CHEMISTRY IN THE LIFE OF DR. SAMUEL JOHNSON

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Introduction

Our acquaintance with Samuel Johnson, LL.D., the dominating figure of the London literary scene of the mid-eighteenth century, surpasses in a remarkable way the usual knowledge and appreciation of the life of a notable author and scholar. Thanks to his contemporary biographers who wrote from close personal knowledge—the candid James Boswell foremost among them— (1, 2) we possess a portrait well-nigh unique in the annals of literary biography (3, 4): Johnson appears before us with all his personal strengths and weaknesses, habits and foibles, opinions, prejudices and wit. His pungent and penetrating pronouncements continue to suffuse the consciousness of the English-speaking world to this day (Fig. 1) (5).

Figure 1. Johnson and Boswell walking by Temple Bar, Fleet Street. Drawing by Charles Green (Courtesy of Guildhall Library, Corporation of London)

A vast corpus of literary criticism and social, moral, and religious comment has grown around Johnson, until every aspect of his existence has been subjected to the minutest scrutiny (6). This extends from his literary and scholarly achievements and famous conversational powers to his manifold other interests, not least among them his fascination with medicine (7), and his awareness of the importance of the rise of science and technology, and its impact on society.

In modern scholarly inquiries into Johnson's medical and scientific interests, chemistry has occupied a subordinate position: of 42 relevant abstracts that appeared in the authoritative *Isis Bibliography* between 1913 and 2000 (8), 20 referred to medicine, 19 to science in general, but only two dealt specifically, albeit briefly, with chemistry (9). In his comprehensive general study of Johnson's manifold involvement with science, Schwartz (10) has analysed Johnson's interest in the emerging sciences in all their technical, philosophical, and more particularly

social and religious ramifications, and devoted such attention to chemistry as was relevant to his central theme. The present essay attempts to focus on Johnson's preoccupation with this, his favorite scientific subject.

Johnson's Chemistry, Philosophical and Practical
His Biography of Boerhaave

Johnson is likely to have had his first occasional encounters with 'natural philosophy' of one form or another in his father's bookshop, where he read widely, and while an undergraduate at Oxford. A deeper and lasting attachment to chemistry was awakened by his writing a biography of Herman Boerhaave for the *Gentleman's Magazine* in 1739 (11), shortly after the death of the celebrated Dutch physician and chemist. The task required but little research on his part, ample material being available in the *Memorial Oration* (12) delivered in Latin by Boerhaave's friend, the eminent scholar Albert Schultens (Fig. 2) (13). Johnson dwelled on Boerhaave's scientific achievements as a physician, botanist, and chemist, as well as his exemplary modesty and piety (14). However, chemistry emerged in particularly favorable light: Johnson clearly admired Boerhaave's treatment of that science 'with an elegance of style not often found in chemical writers,' and was impressed by 'his theory, more philosophical, exact and full, and his processes more methodical and regular than those of any preceding author on the subject.' The biography was reissued in an expanded form in Robert James' *Medicinal Dictionary* (15). Boswell's assertion (16) that Johnson's 'love of chymistry which never forsook him' was inspired by his admiration of Boerhaave may well have been near the truth (17). Again, in his short account of the life of Sarpi (18), Johnson stressed the part that natural philosophy and especially chemistry played in the education of this theologian, 'which enabled him to converse with chemists upon the analysis of metals not as a superficial enquirer, but as a complete master' (19).


ALBERTI SCHULTENS
ORATIO
ACADEMICA
IN MEMORIAM
HERMANNI BOERHAAVII,
VIRI SUMMI.
EX DECRETO
RECTORIS MAGNIFICI ET SENATUS ACADEMICI
HABITA
Die xv. Novembris, An. MDCCXXXVIII.
LUGDUNI BATAVORUM,
Apud JOHANNEM LUZAC, 1738.

Figure 2. Title page of Albert Schulten's Memorial Oration on the life of Herman Boerhaave (Ref. 12).

Johnson, the Chemical Operator

Against this background, Johnson's scientific interest gravitated particularly towards chemistry. His fondness of performing chemical experiments repeatedly aroused the curiosity of his friends; but, being themselves unfamiliar with scientific matters, they could not fully appreciate and describe his chemical preoccupation. Boswell, being admitted to the garrets above Johnson's chambers in the Inner Temple, noticed 'an apparatus for chymical experiments, of which Johnson was all his life very fond' (20). It was likely to be of the simplest form, probably of the kind alluded to in his tale of Mr.Sober (with whom he identified himself (21)). After failing to overcome his ennui by various distractions, Sober finds comfort in chemical experiments (22):

> His daily amusement is in chemistry. He has a small furnace, which he employs in distillation, and which has long been the solace of his life. He draws oils and waters and essences and spirits . . . and counts the drops, as they come from his retort.

Arthur Murphy (23), on his first visit to Johnson in 1754 (24), found him in a little room, intent on making ether

'covered with soot like a chimney-sweeper, . . . as if he had been acting Lungs in The Alchymist' (25).

Producing ether by distilling a mixture of alcohol and concentrated sulfuric acid was one of Johnson's favorite experiments, in which he followed the detailed directions of Boerhaave (26) or Lewis (27) for the safe management of this somewhat hazardous reaction. Heeding their warnings, he operated on a small scale, using no more than one ounce of sulfuric acid at a time. On one recorded occasion, he sent Mr.Peyton, his amanuensis, to procure it, taking care by the politeness of his request not to offend the sensibility of his literary assistant (28):

> Mr.Peyton, Mr.Peyton, will you be so good as to take a walk to Temple Bar? You will there see a chymist's shop: at which you will be pleased to buy for me an ounce of oil of vitriol; not spirit of vitriol, but oil of vitriol. It will cost three half- pence.

Peyton immediately went and returned with it, and told him it cost but a penny. When during the last 20 years of his life Johnson was a family friend of the Thrales and enjoyed their hospitality at their country mansion at Streatham, his enthusiasm for 'chemical operating' was so far indulged as to establish a simple laboratory, prudently set up in the grounds at some distance from the house. Its central feature was a furnace constructed according to Johnson's detailed directions. Here, in the intervals between good dinners, animated conversation, and the composition of his last master-piece, the *Lives of the Poets*, Johnson would entertain Mrs. Thrale, her daughters, and servants with chemical demonstrations and distillations, 'withdrawing essences and coloured liquors' from various plant materials (29). His short-sightedness, coupled with the combustibility of his wig, was a constant anxiety to his friends, especially since ether continued to occupy a prominent place in the practical syllabus, as Mrs. Thrale recalled in after-years (30):

> If you pour one Table-Spoonfull of [Aether] into a Copper Pot full of boyling Water, & then approach with a lighted Candle, the most vivid & verdant & beautiful Flash of Lightning possible is immediately produced; & you had best hold your Candle with a Pair of Kitchen Tongs, or evil Consequences may ensue from ye Experiment (31).

In the end, Mr. Thrale, alarmed over his guest's and household's safety, called a halt to all further chemical enterprise, ordering that 'nothing more should be done towards finding the Philosopher's stone' (32).

Apart from his own practical exercises, Johnson was keen to witness philosophical experiments, whenever the opportunity offered, and took part in experiments of his friend Beauclerk at Windsor. His chemical efforts were sufficiently notorious among his friends to become the object of gentle raillery. When a friend suggested to him that Pope, seeing him at his distilling, might consider him "to have little to do," Johnson promptly retorted, "Sir, if Pope had told me of my distilling, I would have told him of his grotto" (34).

Johnson, the Student of Chemistry

More significant than Johnson's partiality to chemical experiments was his diligence in gaining wider information by his acquisition of a fairly complete collection of chemical treatises and in his sifting of chemical terms for his Dictionary. He attended lectures, visited manufactures, and sought information from instructed friends. At the Ivy Lane Club, Samuel Dyer (35), who attended Dr. Pemberton's chemistry course at Gresham College (36), occasionally entertained his fellow members with accounts of the lectures (37), to which Johnson listened attentively (38).

A welcome link to chemistry was forged by his acquaintance about 1757 with Robert Dossie (39), who had recently arrived in London from Sheffield (40). He was an accomplished chemist of wide experience, who had rapidly gained a high reputation, especially by the publication in quick succession of three excellent treatises on chemistry (41). Johnson said of him that 'he knew more than any man of the chymical effects of bodies operating on other bodies' and went to great lengths to secure his election to the recently founded (1754) Society of Arts (42), of which Dossie became a prominent member.

Even during Johnson's tour to the Hebrides late in life (1773), when the fatigues of travel and unaccustomed surroundings engrossed his attention, chemistry was not forgotten. Being shown the military installations of Fort George by two garrison officers, he met them on their own ground with a disquisition on the manufacture of gun powder, dwelling on the importance of the correct proportion of charcoal and saltpetre and the need for its granulation and giving it a gloss (43). Later, while staying as the guest of Lord Macleod at Dunvegan Castle, he discussed, in the course of the drawing room conversation, the process of tanning, the nature of milk, and the various operations upon it, thus astonishing if perhaps not delighting the company with the unexpected variety of his information (44).

