neither muriatic acid nor potash, but potassium and chlorine, though many eminent chemical philosophers disagree with him, so the matter is still "sub judice." Soda also yields a similar reactive metal. Larger quantities of potassium can be obtained without electricity using iron turnings at white heat and melted potash in a curved gun barrel, air excluded. The large quantities so obtained are identical in properties to those described by Davy.

Item 22: Account of the Public Schools at Geneva. (Monthly Mag. for 1814, vol. xxxviii. p. 221. and 307.)

> "A Concise Account of the Public Establishments for Education at Geneva; Extracted from a Letter Written by an English Traveller to a Friend in London." *Monthly Magazine,* **1814***, 38*, 221-225, 307-313.

The letter was published in two parts. There is no writer identified, but some correspondence about ten years earlier between Marcet and the editor of the *Gentleman's Magazine,* Charles Aikin (1775-1847), shows that Marcet had wished to describe in an article the reactions of an Englishman to visiting Geneva. In mid-1803 Alexander was thinking of Jane's work being published as articles in a magazine, not as a book, and was also trying to publish some favorable publicity concerning his home city, Geneva, though an earlier effort had not been accepted. Aikin's letter (17) runs as follows:

> Dear Sir
>
> I return you the account of Geneva which I have read with singular pleasure & satisfaction. With regard to the assumed character of an English traveller, one might perhaps be inclined to suspect him to be a true Genevan at heart, but the real matter of fact which is related is such as amply to justify the esteem for the Republic which is so cordially expressed. In any form it will be a very valuable acquisition for the Magazine, but as I am glad to find it longer than I expected, I should tell you that it will be beyond the length of a single letter in a journal in which variety is always as much as possible consulted. It would make two or even three very interesting letters...

However, the articles do not appear to have been published in the *Gentleman's Magazine*, whatever their length.

The two articles seem to have been derived from the same basis as the report written by Marcet for the Archbishop of Canterbury at a time when the Church of England was considering setting up a system of public schools for the public at large, and Geneva might have been a model. The original of that report is to be found in the library of Lambeth Palace. The account states that the education system in Geneva was open to all citizens and free of cost. The letters describe the Geneva system together with details of persons and contemporary events. Marcet had close contacts with Geneva, but there is no record of him visiting there in 1814. Though there is no doubt that although Marcet wrote the letter as published, the precise source of some of the information contained in it is not evident. However, Marcet had certainly himself passed through that education system before being exiled in 1794.

The articles purport to be a letter to a friend seeking a place on the Continent where his son might learn French. The system of public education in Geneva is devoted to three classes: childhood, adolescence, and professional studies covering divinity, law and physic. The first class, being "similar to our public schools of Eton and Winchester" is called a College. These are not boarding establishments, though the pupils remain there all day from ages 5 or 6 to ages 14 to 15. There is no fagging or flogging. Pupils are assessed each year before being allowed to advance, after a public ceremony which the writer claims to have attended on June 20, 1814. The various lectures and the following handsome collation are described in detail. The adolescent department corresponds in some measure to Oxford and Cambridge and the course lasts four years. Teaching religion is very important, but since the lower classes, and especially the female children did not, in the past, receive more than basic instruction in reading and writing, early morning and late evening schools superintended by clergy have been established, where young people may be instructed without interfering with their ability to work a full day.

All the schools are free, also to foreigners. The School of Divinity has 60 students, candidates for ordination. There is a Department of Law, which includes Philosophy and combines moral and natural Philosophy and Mathematics, taught by several eminent philosophers, including Messrs. Prevost (Pierre Prévost, F.R.S., 1751-1839), Pictet (Marc-Auguste Pictet, 1752-1825, founder and editor of the *Bibliothèque Britannique*) and L'Huilier (Simon L'Huilier, 1750-1840). The professors in the School of Medicine include Odier, De La Rive (Charles-Gaspard De la Rive, 1770-1834), and De

Roches, all Fellows of the Royal Medical Society of Edinburgh, and there are professors of anatomy, zoology, mineralogy, and chemistry. Clearly the system of education in Geneva has been well designed and employs very distinguished teachers.

Item 23: In 1815, some Experiments on the Chemical Nature of Chyle; with a few observations upon Chyme. (Medico-Chirurgical Transactions, vol. vi. p. 618.)

> "Some Experiments on the Chemical Nature of Chyle with a few Observations upon Chyme." By Alexander Marcet, M.D. F.R.S. One of the Physicians to Guy's Hospital. *Medico-Chirurgical Transactions*, **1815**, *6*, 618-631.

Chyle is a milky bodily fluid consisting of lymph and emulsified fats, or free fatty acids, formed in the small intestine during digestion of fatty foods, and taken up by lymph vessels specifically known as lacteals. Marcet analyzed chyle from an animal which had eaten solely vegetable food and from another which had eaten solely animal food. The principal constituent of the former is albumen, but dry distillation also yields carbonate of ammonia and a heavy oil. The latter contains less charcoal but more carbonate of ammonia, oil, and cream-like matter; it also contains much albumen. Chyme or chymus is the semi-fluid mass of partly digested food that is expelled by the stomach, through the pyloric valve. Chyme slowly passes through the pyloric sphincter and into the duodenum, where the extraction of nutrients begins. It contains albumen, but that from vegetable food (the only kind he analyzed) contains much more solid matter than other animal fluids and four times as much charcoal as chyle from animal food, though less saline matter. Neither chyle nor chyme contains gelatine.

Items 24: In the same work there have appeared, at different times, communications from him on the subject of the employment of Nitrate of Silver as a Test of the presence of Arsenic. (See vol. ii. p. 155.; vol. iii. p. 342.; and vol. vi. p. 663.)

> **24a:** "A Case of Recovery from the Effects of Arsenic; with Remarks of a New Mode of Detecting the Presence of this Metal." By Peter M. Roget, M.D. *Medico-Chirurgical Transactions*, **1811**, *2*, 136-160.

This "same work" is *Medico-Chirurgical Transactions*, cited in Item 23 above. The paper details an attempted suicide by consuming "white arsenic," after which the patient was treated with a lot of water, then magnesium sulphate, potassium bicarbonate and tartarised antimony. The patient was kept warm and blistered. Roget also administered Ol. Ricini (Oleum Ricini, or castor oil), Capt. Statim Aq. Menth. Pip. (peppermint water, taken immediately) and Mist. Camphor (an alcoholic solution of camphor) with Aq. Font. (spring water). Marcet helped in the treatment. Castor oil and barley water were also administered. The patient was treated with a range of substances and silver nitrate was used to detect arsenic.

Roget and Marcet tested the sensitivity of their method of detecting arsenic, which employed silver nitrate, on small quantities of arsenic, a Marcet specialty. The last few pages of the paper (155-160) contain an extended description, with appropriate literature references, of Marcet's joint work with Roget to determine whether arsenic was detected in the material ejected from the patient's stomach. In fact none was.

> **24b:** "Some Remarks on the Use of Nitrat of Silver, for the Detection of Minute Portions of Arsenic." By A. Marcet, M.D. F.R.S. one of the Physicians to Guy's Hospital. *Medico-Chirurgical Transactions*, **1812**, *2*, 343-347. The same paper also appeared in *Nicholson's Journal of Natural Philosophy, Chemistry, and the Arts*, **1813**, *34*, 174-177.

This paper notes that Roget's patient described in Item 24a had recovered. Its main purpose was to discuss and surmount an objection raised in the literature to the method used. The objection, raised by Charles Sylvester in a letter to *Nicholson's Journal* (18), was about interference with the test by the presence of muriatic (hydrochloric) acid, likely to be found in the stomach.

24c: "Note on the Use of Nitrat [sic] of Silver, for the Detection of Arsenic, in Reference to a Paper on this Subject in Vol. III of the Society's Transactions." By Dr. Marcet. *Medico-Chirurgical Transactions*, **1815**, *6*, 663-664.

The use of silver nitrate to detect arsenic by causing a yellow precipitate may by misleading if phosphate is also present, since this also causes a yellow precipitate. The precipitate should be checked by heating with charcoal (to produce visible metallic arsenic) or using alkaline copper sulfate (to produce Scheele's Green).

Item 25: In 1816, Particulars respecting the Case of Professor De Saussure. (Ibid. vol. vii. p. 228.)

> "Additional Particulars, Connected with Professor De Saussure's Case." Communicated by Dr. Marcet, M.D. F.R.S. Physician to Guy's Hospital. *Medico-Chirurgical Transactions*, **1816**, *6*, 228-236.

H. Benedict de Saussure (1740-1799), who had been Professor of Medicine at the Academy of Geneva, had

died of hemiplegia (a form of paralysis that affects just one side of the body) in unfortunate circumstances. The case was described by Odier in detail in the paper immediately preceding Marcet's paper noted here (19). Marcet here details that, while he was studying in Edinburgh (1794-1797), he received a request from De Saussure *via* his relative, Professor Prévost in Geneva, to beg Dr. Black to provide the details of the treatment of the historian and moral philosopher Prof. Ferguson (Adam Ferguson, 1793-1816), who also suffered from hemiplegia and who was cared for and cured by Black. These details, "drawn up by Dr. Black, in May, 1797" were sent as requested. It is notable that Black's reputation is now as a chemist, though in 1797, he was still practicing medicine. After receiving the details, De Saussure had written to Marcet thanking Black profusely and, as a sick person and a lover of geology, expressing the wish to visit him to benefit from his acquaintance. However, Black's regime was very demanding and seems to have required fasting. De Saussure could not follow it and he died in 1799.