On a journey with Boswell into Bedfordshire in 1781 (45), Johnson talked little to the other passengers in the carriage, being engrossed in the study of Watson's second volume of Chemical Essays just published (46). Only one year before his death he attended a lecture given by a physician in Salisbury on the 'different kinds of air' lately discovered by Priestley. Johnson, provoked by the repeated mention of the name of the scientist, whose radical political and doctrinal opinions were odious to him, inquired severely, "Why do we hear so much of Dr. Priestley?" Upon being properly answered: "Sir, because we are indebted to him for these important discoveries," he appeared mollified and observed, "Well, well, I believe we are; and let every man have the honour he has merited" (47).

Johnson and Alchemy

Remembering Johnson's robust common sense and distrust of all pretence, it is surprising that he did not reject the claims of alchemy as decidedly as might be expected. He was, on the contrary, much intrigued by its doctrines (48) and defined it, in his Dictionary, as 'the more sublime and occult part of chymistry, which proposes for its object the transmutation of metals and other important operations,' adding a quotation (49) to the effect that 'alchemy changes, or would do, the substance of metals.' According to Boswell (50), Johnson 'was not a positive unbeliever, but rather delighted in considering what near approaches there had been to the making of gold, . . . and that it was not impossible, but it might in time be generally known.'

In this attitude, Johnson may well have been influenced by his first contact with Boerhaave, who for all his chemical insight did not deny the possibility of transmutation (51). Such uncertainties were hardly dispelled by Boyle's surmise that all elements consisted of the same ultimate matter, differing from one another in the individual shapes and motions of the particles of this primary substance, an idea that seemed to make interconversions between metals feasible (52). Boyle's decided enthusiasm for alchemy has recently been underlined by the resurrection of his 'lost' *Dialogue on Transmutation* (53); Newton's preoccupation with its mysteries has also been minutely documented by modern scholarship (54).

Alchemists' claims and doctrines continued to linger into the early 18th century, though increasingly in an atmosphere of fraud and deception. George Wilson's *Chymistry* (1746), a book in Johnson's possession, still included a serious discussion of the transmutation of the metals, describing a series of the author's attempts made between 1661 and 1704, to produce the 'universal solvent' and effect transmutations. Although Wilson reported honestly his invariable failure, his protracted efforts clearly implied a hope of eventual success. To these and similar causes may be ascribed Johnson's conclusion that 'among the numerous students of Hermetic philosophy, not one appears to have desisted from conviction of its impossibility, but from weariness of toil, or impatience of delay, a broken body or exhausted fortune' (56).

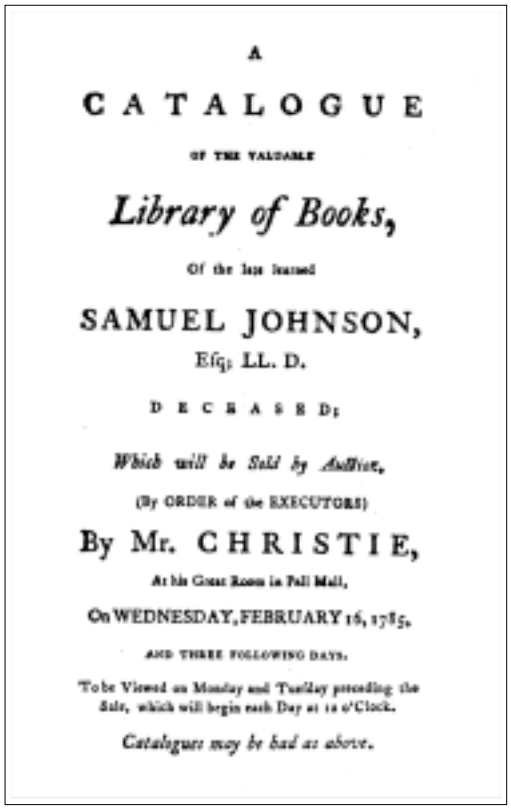
The overall picture of Johnson's commitment to chemistry that emerges from the contemporary anecdotal accounts, though authentic and colorful, is the product of chance, and necessarily lacks balance and precision. However, these shortcomings are largely redressed by a survey of the numerous chemistry books that formed part of Johnson's personal library—or were consulted by him elsewhere—and by a census of the chemical terms that he admitted to his Dictionary, and which he defined and illustrated by a judicious choice of references. This evidence is presented in the following discussion.

Johnson's Library and its Dispersal

It is hardly surprising that Johnson, the son of a bookseller, the co-author of the monumental catalogue of the *Bibliotheca Harleiana*, the companion of London publishers, and dedicated scholar, should accumulate a personal library, even in the face of early adversity and want. What is indeed exceptional is the inclusion in the library of this essentially literary figure of an impressive assembly of scientific books, testifying to their owner's devotion to the serious study of the natural sciences, medicine, and chemistry (57).

Johnson accumulated his books for use rather than ostentation and was indifferent to their condition or preservation. It was unsafe, as his friends knew to their cost, to lend him any fine or rare volume (58), for it was apt to be returned—if at all—the worse for rough usage. When Boswell obtained a sight of his library, stored in two garrets over his chambers in The Temple, he 'found a number of good books, but very dusty and in great confusion' (59). At the time of their dispersal after Johnson's death, they were, as one viewer noted, in a 'most woful condition' (60). This gave the auctioneer, James Christie, little incentive to bestow much care on the preparation of the Sale Catalogue, which has conse-

quently proved a very defective guide to later researches. We are nevertheless dependent on this list (61), whatever its shortcomings deplored by bibliographers (62), for our knowledge of the remarkable range of Johnson's library. This poorly printed 28-page pamphlet (Fig. 3), of which only very few original copies have survived (63), was reissued in facsimile for the Oxford Meeting of the Johnson Club in 1892; this limited edition of 150 copies has also long since disappeared. More recently, the original Harvard copy, interleaved with a list of prices and the names of buyers in a neat contemporary hand, has been reproduced (64) and supplemented with an annotated guide (65) to its contents.



A

CATALOGUE

OF THE VALUABLE

Library of Books,

Of the late learned

SAMUEL JOHNSON,

Esq; LL. D.

DECEASED;

Which will be Sold by Auction,

(By ORDER of the EXECUTORS)

By Mr. CHRISTIE,

At his Great Room in Pall Mall,

On WEDNESDAY, FEBRUARY 16, 1785,

AND THREE FOLLOWING DAYS.

To be Viewed on Monday and Tuesday preceding the Sale, which will begin each Day at 12 o'Clock.

Catalogues may be had as above.

Figure 3. Title page of the Sale Catalogue of Johnson 's Library (Ref. 61)

As in all large library sales by auction, only the more valuable volumes were catalogued individually. By far the greater number of books were combined into parcels, of which only the leading item was identified by author and title. Although the academic standard of Johnson's collection was indeed distinguished, a large proportion of its books was relegated into this 'unnamed' category, partly because of their poor condition, partly because of the hurried cataloguing, which condensed some 3,000 volumes into 650 'lots,' so that three quarters of the books passed anonymously under the hammer. The financial outcome was correspondingly modest, the total sum realized amounting to £242 (66). The material on chemistry and the sciences realized even lower prices than that of the humanities; appealing to a narrower section of the public, it was mostly acquired by booksellers for stock, for derisory sums.

Johnson's Collection of Chemistry Texts

The sale catalogue identifies some 40 named works on chemistry, including some general encyclopaedias. Another 20 titles familiar to Johnson are traceable through quotations in his Dictionary or miscellaneous writings. A consolidated list of titles from all available sources is given in Appendix 1.

Discounting the large cyclopædias containing incidental chemical information, which might have been found in any large private or academic library, Johnson had assembled a very respectable, specialized collection of chemistry texts by the leading authors. Classical antiquity was represented by Pliny and Lucretius, the mystic and alchemical phase by Roger Bacon and van Helmont, the iatrochemical and spagyrical interlude by Paracelsus, and the reign of the phlogiston doctrine by Becher and Stahl. The increasingly rational approach to chemical philosophy was to be found in the works of Boyle, Newton, and Boerhaave. Treatises of more recent date containing sound practical information, such as those of Lewis, Marggraf, and Macquer were also on hand, as were more specialized texts on mineralogy, mining, metallurgy, and the manufactures (e.g. glass, nitre, etc.).