Items 26: On the Medicinal Properties of Stramonium, with illustrative Cases. (Ibid. vol. vii. p. 551.) And on the Preparation of the Extract. (Vol. vii. p. 594.)

> **26a:** "On the Medicinal Properties of Stramonium; with Illustrative Cases." By Alexander Marcet, M.D. F.R.S, Physician to Guy's Hospital. *Medico-Chirurgical Transactions*, **1816**, *7,* 551-575.

Datura Stramonium (Thornapple) extract reduces pain more effectively than any other narcotic. It can be chopped up and smoked to relieve asthma. Generally the seeds are poisonous but a seed extract can be used with care. It was a folk remedy. The paper contains a general account of several different cases, from asthma, through sciatica to cancer, though the beneficial effects for pain relief were limited.

> **26b:** "Additional Particulars on the Preparation of the Extract of Stramonium, by Dr. Marcet, in Reference to the Paper Published by Him, in the Last Volume of these Transactions, (p. 551)." *Medico-Chirurgical Transactions*, **1817**, *8*, 589-592.

Apparently the efficacy for pain-relief diminishes with repeated use, and this had already been noted by Dr. Hudson. His attached letter describes how the method of extraction affects the quality of the product. Further work is necessary to optimize the extraction of a suitable, stable material.

Items 27: In 1817, appeared his valuable work, entitled "An Essay on the Chemical History and Treatment of Calculous Disorders;" of which a second edition was published in 1819.

> *An Essay on the Chemical History and Treatment of Calculous Disorders*. By Alexander Marcet**,** M.D. F.R.S. Physician to Guy's Hospital. Longman, Hurst, Rees, Orme, and Brown, London, 1817. Second edition, revised and enlarged, 1819.

The publishers of this essay were also Mrs. Marcet's publishers. The essay was dedicated to Wollaston, who was also interested in calculi. Marcet had an interest in lithic acid (now known as uric acid or, systematically, as 2,6,8-trioxypurine), gout and calculous disorders. It was "gout of the stomach," presumably a calculous disorder, which eventually killed him**.** The text covers about 200 pages, and Marcet noted that the nature of the calculi and the occurrence of calculi in his patients seemed to vary with where they lived. He therefore became interested in analyzing them, to discover whether this would inform him of the nature of their generation. (Figure 1, a plate from the monograph, shows some of the common tools of wet analytical chemistry he practiced.) However, he considered such stones to be essentially mineral materials since the idea of organic and inorganic compounds as classes was not yet recognized. However, one of the stones he discovered and characterized was actually the first recorded description of xanthine. He used alkali to dissolve calculi, and considered diet too, advising against animal food. He isolated calcium oxalate from calculi and noted that lithic acid was excreted in some cases. The essay contains pictures of sections of various calculi, and also of a typical laboratory of the period.

The title page lists him as a lecturer on chemistry at Guy's Hospital and a member of various medical societies in in Stockholm, Paris, Edinburgh, Geneva and London. Physician to the Spanish Embassy in London was added in the second edition.

Item 28: In 1819, he published an introductory Clinical Lecture. History of a Case of Nephritis Calculosa, in which the various periods and symptoms of the disease are strikingly illustrated; and an Account of the Operation of Lithotomy, given by the patient himself. (Med.-Chir. Trans. vol. x. p. 147.)

> "History of a Case of Nephritis Calculosa, in which the Various Periods and Symptoms of the Disease are Strikingly Illustrated, and an Account of the Operation of Lithotomy, Given by the Patient Himself." By Alex. Marcet, M.D. F.R.S. one of the vice-presidents of this society. *Medico-Chirurgical Transactions*, **1819**, *10*, 147-160.

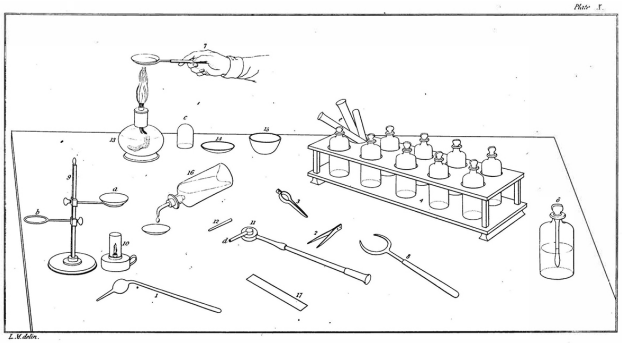

Figure 1*. Plate X from Item 27, second edition (1819) depicting common tools of the wet analytical chemistry Marcet practiced. They include 1) glass blowpipe; 2-3) small platinum tongs; 4) tray for test-bottles and tubes; 6) test-bottle with glass dropper attached to the stopper; 7) use of an appropriate support for suspending a watch glass (or other object) over a spirit lamp; 8) the support used in 7; 9) stand to support watch-glasses or cups over a lamp; 10) lamp; 11) brass blowpipe; 12) a platinum tip for 11, fitting at d; 13) spirit lamp, with a glass cup, c, to cover it, when not used; 14) watch-glass; 15) glass capsule; 16) bottle, with a tube through its cork, to obtain water drop by drop; 17) slip of common window glass.*

The introductory clinical lecture, may be distinct from the published article cited here. Information on Marcet's teaching at Guy's is not easily to hand, though he did contribute to a revised syllabus of chemistry taught to Guy's Hospital students. (See Item 34 below.) An account of the teaching and research on chemistry at Guy's Hospital which includes the period when Marcet was active there has been published (20).

This paper from *Transactions* describes the case of a man who started discharging a white chalky substance, and who later developed pain, retching and constipation. His kidneys had been affected. A stone developed in the bladder. The stone was eventually removed by forceps via the urethra, and the patient himself describes in considerable detail his feelings and reactions during the removal. On the whole, he considered the pain he experienced during the incision and extraction—without anesthesia, of course—to have been less than what the stone itself had caused in one night. The calculus was fusible and Marcet advised discontinuation of alkaline remedies but to take muriatic acid. The patient's health varied, and he did hemorrhage blood. He passed small calculi of phosphate of lime, and magnesia reappeared after the muriatic acid treatment ceased.

Item 29: On the Specific Gravity and Temperature of Sea-Waters, in different parts of the Ocean, and in particular Seas; with some account of their saline contents. (Philosophical Transactions for 1819, p. 161.)

> "On the Specific Gravity, and Temperature of Sea Waters, in Different Parts of the Ocean, and in Particular Seas; with some Account of their Saline Contents." By Alexander Marcet, M.D. F.R.S. &c. *Phil. Trans. Roy. Soc. London*, **1819**, 161-208.

A whole series of measurements in apparatus designed by Marcet on waters sourced from various parts of the globe. Altogether some 68 samples are listed, with the names of the collectors. Marcet attempted to correlate density to characteristics of the source such as temperature and depth. Warmer waters appear to be a trifle denser than colder waters. In general, the deeper the sample origin, the denser the water. The temperature of the water generally drops with depth but sometimes the converse occurs: in Davis Straits in Baffin Bay the surface is warmer than at depth whereas to the east of Greenland and further north the opposite occurs. The differences are perhaps related to the North-west Passage. With Wollaston's urging he detected potassium in sea water, isolating it as potassium chloroplatinate, though he did not use this name. Principal saline contents are muriate of soda and of magnesia, and also sulfuric acid and lime. He imagined the salts (as chlorides or sulfates) persisted in solution, but he did not know which part partnered which. We now know that this is a meaningless question. Marcet calls salt lakes "mere salt ponds," and they may have different composition than the seas. Sea waters, though, contain the same materials in the same relative proportions everywhere but with different total concentrations. Among the various contents Marcet analyzed are muriate of silver (also known as luna cornea), sulfate of barytes, oxalate of lime, and phosphate of magnesia.

Two extended excerpts from this paper, in French and not listed by Roget, were published in the Geneva *Bibliothéque Universelle* (**1819**, *12*). The first part, concerned with specific gravity was classified under physique ("Sur la pesanteur spécifique et la température des eaux de la mer dans diverses parties de l'Océan et dans des mers particulières, et quelque examen des matières salines qu'elles contiennent," 22-34). The second part, concerned with salts dissolved in the waters was classified under chimie ("Sur les matières salines que contiennent différentes mers," 110-117).

Item 30: A paper, in French, on the subject of Vaccination. (Bibliothèque Universelle for November 1819.)

> "Quelques remarques sur la Vaccination, et sur le degré de confiance que l'on peut avoir dans ses effets

préservatifs; adressées au Prof. Pictet, l'un des Rédacteurs de la *Bibliothèque Universelle*." Par le Dr. MARCET, Membre de la Société Royal de Londres, ci-devant Médecin de l'Hôpital de Guy, etc. *Bibliothèque Universelle*, **1819**, *12*, 206-216.