That Johnson's chemical library was, by contemporary standards, reasonably complete, may be concluded by reference to Spielmann's chemical bibliography of 1762 (67), which catalogued the total chemical literature of the mid-18th century. According to this listing, Johnson's collection lacked relatively few major works; among these, the renowned textbooks of Nicolas Lemery and of Jean Beguin were probably the more conspicuous examples. Joseph Black's celebrated lectures, published posthumously (68), were as yet not available, but the absence of Priestley's pioneer accounts on the 'different kinds of air' (1774-7) (69) may have been due as much to their late appearance in Johnson's life, as to his deep suspicion of Priestley's radical political views, which clouded his opinion of their author's scientific merits. Treatises of the leading Swedish and German chemists, such as Torbern Bergmann, Andreas Libavius, Johann Glauber, Christlieb Gellert and Kaspar Neumann found apparently no favor with him, in spite of the existence of Latin or French translations, and in the case of Neumann, of an excellent English version

(70). It will be understood that some of these works may indeed have been among the 'hidden' items of the sale: its catalogue was designed to appeal to British readers, whose interest in foreign, especially German, titles might be expected to be limited.

The Thrale Library at Streatham Park

The account of Johnson's chemistry books would be incomplete without a brief reference to his 'branch library' at the handsome country mansion of the Thrales at Streatham, South London, in what was then still a pleasant rural retreat (Fig. 4). During his long friendship with the family, a comfortable room at Streatham Park was permanently set aside for his reception; it adjoined the library, in which he took a watchful interest (71).

Figure 4. Streatham Place, the Thrales' country mansion

Once again, an approximate inventory of this collection has been preserved in the form of its sale catalogue (72). When in 1816, seven years after the death of Mrs. Thrale's second husband Gabriel Piozzi, the house at Streatham was given up, its contents, including the library of some 3,000 volumes, were dispersed by auction. Johnson's influence is evident not only in the gathering of the more ponderous classics, but once again, in the inclusion of an effective range of chemistry books, duplicating on a smaller scale his own town collection (see Appendix II). Mr. Thrale's brewing interests were reflected in two specialist treatises and by a collection of tracts on distilling. The maintenance of a cross-section of the standard chemical works at Streatham confirms Johnson's sustained interest in the science, long after the Dictionary had first been printed in 1755 (73).

Through his acquaintance with F. A. Barnard, the King's librarian, Johnson enjoyed in later life the privilege of access to the extensive royal collections. A revealing illustration of his attitude toward the effective use of books occurred at a dinner given by R. O. Cambridge (74). As soon as it was decently possible, Johnson ran eagerly to the shelves of the library, surveying the rows upon rows of books. Being teased by Sir Joshua Reynolds, another guest at the dinner, about his 'enjoying the sight of their backs,' he replied without hesitation, "Sir, the reason is very plain, knowledge is of two kinds: We know a subject ourselves, or we know where we can find information upon it. When we enquire into any subject, the first thing we have to do is to know what books have treated of it. This leads us to look at catalogues, and at the backs of books in libraries" (75).

Chemistry in Johnson's Dictionary

A second important key to estimating Johnson's sympathy towards chemistry is his treatment of the subject in his Dictionary (76). Speaking eloquently, in its Preface, of the difficulties and tribulations that fall to the lot of the lexicographer, he dwelled on the impossibility of including all 'Terms of Art' of every technical field and admitted that 'many terms appropriate to particular occupations, though necessary and significant, [were] undoubtedly omitted.' Yet the breadth of his coverage of chemical terms, their clear definition, and their apt illustration by well chosen references were obviously the work of a person having first-hand knowledge of the chemical usage of the time (Fig. 5).

Retrieval of Chemical Entries

For the present purpose, the chemical items among the 40,000 entries of Johnson's Dictionary were located with the aid of a standard list of chemical terms drawn from Nicholson's *Dictionary of Chemistry* (77), supported by supplementary sources (78). By the use of this more comprehensive listing as the working basis it was hoped to ensure that few of Johnson's less numerous Dictionary entries would be missed. In theoretical questions, Nicholson's work of 1795 inclined towards the new system of chemistry but did not exclude consideration of

Figure 5. The house at 17 Gough Square, Johnson's home, 1749-59. Its top floor was the scene, during six years, of his and his assistants' labors in the compilation of the Dictionary. The building, restored to almost its original state, now houses the Johnson Museum.

the phlogistic doctrine; nor had the new French nomenclature of 1787 (79) displaced the old names in its text, but was relegated to a separate discussion. Of the 600 monographs of Nicholson's compilation, only 300 were of a strictly chemical character, the remainder being devoted to mineralogy (ca. 150), materia medica (ca. 75), and technical subjects (e.g. silk, porcelain, etc.). Johnson's Dictionary dealt with 175 of these chemical items.

Johnson's Choice of Chemical Authorities

In illustrating his chemical terms, Johnson referred chiefly to the existing scientific bibliographic resources, but would occasionally introduce a felicitous literary allusion with agreeable effect.

The definition for chemistry itself was appropriately adopted from his first mentor Boerhaave as:

> an art, whereby sensible bodies . . . are so changed, by means of certain instruments, and principally fire, that their several powers and virtues are thereby discovered, with a view to philosophy, or medicine.

The severe proposition was softened by the addition of Pope's couplet of the happy man who (80):

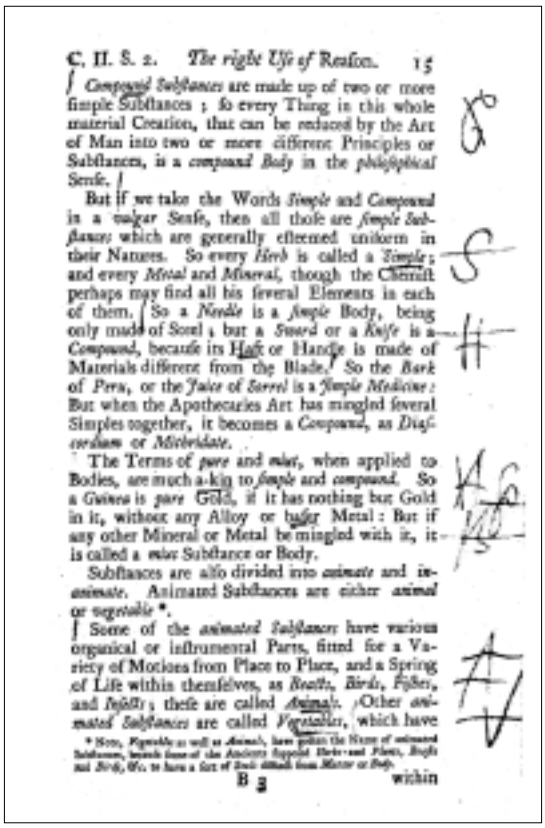
> With *chymic* art exalts the min'ral pow'rs
> And draws the aromatick souls of flow'rs.

Too high an expectation of the powers of chemistry was guarded against by Arbuthnot's caution that 'Operations of *chymistry* fall short of vital force: no chymist can make milk or blood of grass' (81).

In elucidating the terms 'principles and elements,' Johnson surprisingly relied on his favorite philosopher Isaac Watts (82) rather than a chemist, quoting from his *Logick* (83), that 'the first principles of bodies, usually called *elements*, [are the simple substances], of which other bodies are compounded,' a definition falling short in precision of that of the *Sceptical Chymist* (84). 'Air' was defined, again somewhat vaguely after Watts, as 'that invisible matter which fills all places near the earth, or which immediately encompasses the globe of earth and water.' If Watts' chemical definitions left room for improvement, his book has fortuitously proved of singular bibliographical interest: The copy, used personally and annotated by Johnson in the preparation of the Dictionary, has survived in an excellent state of preservation and clearly illustrates his method of collecting and arranging his material (85). When searching for words and quotations from a particular book, Johnson read it through, underlining in pencil all the words to be extracted, indicating by vertical lines the limits of the context to be quoted, and boldly marking the initial letter of the selected word in the margin. His amanuenses thereupon copied the selected passages on separate slips and pasted them in alphabetic order on quarto sheets of paper, leaving space for Johnson to supply the definition and etymology. Watts' *Logick* contains on its 365 pages over 900 marginalia in Johnson's hand, but only a few of them refer to scientific matters (Fig. 6).

In Johnson's roll of the 'best writers' whose aid he enlisted, the most renowned natural philosophers were undoubtedly Bacon, Boyle, and Newton, even though their writings were somewhat archaic even in his own days. Francis Bacon was a favorite authority of Johnson's, but was apparently discovered by him only when compiling the Dictionary (86). Among the very numerous general quotations extracted from his extensive writings, chemical references are drawn chiefly from his *Natural History* (87) and *Apophthegms* (88) and are characteristic of his style and penetration.

Boyle's Works, a collected edition of which (89) was in Johnson's possession, yielded some 30 citations on all aspects of chemistry, ranging from theoretical concepts (combination, compound, element, earths, salts), practical operations (distillation, rectification, incineration), individual substances (oil, saltpetre, sugar of lead) to laboratory apparatus (alembic, cucurbite) (90). Newton's chemical reflections, though remaining largely unpublished (91), emerged intermittently in his *Optics* (92), from which Johnson gleaned a number of quotations. They referred mostly to physical phenomena encountered in chemical processes, such as flame, vapor, volatility, sublimation, and explosion. Newton's allusion to cinnabar, in which 'the particles of mercury are united to the particles of sulphur' underlined his familiarity with the favorite substances of the alchemists and his remarkable intuitive perception of chemical combination.