The *Bibliothèque Universelle* succeeded the *Bibliothèque britannique* as a Genevan journal in which to publish important discoveries (21). This article is an account of the value of vaccination, which had been received with skepticism in Geneva. Marcet was a friend of Jenner (see Item 5 above), and used vaccination extensively in his career as a doctor in London. There was also skepticism in London, and Voltaire (1694-1778) had thought the whole process peculiar (22), but it was adopted by members of the Royal Family and after 20 years of practice it was widely accepted. In 1779-1798 there were 38056 deaths from smallpox in London. During the 20 years after the introduction of vaccination (1799-1818) there were 23294 out of a larger population, thus saving the lives of 14672 individuals.

Item 31: Account of a singular Variety of Urine, which turned black soon after being discharged; with some particulars respecting its Chemical Properties. (Medico-Chirurgical Transactions, vol. xii. p. 37.)

"Account of a Singular Variety of Urine, Which Turned Black soon after being Discharged; with some Particulars Respecting its Chemical Properties," *Medico-Chirurgical Transactions*, **1823**, *12*, 37-45.

In 1814 Marcet was shown a sample of urine which looked like licorice solution or port wine with no deposits. It came from a healthy male child aged seventeen months, and it had changed color after emission. Marcet collected samples himself. The samples did not all change color, and the color was stable for years. Carbonate of potash and carbonate of ammonia produced a precipitate. The colored urine was alkaline, smelled of ammonia, and gave a black deliquescent residue on evaporation. This did not contain iron. Alcohol had little effect, and did not dissolve the color. Nitric acid extracted no color. Marcet had once treated a young woman who had paroxysms and also produced black urine. She took Peruvian Bark and later silver nitrate, after which she recovered.

After describing the case of the woman, Marcet returns to the residue of the urine he had begun to describe, and says that he turned it over to Dr. Prout for further analysis, as he did not have lab facilities at his command. Prout reported that the dried urine residue did not contain lithic acid or urea. Adding acid to the urine slowly generated a black precipitate in a clear liquid. Dr. Prout is William Prout (1785-1850), best known to later chemists for his speculation that all elements might be comprised of hydrogen since their atomic weights seemed to be multiples of that of hydrogen (23). As a physician, Prout was expert in diseases of the urinary tract and in analysis of urine (24).

This item was read to the Medical and Chirurgical Society in March 1822. It was published in 1823, after Marcet's death on 19 October 1822.

Item 32: Account of a Man who lived ten years after having swallowed a number of Clasp-knives; with a Description of the Appearances of the Body after Death. (Ibid. vol. xii. p. 52.)

"Account of a Man who Lived Ten Years after Having Swallowed a Number of Clasp-Knives." By ALEX. MARCET, M.D. F.R.S. &c. late physician to Guy's Hospital. *Medico-Chirurgical Transactions*, **1823**, *12***,** 52-75.

Like the previous item, this was read to the Medical and Chirurgical Society in March 1822 and published in 1823, after Marcet's death.

In 1799 an American sailor at a fair in Le Havre saw a man (a magician) "swallowing" clasp knives in a show. He said he could do this, and swallowed one himself. He repeated this several times over many years in different places. He was eventually caught as a smuggler and pressed into a British ship. In December 1805 he became very ill (not for the first time) and he continued under medical care until he died in March 1809. The case was noted in several contemporary London journals. He was reckoned to have swallowed thirty-five clasp knives and occasionally passed pieces of knife. The patient wrote a detailed account of his history of clasp-knife consumption and of his reactions. He was treated with opium from time to time, but suffered great pain. Marcet obtained a sample of the patient's bile, which tested positive for iron (prussiate test). After death, most of the body organs looked normal apart from some membranes being slightly thicker than normal. The stomach seemed capable of accommodating the clasp knives as long as they caused no physical damage. The illustrated stomach contents consisted of a large number of clasp knives both effectively whole and also in pieces. There were at least a dozen, and they were exhibited to the Medico-Chirurgical Society.

Item 33: Some Experiments and Researches on the Saline Contents of Sea-water, undertaken with a view to correct and improve its chemical analysis. (Philosophical Transactions for 1822, p. 448.)

"Some Experiments and Researches on the Saline Contents of Sea-water, Undertaken with a View to

Correct and Improve its Chemical Analysis." By Alexander Marcet M.D. F.R.S. Honorary Professor of Chemistry at Geneva. *Phil. Trans. Roy. Soc. London* **1822**, *112*, 448-456.

Marcet could not detect any mercury in English Channel sea water or the salts obtained from it. Some very careful and quantitative analyses are reported. He concluded that there is no mercury or mercurial salt in ocean water, attributing contrary reports by other researchers to local circumstances. Marcet found ammonia but not nitrates, carbonate of lime but no chloride of lime. He also reported a salt of sulfate with both magnesia and potash in solution. This work was performed before accurate combining proportions had been established (principally by his friend Wollaston in the first place) and before understanding of ions in solution.

This paper was read before the Royal Society on 27 June 1822. It was Marcet's last scientific contribution (25).

Item 34: [not mentioned by Roget]

A Syllabus of a Course of Chemical Lectures Read at Guy's Hospital. William Babington, M.D. F.R.S., Alexander Marcet, M.D. F.R.S., Physicians to the Hospital, and William Allen, F.R.S.& F.L.S. W. Phillips, London, 1816.

To the list of papers Roget mentions in his obituary of Marcet (6), we add this monograph omitted by Roget. Indeed, Marcet was decidedly the junior partner in this endeavor, which had been in print in various forms for many years before his involvement.

William Babington (1756-1833) was apothecary to Guy's Hospital and later, after completing a medical degree from Aberdeen, Physician to Guy's (26). He published the first version of the *Syllabus* in 1797 (27). This course reflected the chemistry established by Lavoisier and his followers, for "… the systems of the older chemists are now exploded, and many of their principles shewn to be fallacious…" A table of nomenclature, including old and new is included at the end of the syllabus, though, to render intelligible the writings of older chemists—which still contain much relevant factual matter. The course starts with sections on Caloric and Oxygen, sure signs of the new chemistry (27). After treating common gases and water, sections on acids, alkalis, earths, metals, and combustibles follow.

William Allen (1770-1843), a chemist (i.e., pharmacist) by trade, was a lecturer in chemistry at Guy's Hospital from 1802 at the invitation of Babington. The two of them published another edition of the *Syllabus* that year. After only five years, there were some changes in organization, if not monumental ones. A discussion of forces including electricity and gravitation precedes the sections on Caloric and Aeriform Substances (gases). Alkalis precede acids; then follow earths, metals, and combustibles and a short new section on "organized bodies" both vegetable and animal (28).

Allen was interested and active in a wide range of scientific and social activities. In the same year he started lecturing at Guy's he was elected a fellow of the Linnean Society of London. Shortly afterwards he was also delivering lectures at the Royal Institution at the invitation of Davy. Allen was a social activist, involved in abolitionist and educational causes (29).

Marcet joined Babington and Allen as an author of the 1816 edition. By this time, the new nomenclature was no longer considered an entirely trustworthy guide: the preface notes that "the new Nomenclature, though admirably contrived, appears from Sir Humphry Davy's late brilliant discoveries, to have in some instances been at variance with facts" (30). For this reason, the table of nomenclature present in previous editions has been replaced by a list of simple bodies, or rather of bodies that have not been decomposed. That list of simple bodies includes three classes, namely the imponderables (Caloric, Light, and Electricity), agents that can unite with inflammable bodies (oxygen, chlorine, and iodine), and the simple combustible bodies (those capable of uniting with oxygen and its class—that is, all of the other simple bodies). The bulk of the syllabus was organized as previously. It is worth noting, though, that the last lines of the syllabus deal with urinary calculi.

Conclusions

Marcet's scientific interests, as exemplified by his publications, were certainly varied. As Table 1 illustrates, chemistry and medicine were the predominant but not exclusive subjects of his interests. We have given more than one subject to several items, so the number of items by subject sums to more than the 34 numbered items presented above. Many of these duplicate classifications were chemistry and another discipline (most often medicine), reflecting cases in which chemical analysis was brought to bear on a problem within another discipline (such as the properties of biological fluids or of seawater).

Table 1. Marcet's scientific publications grouped by subject.

Subject	Number of items	Item numbers
chemistry	24	2, 4, 6, 8, 11, 13-21, 23-24, 27, 29, 33-34
medicine	19	1-3, 5, 7, 9-10, 12-15, 23, 25-28, 30-32
physics	4	17-18, 20, 29
geology	6	6, 8, 11, 19, 29, 33
education	1	22

Marcet's career spanned the period when a great many of the practitioners of chemistry in Great Britain were physicians. If one thinks of the important developments in British chemistry during the first two decades of the nineteenth century, the prevalence of physicians in chemistry may be surprising. The pre-eminent achievements that come to mind include Dalton's atomic theory, Davy's employment of electricity to isolate new elements from familiar compounds, Wollaston's scale of equivalent weights and Tennant's and Wollaston's work on new elements in platinum ores—none particularly related to medicine or even to the chemistry of organisms. Yet much of that chemistry was done by men who had medical degrees.