C. II. S. 2. *The right Use of Reason.* 15

Compound Subſtances are made up of two or more ſimple Subſtances; ſo every Thing in this whole material Creation, that can be reduced by the Art of Man into two or more different Principles or Subſtances, is a *compound Body* in the *philoſophical* Senſe.

But if we take the Words *Simple* and *Compound* in a *vulgar* Senſe, then all thoſe are *ſimple Subſtances* which are generally eſteemed uniform in their Natures. So every *Herb* is called a *Simple*; and every *Metal* and *Mineral*, though the Chemiſt perhaps may find all his ſeveral Elements in each of them. So a *Needle* is a *ſimple* Body, being only made of Steel; but a *Sword* or a *Knife* is a *Compound*, becauſe its Haft or Handle is made of Materials different from the Blade. So the *Bark of Peru*, or the *Juice of Sorrel* is a *ſimple Medicine*: But when the Apothecaries Art has mingled ſeveral Simples together, it becomes a *Compound*, as *Diaſcordium* or *Mithridate*.

The Terms of *pure* and *mixt*, when applied to Bodies, are much a-kin to *ſimple* and *compound*. So a *Guinea* is *pure* Gold, if it has nothing but Gold in it, without any Alloy or baſer Metal: But if any other Mineral or Metal be mingled with it, it is called a *mixt* Subſtance or Body.

Subſtances are alſo divided into *animate* and *inanimate*. Animated Subſtances are either *animal* or *vegetable* *.

Some of the *animated Subſtances* have various organical or inſtrumental Parts, fitted for a Variety of Motions from Place to Place, and a Spring of Life within themſelves, as *Beaſts*, *Birds*, *Fiſhes*, and *Inſects*; theſe are called *Animals*. Other *animated Subſtances* are called *Vegetables*, which have

* Note, *Vegetable* as well as *Animal*, have gotten the Name of animated Subſtances, becauſe ſome of the Ancients ſuppoſed Herbs and Plants, *Beaſts* and *Birds*, &c. to have a Sort of Soul diſtinct from Matter or Body.

B 3 within

Figure 6. A page of Watt's Logick (Ref. 83), annotated by Johnson in the preparation of the Dictionary

On the whole, Johnson preferred to use encyclopaedic manuals rather than individual textbooks. Five authors provided him with no less than three-quarters of his 200 core-quotations (see Appendix III), viz., Boyle, Quincy (93), Arbuthnot (94), Hill, (95), and Chambers (96), all except Boyle writing recently, during the earlier part of the current century.

The largest contribution was that of Quincy's popular *Lexicon Physicomedicum* (97), which, ultimately based on the cyclopaedia of Bartholomew Castellus (98), was issued twelve or more times between 1717 and 1811. Its plain and succinct chemical entries were suitable for direct transfer to the Dictionary, often without change or abridgement. Its more serviceable quotations dealt with concrete rather than abstract matters, especially with laboratory apparatus such as aludels, mattrasses, sand and water baths, Mr. Papin's pot, and the ancient 'athanor' beloved by the alchemists:

> [Athanor], A digesting furnace, to keep heat for some time; so that it may be augmented or diminished at pleasure, by opening or shutting some apertures made on purpose with slides over them, called registers.

The lexicon also described chemical processes and miscellaneous substances, such as bismuth, glass, spermaceti, sugar, and tartar, but was not free from an occasional blunder, carrying Johnson with it, as in the case of borax:

> An artificial salt, prepared from sal ammoniac, nitre, calcined tartar, sea salt, and alum, dissolved in wine. It is principally used to solder metals.

A similar work extensively consulted by Johnson was Arbuthnot's *Nature of Aliments* (99). Addressing a wider public, the author was careful to explain the chemical terms that the reader would encounter. Here again was a ready stock of definitions that could be incorporated almost unchanged into the Dictionary. Quincy's and Arbuthnot's works complemented one another, in that the latter paid greater attention to the living organism with such entries as fat, wax, jelly, oils, sugar, blood, serum, and urine. One of the references alluded to Boerhaave's process of producing the 'native salt of urine,' probably the first account of the isolation of urea (100).

In both these and other contemporary works, the concept of acids, alkalis, salts, earths, and the nature of chemical change inevitably presented serious difficulties; but creditable approaches were sometimes achieved. Thus, under the heading 'alkali,' the manufacture of potash is readily recognized:

> The Egyptians burn the herb 'ka'i' to ashes, boil them in water, and after having evaporated the water, there remains at the bottom a white salt; this they call '*sal kali*' or '*alkali*'.

Johnson was on firmer ground when dealing with plain mineral chemistry. Long traditional practice in mining and metallurgy, as well as the experience gained in the rudimentary chemical manufactures, had stripped away much of the mystery surrounding the metals, the smelting of their ores, and the properties of some of their compounds. This information was beginning to be collected systematically in the large universal encyclopaedias that made their appearance in the early 18th century. Chambers' *Cyclopædia* (1738) (101), published in two massive folios in 1738, one of the first, supplied Johnson with many of his chemical and technical entries. Curiously, after the completion of the first few letters of the alphabet, he largely neglected it in favor of Hill's *Materia Medica* (102) and illustrated *Natural History* (103). Their substantial chemical sections yielded notices on metals (cobalt, copper, gold, lead, iron, mercury, steel), individual chemicals (nitre, lime, potash, opium) and natural products (ivory, isinglass, naphtha). The same ground was gone over, though more narrowly, by J. Woodward (104), who described and classified his own extensive cabinet of minerals and fossils in a useful catalogue (105). Quotations for the remaining items not covered by Johnson's chief authorities were culled from a miscellany of books, several of them of a specialized character (see Appendix III).

In accord with the general plan of the Dictionary, the chemical entries were concise and closely targeted, amounting in each case to no more than three or four lines. It seems, however, that Johnson considered certain subjects, particularly those of general usefulness, to demand closer attention. Thus, accounts of 200-250 words were devoted to such topics as aqua fortis, sal ammoniac, diamond, naphtha, oil, potash, and iron (106).

As a consequence, a certain unevenness in the overall treatment has occasionally crept in: the 750-word monograph on 'nitre,' occupying nearly a whole folio-column of print, enters into technicalities in greater detail than literary critics might consider appropriate in a dictionary of the English language. Silver, by contrast, surely of the highest historical, economic, and cultural importance, is dismissed in one line, surprisingly selected from Watts' *Logick* (107) ('a white and hard metal next in weight to gold'), while the ancient metal zinc is overlooked entirely. The meager reference to phlogiston as 'the inflammable part of any body, a chemical liquor extremely inflammable,' is understandable, in view of the difficulty it posed to the comprehension of the non-expert.

The fourth edition of the Dictionary, published in 1773, again in two volumes folio (108), was the last to be revised personally by Johnson. Among the numerous corrections that he introduced (109), the chemical entries remained essentially unaltered apart from occasional abridgements. The composition of gunpowder appears to have fascinated him, for he changed the proportions of its constituents, nitre, sulphur, and charcoal from the original 20:3:3 to 15:3:2. Nothing of true importance was added. The great discoveries of pneumatic chemistry of the 1770s by Scheele, Black, Cavendish, and Priestley, culminating in the detailed study of the gaseous elements (inflammable, dephlogisticated, and phlogisticated airs, i.e., hydrogen, oxygen, and nitrogen), as well as gaseous compounds (carbon dioxide, ammonia) were either too recent or indeed too late to be incorporated even in the 1773 edition of the Dictionary.

With his vast literary background, Johnson could not help but supplement his chemical references with occasional quotations from the realm of letters. If sufficiently apt, they superseded technical comment altogether, as did the stern warning of Scripture:

> They that touch *pitch* will be defiled. Ecclesiasticus, 13, 1.

Milton's powerful image of the infernal regions served to illustrate the chemical effects of sulfur on metals:

> A hill not far
> Shone with a glossy surf, undoubted sign
> That in his womb was hid metallick ore,
> The Work of sulphur.'. *Paradise Lost.*

In a lighter mood, the use of lime in building was alluded to in Swift's satire:

> As when a lofty pile is rais'd
> We never hear the workmen prais'd
> Who bring the *lime* and place the stones,
> But all admire Inigo Jones!

The term 'alloy' appeared, with sober precision, in the context of the debasement of the coinage:

> Let another piece be coined of the same weight, wherein half the silver is taken out, and copper, or other *alloy* put into its place, every one knows it will be worth but half as much; for the value of the alloy is so inconsiderable as not to be reckoned. Locke.

Numerous other examples were in a similar vein.

Johnson and Hill. It is disappointing to discover that Johnson, having found Hill's compilations highly acceptable for his purpose, failed to render their author a service, when it was in his power to do so during his celebrated interview with King George III in 1767 (110).