Indeed, Tennant and Wollaston had earned medical degrees, as has been noted above. Davy was not a physician, but he had been apprenticed to a surgeon and apothecary. Davy launched his scientific career from the Pneumatic Institution Thomas Beddoes (1760-1808) founded to investigate physiological effects of gases (31). Indeed, of the researchers mentioned in the preceding paragraph, Dalton was the only one not connected to medicine. Add to the list of medically connected chemists Humphry's brother John Davy (1790-1868), Prout (of the protyle hypothesis), and Thomas Thomson (1773-1852), who championed both Dalton's and Prout's ideas), and we see that many significant contributors to British chemistry at this time were physicians.

As noted above, medical faculties were among the few educational contexts where chemistry was part of the curriculum in Britain at this time. At this time, chemistry was already intellectually independent as a discipline, having methods and interests of its own distinct from medicine (even though its methods could be useful to medicine). It was also a popular subject—at least for self-improving minds—as evidenced by the success of Jane Marcet's *Conversations on Chemistry* and the popularity of lectures like Davy's at the Royal Institution (32). Chemistry, however, had few institutions devoted to its practice. Davy was fortunate to have a professorship of chemistry at the Royal Institution: there were not many positions in Britain like his. Dalton was a teacher of natural philosophy at a dissenting academy. Medicine was one of the avenues by which a respectable person could pursue an interest in chemistry.

Some of the chemist/physicians mentioned above are better known to posterity as chemists than physicians. Marcet, however, belonged firmly in both camps. For example, at this time and even earlier, it was widely believed that mineral waters had curative properties; spas were very popular in Regency England, as every reader of Jane Austen knows. Hence Marcet's interest in the identities and amounts of the contents of mineral waters, natural and synthetic, as well as his original attempts to discover whether sea water itself varied in content with region and temperature. It must also have seemed evident that investigating the input and output of the human machine would yield valuable information on what might go wrong when such a body malfunctioned. Since the chemists and medical practitioners had little knowledge of the cause of diseases and of what today we recognize as organic chemistry, such researches were bound to be unsuccessful in their basic aim. Marcet's publications (Items 2, 4, 6, 8, 9, 11, 13-15, 19, 23, 27, 29, 33) show the great effort he put into trying to understand bodily function essentially in terms of aqueous chemistry.

Incidentally he isolated several new body products, especially what he termed calculi. However, it should be remembered that physicians of the time, including Marcet, were eager to investigate the effects of newly isolated compounds on their sick patients, and must have caused damage to some. They also asked how and in what form these compounds were excreted, so that the practice of medicine itself was also influenced. The chemistry and medicine interacted reciprocally.

Such calculi had long been recognized as being related to gentlemen's diseases, though presumably women must have suffered similarly. Gentlemen clearly desired some kind of cure. A particular often-cited example is that of Joanna Stephens (d. 1774), who was awarded by Parliament the enormous sum of £5000 for the discovery of a remedy for kidney stones, which were a common and painful affliction. This remedy first publicized in 1738, and subsequently in 1739 and 1741 by the philosopher and physician David Hartley (1705-1757) in a book, *Ten Cases of Persons who have Taken Mrs. Stephens Medicines for the Stone* (33). However, careful reading of the

relevant Act of Parliament (34) makes it clear that the award was not for medical research, but for discovery, in the sense of public disclosure, of her remedy, including its preparation. The award was conditional upon its efficacy being proved by many eminent men, including the Archbishop of Canterbury, the Lord President of the Council, and the Speaker of the House of Commons. Presumably they all suffered from kidney stones. These gentlemen apparently found that the cures worked, though one wonders why. In the entry devoted to Stephens in the *Dictionary of National Biography* (33) the remedy is stated to have been a powder (of calcined egg shells and snails), a decoction (prepared by boiling herbs with soap), and pills (of calcined snails). Such stones were an interest of several chemists of the period, including the great man Wollaston himself (35) and Yelloly (36). Roget, in contrast, seems to have shown an interest in phrenology, theology, the eye, mechanical calculators and, most famously, his Thesaurus (7).

Marcet's research in what we today classify as physical sciences was rather limited. He was interested in methods to obtain both low and high temperatures (Items 16, 17, 18, 20, and 21), and he took pleasure in demonstrating low-temperature effects to his friends and family. His work in his home laboratory with Berzelius (also M.D., F.R.S.) (Item 16) describing the preparation and properties of carbon disulfide is unusual in reading very much like a modern chemistry paper, and it was one of the few of its kind he was concerned with, the others being Items 21 and 24. He also published papers directly concerned with medicine (Item 3), especially but not exclusively with dissections (Items 1, 5, 7, 9, 10, 12, 25, 26, 28, 31, and 32). His interest in the changes caused by the consumption of unusual materials (from arsenic through clasp knives to laudanum) reflected the attitude of a chemist who regarded the human body as a rather complicated chemistry machine somewhat prone to malfunction. Finally Marcet was deeply concerned with the social implications of his work, though also very proud of his original home state of Geneva. This led him to encourage the practice of inoculation (Items 5 and 30) and the adoption for the British population of a type of education like that in Geneva (Item 22).