The young king, himself a dedicated collector of books and scientific instruments, had heard of Johnson's visits to the library in Buckingham House (111), expressed a wish to meet him there, and one day went to him in the company of Frederick Barnard, his librarian (112), who presented the author to his sovereign. Although quite unprepared for this attention, Johnson conducted himself in a candid and confident manner. The king canvassed several literary topics, and at length asked his opinion of Dr. Hill. Johnson replied that he was an 'ingenious man, but lacked veracity,' mentioning one example of Hill's lapse from accuracy, that was in truth but a trifling matter. The king's unfavorable impression was hardly lessened when Johnson, realizing perhaps that he had gone too far, attempted to soften his verdict by adding that Hill was a curious observer who, 'if he would have been contented to tell the world no more than he knew, he might have been a very considerable man,' but by then the king turned the conversation to other matters.

It is true that Hill had led a checkered life as apothecary, botanist, journalist, and would-be playwright; and, being forever involved in quarrels, in which he was generally the loser, he commanded little respect from his contemporaries. He was nevertheless an indefatigable author of many books and bulky compilations of considerable merit (113), who, still living at the time, deserved a more generous commendation to the king.

Chemistry in Johnson's Miscellaneous Writings

Just as Johnson's erudition illuminated his scientific writing, so was his chemical knowledge likely to diffuse into his literary creations. While the work on the Dictionary was steadily going forward, Johnson issued, between 1750 and 1752, *The Rambler*, a series of essays in which he discussed social and moral questions of the day (114). Their composition afforded him some intellectual relief from the seemingly endless lexicographic toil. Chemical notions originating in these labors overflowed occasionally into these essays; here they served to instruct and amuse a wider reading public, and to emphasize Johnson's general moral arguments. Thus, for example, when castigating vain projects, he compared them to those of 'the chemist, who employs the arts of separation and refinement upon ore in which no precious metal is contained to reward his operations' (115). His own fascination with alchemy notwithstanding, he did not hesitate to mock the hopeful virtuoso, who sits 'whole weeks without sleep by the side of an athanor, to watch the moment of projection' (116).

Indeed, to Johnson's strong political and social instincts, chemists as a class did not appear to great advantage. In his opinion, they could hardly be credited with liberal interests (such as the merits of different forms of government, or the reform of the legal system) having never accustomed their thoughts to any other subject but salt and sulfur (117), and the endless metamorphoses of their darling mercury (118). On the other hand, his general readership did benefit from gaining certain ideas of chemical doctrine, such as the principle that 'all bodies are resolvable into the same elements, and that the boundless variety of things arises from the different proportions of very few ingredients' (119). Other chemical allusions related to mineral springs, the distillation of herbs and spices, and similar subjects of popular concern (120). Johnson resumed publication of another collection of essays, *The Idler*, in the *Weekly Gazette* in 1758-60. His own appearance in these papers in the guise of 'Mr.Sober,' with his chemical amusements, has already been mentioned (121).

After the completion of the Dictionary, Johnson's livelihood continued to depend on the employment of his pen (122). In 1756 he participated in the conduct of the newly founded *Literary Magazine* (123), writing the Introductory Plan for its first number (124) and contributing numerous essays and book reviews to its pages (125). These dealt chiefly with political, moral, and literary questions, but included several reviews of books with a chemical background.

In reviewing Dr. Lucas' (126) *Essay on Waters* (127), Johnson faced a massive tome of some 900 pages that aimed at encompassing all existing knowledge concerning fresh, sea, and mineral waters. He commended the author's diligence in collecting and methodizing the large body of information, and his personal experimental contributions, especially the careful chemical analyses of more kinds of water and springs than anyone had attempted before. His own conviction 'that the natives of this island have little interest in foreign waters (more commonly visited by voluptuousness or curiosity than sickness)' absolved him from the need of reviewing the Continental mineral springs, which Lucas had studied minutely on his travels (128). In contrast, the waters of Bath, 'deserved to be considered with particular attention,' in all their chemical, medical, and social aspects (129).

In selecting Home's (130) *Experiments on Bleaching* (131) as a work worthy of the public's attention, Johnson stressed the scientific and economic interest of this important technical trade, but warned the reader that the book was intended to instruct rather than delight. He supported the author's argument, that improvements in the art of bleaching depended on a close understanding of its chemical processes, requiring systematic research. For once, Johnson's complaint of the use of terms that 'none but a bleacher understood' was hardly justified, for all such operations as steeping, bucking, souring, etc. were clearly explained in the account of the progress of a piece of cloth from the loom to the finished article. More reasonably, Johnson censured the author for measuring reagents 'by the spoonful,' declaring from his own experience, that 'accuracy is always desirable, even if the error cannot be great or significant' (132).

S. Hales (133), distinguished for his pioneer work on the movement of fluids through plants and blood vessels (134), issued, at the age of 80, a pamphlet that described useful inventions he had perfected over many years (135). The chief among these was an improved distillation procedure for converting sea water into fresh water by blowing a rapid stream of air through the boiling sea water in the still. The rate of distillation and the supply of potable water was thereby doubled, a factor of no small importance on long sea voyages at the time. Johnson—no stranger to the management of distillations—sensed a fallacy in the claimed saving of fuel in the modified process but, conceding that Hales understood these matters better than himself, would rather dwell on the merits of the modest author's 'life spent in the service of mankind' (136).

Scientific Societies

Although not a Fellow himself, Johnson maintained links with the Royal Society at various levels (137), cultivating friendly relations with its Secretary, Dr. Birch, whose *History* (138) of the Society he reviewed in the *Literary Magazine* (139). Anxious to promote the public appreciation of the Society's important role in the scientific life of the country, he advocated the wider circulation of its *Philosophical Transactions*, whose high standards 'did so much honour to the English nation.' Characteristically, he tempered his tribute with a literary homily, charging the editor 'to have some regard to the purity of the English language, which was too frequently assailed by the correspondents and translators.'

In his successive clubs (the Ivy Lane, the Literary, and the Essex Head Club, established in 1749, 1764 and 1783, respectively) and elsewhere, he made the acquaintance of at least 36 Fellows of the Royal Society, among them two of its presidents (Sir John Pringle and Sir Joseph Banks) and four secretaries (Dr. Thomas Birch, Sir Charles Blagden, Samuel Horsley, and Matthew Matey). Under these circumstances, his election to the Fellowship should have presented no difficulties—the less so, since professional eminence in a particular scientific discipline was at the time not essential—but Johnson does not appear to have aspired to this honor (141). The fellowship of the close circle of friends within his own clubs, where he played a leading rather than a subordinate role, and his enjoyable social life in his later years presumably met all his wishes (142).

For a short period, Johnson was a member of the Society of Arts (143) and served on several of its *ad hoc* committees, in the company of Dr. Fordyce, Benjamin Franklin, and his protégé Robert Dossie, who examined and evaluated technical proposals submitted to the Society (144). Whereas Dossie was to become one of the mainstays of the Society (145), Johnson's name disappeared from its records after 1762. The Society was nevertheless proud to proclaim its association with him in its annals, and more visibly in its house: when it commissioned (1777) the artist James Barry (146) to embellish its Great Room with a painting running uninterruptedly around its upper walls (147), he incorporated a portrait of Johnson in one of the allegorical compositions. The familiar likeness of his mature years appears near that of Mrs. Montagu (148), the notable intellectual, and between the Duchesses of Rutland and Devonshire, perhaps as a subtle allusion to his being by no means averse to the company and conversation of accomplished and attractive women (149).

Conclusion

Samuel Johnson is widely accepted as the dominating figure of the literary scene of his time. Such has been his influence on the imagination of literary historians, that the period which produced such brilliant novelists and poets as Fielding (1707-54), Sterne (1713-68), Smollet (1721-71), Goldsmith (1728-74), and Gray (1716-71), has nevertheless been called the Age of Johnson (150). Inevitably, his literary preeminence has overshadowed and all but extinguished the recognition of his life-long interest in the phenomena of the physical world, especially as they affect the life and condi-

tion of man. He had a more intimate acquaintance with the chemistry of his day, and a sounder understanding of its role in the manufactures, arts and medicine than could fairly be expected of a scholar of the humanities. Not surprisingly, commentators and critics have long neglected, if not actually denied, his scientific credentials, asserting, for example, that his esteem of scientific talent was low (151), or that he seldom showed more than a passing interest in science (152).

On the strength of a few selected passages from Johnson's writings, one critic (153) has gone so far as to represent him as an 'antiscientist,' who scorned as idle the pursuit of natural philosophy, in comparison with inquiries concerning fundamental moral and ethical issues. It is true, as was urged, that Johnson placed moral and religious values above mere worldly knowledge. This conviction emerges in numerous passages of his writings, probably most famously in his Life of Milton (154):

> The knowledge of external nature, and the sciences which that knowledge requires or includes, are not the great or the frequent business of the human mind . . . the first requisite is the religious and moral knowledge of right and wrong; the next is an acquaintance with the history of mankind, and with those examples which may be said to embody truth and prove by events the reasonableness of opinions. Prudence and justice are virtues and excellences of all times and of all places; we are perpetually moralists, but we are geometricians only by chance. Out intercourse with intellectual nature is necessary; our speculations upon matter are voluntary and at leisure.

Johnson was not above mildly satirizing—in pity rather than contempt—the vain efforts of misguided dilettanti (155) and even insinuating certain shortcomings of the Royal Society (156). However, none of these opinions interfered with his genuine interest in the advancement of science, his appreciation of its universal utility, or his ability to comment incisively on a wide range of technical subjects. In Johnson's world, moral, literary, and scientific endeavors in no way excluded one another. Schwartz's acute analysis probably comes nearest the truth in its conclusion that Johnson was (157):

> …a commentator, not a serious experimenter or professional 'philosopher,' but his role as such is justified by his personal scientific learning, and enhanced by his knowledge of the human issues, explicitly related to scientific methods and advances . . . The quality of his commentary on scientific matters often surpasses the writings of the scientists themselves, because of the reserves of intellectual sophistication, rhetoric skill and personal experience on which he was able to draw.

Similarly, in critical assessments of Johnson's personal library, its scientific components have at times been ignored (158), or represented as mere tools for use in the compilation of his Dictionary. However, as is now shown, Johnson used in fact less than half of his chemistry books as sources of dictionary quotations, having clearly acquired the others for their intrinsic interest. Indeed, he regarded as superfluous the inclusion of technical works in the private library of a gentleman, unless they served the owner's special interests. Thus when, in 1768, the King's librarian was about to embark on a tour of the European Continent in search of rare books for the royal collection, Johnson, having apparently been approached for advice, gave his considered opinion regarding the most desirable categories of books to be procured: science books were not among them (159).

As for himself, he continued to collect chemistry books; he studied them, reviewed them, and with his fabulous memory, made much of their contents his own. When Murphy, his faithful friend (160), visited him during one of his last illnesses, he found him reading Watson's Chemical Essays with evident satisfaction, and expressing his approbation in his usual forceful way: 'From this book, he who knows nothing may learn a great deal, and he who knows will be pleased to find his knowledge recalled to his mind in a manner highly pleasing' (161).

Turning to Johnson's love of performing chemical experiments, a more favorable estimate of their benefit to him than has hitherto been allowed may justifiably be claimed. Modern opinion (162) has deviated little from the view of his contemporary friends, that his chemical 'operating' was a harmless amusement. Literary critics with little scientific background have regarded his experimenting, at best, as yet another engaging idiosyncracy of their hero (163), or at worst a trivial pursuit to be dismissed with near contempt (164). Yet it is an established fact that interest in the study of chemistry is most effectively sustained by the personal performance of laboratory experiments, however modest and elementary: the management of apparatus, familiarity with chemical substances, and close attention to phenomena, afford first hand insights that no amount of reading can provide. Johnson's experiments were by no means all routine exercises which—barring accidents—gave predetermined results. They did not lack variety and a measure of originality, as when he "drew" the essences from different plants by distillation. He gave detailed directions for the construction of a chemical furnace and

was emphatic about the need for accuracy in weighing and measuring the substances used in chemical operations. All in all, Johnson's personal experience of chemical work was undoubtedly of no small service to him, rendering dry textbook descriptions familiar territory that could be entered with ease.

Although Johnson was not the only literary figure of his time having a predilection for the chemical and physical sciences, he pursued these studies more resolutely than others. Gibbon and also Rousseau, for example, are credited with an interest in chemistry; and Adam Smith, whose favorite study at Glasgow University was that of mathematics and natural philosophy, left an unpublished manuscript on the history of astronomy. Swift was sufficient familiar with science to satirize its disciples unmercifully. It was only in the next generation, in another country, that a great man of letters exceeded Johnson in scientific competence: the poet, author, and philosopher J. W. Goethe (1749-1832) combined in his person the highest literary genius with scientific talents of an order that enabled him to make original contributions to such divergent fields as geology, chemistry, optics, and botany (165). By the turn of the century, the rapid advance of science restricted its serious study inevitably to the domain of the professional specialist; henceforth the educated enthusiast might still take an informed interest in scientific progress, but had to be content with the role of the spectator.

It must remain a matter for regret that Boswell's attainments in science were decidedly limited. Although he recorded faithfully occasional anecdotes arising from Johnson's contacts with physicians and men of science, his own scientific naïveté was clearly apparent from his artless astonishment, each time Johnson gave an example of his scientific expertise. Had Boswell been able to enter this sphere of Johnson's interests, he would no doubt have elicited—and recorded with his accustomed minuteness—a great deal of Johnson's opinions of the state of contemporary chemistry and its protagonists. As it is, the existing solid evidence of Johnson's writings and known activities firmly establishes him as a committed student of chemistry and the natural sciences in the Baconian tradition. True to its philosophy, and following in the footsteps of his admired mentor Boerhaave, he relied not solely on book learning, but advocated critical study, personal observation and trial, and was as concerned with the elucidation of principles as with their practical application. He maintained that (166):

> A man [may find] in the productions of nature an inexhaustible store of materials upon which he can employ himself . . . He has always a certain prospect of discovering new reasons for adoring the sovereign author of the universe, and probable hopes of making some discovery of benefit to others, or of profit to himself. [This requires not] much force of penetration . . . but only frequent experiments, and close attention. What is said by the chymists of their darling mercury is, perhaps, true of every body . . . that, if a thousand lives should be spent upon it, all its properties would not be found out.

With his high intellectual integrity and ripe scholarship, Johnson was as ready to explore religious, moral, and social problems as scientific questions, always with the ultimate aim of recognizing the true nature of things. His endeavors in the realm of chemistry were an integral part of this pattern and merit their due acknowledgment of posterity.

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Johnson's friendship with the Thrales was formed one year later. Much less is known about his earlier life, though biographies focusing on these years have appeared (see Clifford, Ref. 6).

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30. Ref. 21, Balderston, Vol.2, p 982 (October 6, 1797).
31. Professor Ubbelohde (see Ref. 9) recalled witnessing this experiment on the occasion of an inaugural lecture at Queen's University, Belfast. It frightened the newspaper reporters sitting close to the demonstration.
32. Ref. 3, Piozzi, p 238; or Ref. 3, Shaw, p 139.
33. Ref. 2, Boswell, Vol.1, p l65.

34. Ref. 2, Boswell, Vol.2, p 339.
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41. They were: *The laboratory laid open*, J. Nourse, London, 1758; *The handmaid to the arts teaching a perfect knowledge of the materia pictoria . . . glazings for earthen and stone ware*. 2 vol., J. Nourse, London, 1758; and *Institutes of experimental chemistry, being an essay towards reducing that branch of natural philosophy to a regular system*, 2 vol., J. Nourse, London, 1759.
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52. R. Boyle, *The sceptical chymist, or chymico-physical doubts and paradoxes touching the Spagyrist's principles . . . defended by the generality of alchymists whereunto is praemis'd part of another discourse relating to the same subjects*, printed by F. Cadwell for F. Crooke, London, 1661, 333, 422.
53. L. M. Principe, *The Aspiring Adept. Robert Boyle and his Alchemical Quest*, including Boyle's "lost" Dialogue on the transmutation of metals, Princeton University Press, Princeton, NJ, 1998.
54. B. J. T. Dobbs, *The Foundations of Newton's Alchemy or The Hunting of the Greene Lyon*, Cambridge University Press, Cambridge, 1975; K. Figala, J. Harrison, and U. Petzold, "De scriptoribus chemicis: Sources for the Establishment of Isaac Newton's (Al)chemical Library," in P. M. Harman and A. F. Shapiro, Ed., *The Investigation of Difficult Things*, Cambridge University Press, Cambridge, 1992, Ch.6, 135-80; M. White, *Isaac Newton, the Last Sorcerer*, Fourth Estate, London, 1997, 122, 131-48.
55. Ref. 27, pp 406-28.
56. S. Johnson, *The Rambler*, appearing as a periodical in 208 numbers between 1750 and 1752, was originally published anonymously. Collected in book form, it reached 16 editions in Johnson's lifetime and many more thereafter; e.g. 2nd ed., 6 vol., 12°, London, 1752. Here: No. 63, October 23, 1750.
57. It is recalled that Charles Lamb, the gentlest of critics, denied scientific treatises the dignity of 'books' altogether: "I can read anything which I call a book. There are things in this shape, which I cannot allow for such: Court calendars, directories, scientific treatises . . . and generally all those volumes which no gentleman's library should be without." C. Lamb, "Detached Thoughts on Books and Reading," *Essays of Elia*, Taylor & Hessey, Edward Moxon, London, 1823 and 1833; World's Classics, Oxford University Press, Oxford, 1901, 222-28.
58. Ref. 2, Boswell, Vol.1, p 468. 'Considering the slovenly and careless manner in which books were treated by Johnson, it could not be expected that scarce and valuable editions should be lent to him,' a point aptly illustrated by Johnson's rough handling of Garrick's fine copy of Petrarch. See H. A. Dobson, "Johnson's Library" in *Eighteenth Century Vignettes*. Second Series, Chatto & Windus, London, 1894 , 3 vol.
59. Ref. 2, Boswell, Vol.1, p 291.
60. J. D. Fleeman, Ed., *The sale catalogue of Samuel Johnson's library. A facsimile edition. Made from the annotated copy in Harvard University*, ELS Monograph Series, English Literary Studies No. 2, University of Victoria, B.C. 1975, 7.
61. J. Christie, *A catalogue of the valuable library of books of the late learned Samuel Johnson, Esq., LL.D., deceased; which will be sold by auction (by order of the Executors) by Mr. Christie*, at his Great Room in Pall Mall, on Wednesday, February 16, 1785, and the three following days.
62. D. Greene, *Samuel Johnson's Library. An Annotated Guide*, ELS Monograph Series. English Literary Studies No.1, University of Victoria, B.C. 1975.
63. According to Fleeman (Ref. 60, p5), an original copy of the catalogue was in 1818 in the possession of Will-

iam Upcott, assistant librarian (1806-34) at the London Institution, given him by "William Bray, FSA." The latter was in fact undoubtedly Edward William Brayley, librarian for 36 years (1834-70) at this institution. Another original copy has returned, after some vicissitudes, to the Johnson Museum, at 17 Gough Square, City of London, Johnson's residence during 1749-56, the years of the compilation of his Dictionary (Fig. 5).