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Supplemental Material

The bibliographic part of Roget's obituary of Marcet (Ref. 6) with links to online versions of Marcet's papers can be found in the Supplemental Material for the *Bulletin for the History of Chemistry* at the journal's website,

acshist.scs.illinois.edu/bulletin/index.php.

A copy of the obituary itself can also be found there.

References and Notes

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1812, *39*, 64-72. The same letter appeared in *Nicholson's Journal of Natural Philosophy, Chemistry, and the Arts*, **1812**, *31*, 145-155.

10. G. Pearson, "A Rejoinder to a Paper Published in the Philosophical Magazine by Dr. Marcet, on the Animal Fluids," *Philosophical Magazine,* **1812**, *39*, 289-300. The same letter appeared in *Nicholson's Journal of Natural Philosophy, Chemistry, and the Arts*, **1812**, *32*, 37-49. The only difference in the latter is that the title referred to "the Philosophical Journal" rather than "the Philosophical Magazine" and referred to Pearson's own previous letter in the February rather than the January issue.
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12. J. Dalton, "On the Absorption of Gases by Water and Other Liquids," *Mem. Lit. Phil. Soc. Manchester*, **1805**, *1*[2nd ser], 271-287. Read Oct. 21, 1803.
13. J. Dalton, "On the Constitution of Mixed Gases: and Particularly of the Atmosphere," *Mem. Lit. Phil. Soc. Manchester*, **1802**, *5*[1st ser], pt II, 538-550. Read Oct. 2, 1801. This is essay one of a series of four published as a group on pp 535-602. An illustrative plate appears after p 602.
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About the Authors

G. J. (Jeff) Leigh is an Emeritus Professor at the University of Sussex. After a lectureship at the University of Manchester and a year working in Munich with E. O. Fischer, he spent the rest of his employed career at the Unit (later Laboratory) of Nitrogen Fixation in Sussex, from where he published over 200 papers on the chemistry of nitrogen fixation. He first came upon *Conversations on Chemistry* in 1964 in a second-hand bookshop, and was intrigued by the fact that this book had been written as early as 1806 by a woman who was not a recognized natural philosopher. He has since researched her life intensively and published some papers on her work. During these studies the activities and influence of her husband, Alexander, became very evident and his latest work concerns placing him in an appropriate context of the history of chemistry.

Carmen J. Giunta is Professor of chemistry at Le Moyne College in Syracuse, NY, USA. He is editor of this journal, in which capacity he has enjoyed reading Prof. Leigh's articles on Jane Haldimand Marcet and her husband Alexander. It was his pleasure to work with Jeff on this paper.

2019 Conferences in History and Philosophy of Chemistry

Setting their Table: Women and the Periodic Table of Elements. February 11-12 at the University of Murcia, Spain (www.iypt2019women.es/scientific_topics.php).

Spring 2019 National Meeting of the American Chemical Society will have programming by the division of the History of Chemistry (HIST). March 31-April 4 in Orlando, Florida, USA (www.acs.org/content/acs/en/meetings).

First International Congress on the History of Science in Education. May 30-June at the University of Trás-os-Montes e Alto Douro, Vila Real, Portugal (www.utad.pt/gform/en/event/the-1st-international-congress-on-the-history-of-science-in-education).

Plastics Heritage Congress 2019: History, Limits, and Possibilities. May 29-31 in Lisbon, Portugal (plasticsheritage2019.ciuhct.org).

First International Conference on "Bridging the Philosophies of Biology and Chemistry." June 25-27 at the University of Paris Diderot, France (www.sphere.univ-paris-diderot.fr/spip.php?article2228&lang=en)

International Society for the Philosophy of Chemistry: 23rd annual meeting. July 15-17 in Torino, Italy (www.ispc2019.unito.it).

Fourth International Conference on the Periodic Table, Mendeleev 150, is scheduled for July 26-28 in St. Petersburg, Russia (mendeleev150.ifmo.ru).

12th International Conference on the History of Chemistry (12ICHC). July 29-August 2 in Maastricht (sites.google.com/view/ichc2019).

Fall 2019 National Meeting of the American Chemical Society will have programming by the division of the History of Chemistry (HIST). August 25-29 in San Diego, California, USA.