64. Ref. 60.
65. Ref. 62.
66. Ref. 62, p 6.
67. J. R.Spielmann, *Institutiones chemiae praelectionibus academicis accommodatae,* Apud Johannem Godofredum Bauerum, Argentorati, 1763. Appendix: Syllabus auctorum, 27 pp.
68. [J .Black], *Lectures on the elements of chemistry delivered in the University of Edinburgh by the late Joseph Black*. Now published from his manuscripts by John Robison, LL.D., Longman & Rees, W. Creech, London and Edinburgh, 1803, 2 vol.
69. J. Priestley, *Experiments and Observations on Different Kinds of Air*, London, 1774-7. Subsequent volumes appeared entitled *Experiments and Observations Relating to Various Branches of Natural Philosophy*, J. Johnson, London, 1779-86, 3 vol.
70. C. Neumann, *The chemical works of Caspar Neumann. Abridged and methodized. With large additions . . . by William Lewis, MB, FRS*, W. Johnston, G. Keith, etc., London, 1759.
71. R. W. Chapman, Ed., *The letters of Samuel Johnson. With Mrs. Thrale's genuine letters to him*, Clarendon Press, Oxford, 1952, 3 vol. Letter No. 1104, B. Redford, Ed., *The Letters of Samuel Johnson*, Princeton University Press, Princeton, NJ,. 1992-94, 5 vol., Vol.5, 26-27.
72. Streatham Park, Surrey. *A catalogue of the excellent household furniture of the best description . . . and the extensive and well-selected library, . . . the genuine property of Mrs. Piozzi;* and will be sold by auction by Mr. Squibb on the premises on Wednesday 8 May 1816 and four following days.
73. A Sale, held in Manchester in 1823 of the 'effects of the property Bach-y-Craig, of Mrs. Piozzi, deceased,' once again included a library of books, many of them with Johnsonian associations, but chemistry had all but disappeared. The Catalogues of this and the foregoing sale (Ref. 72) were reprinted in: S. Parks, Ed., *Sale catalogues of libraries of eminent persons* (General editor, A. L. N. Munby), *Vol. 5: Poets and men of letters*, Mansell with Sotheby Parke Bernet, London, 1972.
74. Richard Owen Cambridge (1717-1802), author. DNB, *3*, 723-9.
75. Ref. 2, Boswell, Vol.1, p 595.
76. S. Johnson, A.M., *A Dictionary of the English language, in which the words are deduced from their originals, and illustrated in their different significations by examples of the best writers. To which are prefixed A history of the language and an English grammar*, W. Strahan for J. & P. Knapton, etc., London, l755, 2 vol. Folio. A facsimile reprint of this first edition was issued by Longman (Harlow, 1990). The fourth edition was the last to be supervised by Johnson personally, London, 1773, 2 vol., folio. All the present quotations are taken from the first folio edition, unless otherwise stated.
77. W. Nicholson, *A Dictionary of Chemistry*, G. G. and J. Robinson, London, 1795, 2 vol., 4to.
78. E. J. Eklund, *The incompleat chymist. Being an essay on the 18th century chemist in his laboratory, with a dictionary of obsolete chemical terms*, Smithsonian Institution Press, Washington, DC, 1975
79. L. B.Guyton de Morveau, *Méthode de nomenclature chimique, proposée par MM. de Morveau, Lavoisier, Bertholet (sic) et de Fourcroy. On y a joint un nouveau système de caractères chimiques, adaptés a cette nomenclature, par MM Hassenfratz & Adet*, Suchet, Paris, 1787. Outlined in Ref. 77, pp 519-29.
80. Alexander Pope, "Windsor-Forest," composed 1704, first published, B. Lintott, London, 1713. Nelson Classics ed., London, 1954, 31-43.
81. J. Arbuthnot, *An essay concerning the nature of aliments and the choice of them according to the different constitutions of the human body*, J. Tonson, London, 1731-2, 2 vol.
82. Isaac Watts (1674-1748), author, hymn writer, and philosopher; DNB, *20*, 978-81. Johnson included his biography in the *Lives of the Poets*, Ref. 154.
83. I. Watts, *Logick, or the right use of reason in the enquiry after truth . . . in the affairs of religion and human life, as well as in the sciences*, J. Clark & R. Hett, London, 1725 and numerous subsequent editions.
84. Ref. 52, (1680 London ed.), pp16, 354.
85. The copy in the British Library (8th ed., London, 1745) annotated by Johnson bears Samuel Roger's bookplate and the following inscription on its flyleaf: 'Dr.Johnson's copy, marked for the quotations for his Dictionary. Bought at his sale by Mr. Rogers, and by him given to me, 30 October 1842. Samuel Sharpe. For S. Rogers (1763-1855) and S. Sharpe, FGS (1799-1881), his nephew, see DNB, *17*, 139-42 and *17*, 1363-5.
86. Ref. 2, Boswell, Vol. 2, p 148. This assertion has been questioned by Schwartz, Ref. 10.
87. F. Bacon, *Sylva sylvarum, or a Natural history in ten centuries, whereunto is added . . . the New Atlantis*, William Lee, London, 1685.
88. F. Bacon, *Apophthegms, new and old, collected by the Rt. Hon. Francis Lord Verulam*, H. Barratt & R. Whittaker, London, 1625.
89. T. Birch, Ed., *The works of the Hon. Robert Boyle (with life*), A. Millar, London, 1744, 5 vol., folio (The first complete edition of Boyle's works).
90. P. Shaw, M.D., Ed., *The philosophical works of the Hon. Robert Boyle, Esq. Abridged, methodized and disposed under general heads*, J. Osborne & T. Longman, London 1725, 3 vol.,4to.

91. Ref. 54, Dobbs.
92. I. Newton, *Opticks, or a Treatise of the reflexions, refractions, inflexions and colours of light. Also, two treatises on the species and magnitude of curvilinear figures*, S. Smith & B. Walford, London, 1704, 4to, and subsequent editions.
93. John Quincy (d.1722), medical writer, author of the *Lexicon physicomedicum* (Ref. 97), and the *English Dispensatory* (1721); DNB, *16*, 555-6.
94. John Arbuthnot (1667-1735), medical man, author and wit, physician-in-ordinary to Queen Anne, friend of Swift, Pope, and Congreve; DNB, *1*, 534-7.
95. John Hill, MD (?17l6-1775), apothecary, author, compiler and translator of voluminous works on botany, materia medica, mineralogy, and chemistry. DNB, *9*, 848-52.
96. Ephraim Chambers (?1680-1740), FRS (1729), encyclopaedist, DNB, *4*, 16-7.
97. J. Quincy, *Lexicon physico-medicum, or a new physical dictionary, explaining the difficult terms used in the several branches of the profession, and in such parts of Natural Philosophy as are introductory thereto*, E. Bell, etc., London, 1719. Johnson used the 6th edition, 'with new improvements from the latest chymical and mechanical authors,' London, 1743.
98. B. Castellus, *Lexicon medicum Graeco-latinum. Ex Hippocrate et Galeno desumptum*, Apud G. Valentinum et F. Bolzettam, Venice, 1626, and later enlarged editions, e.g., Leipzig, 1713.
99. Ref. 81.
100. H. J. Backer, "Boerhaave's ontdekking van het ureum," *Nederlandsche Tijdschrift voor Geneeskunde*, **1943**, 1274-8; F. Kurzer and P. M. Saaderson, "Urea in the History of Organic Chemistry," *J. Chem. Educ.*, **1956**, *33*, 492-9.
101. E. Chambers, *Cyclopœdia, or an Universal Dictionary of arts and sciences*, 2.ed., London, 1738, 2 vol., folio. Its French translation became the forerunner of Diderot and D'Alembert's *Encyclopédie*. Johnson used the 4th ed. (1741).
102. J. Hill, *A history of the materia medica, containing descriptions of all the substances used in medicine . . . and an account of their virtues, and of the several preparations from them now used in the shops*, T. Longman, A. Millar, etc., London, 1751, 4to. The first volume is devoted to the mineral kingdom.
103. J. Hill, *A general natural history, or Description of the animals, vegetables and minerals of the different parts of the world, including the history of the materia medica, pictoria and tinctoria of the present and earlier ages*, Thomas Osborne, London, 1748-52, 3 vol., folio.
104. John Woodward (1665-1728), FRS (1693), professor of physic at Gresham College (1692), author of several treatises on geology and mineralogy; DNB, *21*, 894-6.
105. J. Woodward, *An attempt towards a natural history of the fossils of England, in a catalogue of the English fossils in the collection of J.W.*, J. Osborne & T. Longman, London, 1728-9, 2 vol.
106. Ref. 102.
107. Ref. 83.
108. Ref. 76.
109. A. Reddick, *The Making of Johnson's Dictionary*, 1746-1773, Cambridge University Press, Cambridge, 1990; rev. ed., 1996.
110. J. Boswell, *A conversation between His Most Sacred Majesty George III and Samuel Johnson, LL.D., illustrated with observations by James Boswell, Esq.*, London, 1790; also Ref. 2, Boswell, Vol.1, pp 358-62.
111. E. L. MacAdam, *Dr. Johnson and the King's Library*, with a facsimile of Johnson's letter to the King's librarian, Grolier Club, New York, 1955.
112. Sir Frederick Augusta Barnard's portrait, painted by John Prescott Knight, RA, occupies a place of honor in the new British Library.
113. *The Dictionary of National Biography* (Ref. 95) credits Hill with 76 named works on botany, medicine, and a highly popular Herbal. His monumental Vegetable *System*, issued between 1759 and 1773 in 26 volumes, folio, illustrated with 1,600 copper engravings depicting 26,000 plants, earned him the Order of Vasa (1774) from the King of Sweden (the basis of his claim to a knighthood), but is said to have embarrassed him financially.
114. Ref. 56.
115. Ref. 56, No.139, 16 July 1751.
116. Ref. 56, No.199, 11 February 1752.
117. Ref. 56, No.99, 26 February 1751.
118. Ref. 56, No. 5, 3 April 1750.
119. Ref. 56, No. 68, 10 November 1750.
120. Ref. 56, Nos. 25, 51, 83, 103, 120, 142.
121. Ref. 22.
122. The total remuneration received by Johnson from the bookseller syndicate that had commissioned the Dictionary was £1575. Spread over seven years, it had to cover the wages of his amanuenses, the cost of paper and other materials, as well as his domestic expenses, and was spent by the time the Dictionary appeared in 1755. Some supplementary payments were apparently made subsequently. The award to him of the government pension of £300 p.a. was still seven years away (1762).
123. The *Literary Magazine or Universal Review* appeared monthly from May, 1756, but declined when Johnson ceased to write for it after its fifteenth number, and was discontinued in July, 1758.
124. In outlining the plan of the new periodical, Johnson expressed the editor's desire, apparently with an eye to the *Gentleman's Magazine*, 'to advance our interest without lessening that of any other.' Its purview would extend to 'all productions of science.'
125. Ref. 2, Boswell, Vol.1, pp 203-13, especially pp 205-6.
126. Charles Lucas, MD, MP (1713-71), apothecary and physician, Irish patriot; DNB, *12*, 231-4.

127. C. Lucas, *An essay on waters. In three parts, treating I. of simple waters, II. of cold medicated waters, III. of natural baths*, A. Millar, London, 1756. The three parts separately paginated.
128. The minute description of the springs of Spa and Aachen (Aix-la-Chapelle) alone took up some 70 and 195 pages of the book, respectively.
129. S. Johnson (anon.), *The Literary Magazine*, **1756,** *1*, 167-8, 225-9, 288-92.
130. Francis Home (1719-1813), professor of materia medica at Edinburgh; DNB *9*, 1122-3.
131. F. Home, *Experiments on Bleaching*, A. Kincaid & A. Donaldson, Edinburgh, 1756; see also F. G. Page, "Francis Home and Joseph Black: The Chemistry and Testing of Alkaline Salts in the Early Bleaching and Alkali Trade," *Bull. Hist. Chem*., **2000**, *27*, 107-112.
132. S. Johnson (anon.), *The Literary Magazine*, **1756**, *1*, 136-41.
133. Stephen Hales (1677-1761), DD, FRS, physiologist and inventor. Perpetual curate at Teddington, clerk of the closet to the Princess Dowager (1751), and chaplain to her son, afterwards King George III; DNB *8*, 916-20. See also A. E. CIark-Kennedy, *Stephen Hales, DD, FRS. An eighteenth-century biography*, Cambridge University Press, Cambridge, 1929.
134. S. Hales, *Statical essays. Vol.1. Vegetable staticks; Vol.2. Haemostaticks*, W. & J. Innys, London, 1727 and 1733.
135. S. Hales, An account of a useful discovery to distil double the usual quantity of sea-water by blowing showers of air up through the distilling liquor . . . and an account of the great benefit of ventilators . . . in slave and other transport ships; also an account of the good effect of blowing showers of air through milk, thereby to cure the ill taste which is occasioned by some kinds of food of cows, Richard Manby, London, 1756. Reissued from *Philos. Trans. R. Soc.*, **1755**, *49 I*, 312-47. See also: "The Rev. Dr. Hales's method of obtaining plenty of fresh sea-water; Further improvements by the Rev. Dr. Hales," *Gentleman's Magazine*, **1756**, *26*, 78-9 and **1757**, *27*, 503.
136. S. Johnson (anon.), *The Literary Magazine*, **1756**, *1*, 143-5.
137. A. D. Atkinson, "Dr. Johnson and the Royal Society." *Notes and Records of the Royal Society*, **1953**, *10*, 131-8; A. D. Atkinson, "Dr. Johnson and Science," *Notes and Queries*, **1950**, *195*, No. 16, 24, 25, 26; pp 338-41, 516-9, 541-4, 561-3.
138. T. Birch, *The History of the Royal Society of London*, A. Millar, London, 1756, 4 vol., 4to.
139. S. Johnson (anon.), *Literary Magazine*, **1756**, *1*, 30-2.
140. S. Johnson (anon.), "Philosophical Transactions. Volume XLIX. For the year 1755," *Literary Magazine*, **1756**, *1*, 193.
141. The imposition by the Royal Society of an admission fee (of two guineas before 1753, raised to five guineas thereafter), and an annual subscription (of £2:12:0, see Ref. 142) may have been no small disincentive to Johnson of seeking election during his long years of straightened circumstances (see also Ref. 42).
142. C. R. Weld, *A History of the Royal Society*, John W. Parker, London, 1848, 2 vol., Vol.2, 524, 541; *Minute Book of the Royal Society*, 12 March 1752.
143. The signature 'Sam. Johnson' in the Society's membership book is followed by the promise to pay the subscription of 2 guineas.
144. J. L. Abbott, "Dr. Johnson and the Society," *J. R. Soc. Arts*, **1967**, *115*, 395-400, 486-90.
145. See Ref. 39.
146. James Barry (1741-1806), historical painter; DNB *1*, 1241-4.
147. The impressive frieze paintings, 140 ft long and 11_ ft tall, completely covering the upper four walls of the grand lecture room of the Society's mansion in The Adelphi have, with occasional cleaning and restoration, been preserved to this day. The artist has described the creation of the work, which seeks to illustrate, in six allegorical scenes, 'The Rise of Human Culture.' See, J. Barry, *An account of a series of pictures in the Great Room of the Society of Arts, Manufactures and Commerce at the Adelphi*, for the author, London, 1783.
148. Elisabeth Montagu (1720-1800), the original 'blue stocking;' DNB, *13*, 687-91.
149 Ref. 2, Boswell, Vol.2, p 537.
150. A. W. Ward and A. R. Waller, *The Cambridge History of English Literature*, Cambridge University Press, Cambridge, 1907-16, 1932, 15 vol.. Vol. is subtitled "The Age of Johnson;" G. Sampson, *Concise Cambridge History of English Literature*, Cambridge University Press, Cambridge, 1941, 1961, Chap. X, 502- 57.
151. P. Fussell, *The rhetorical world of Augustan humanism: Ethics and imagery from Swift to Burke*, Clarendon Press, Oxford, 1965, l7.
152. W. P. Jones, *The rhetoric of science. A study of scientific ideas and imagery in 18th century English poetry*, Routledge & Kegan Paul, London, 1966, l79.
153. J. R. Philip, "Samuel Johnson as Antiscientist," *Notes and Records of the Royal Society*, **1974-5**, *29*, 193-203.
154. S. Johnson in G. B. Hill, Ed., *Prefaces, biographical and critical to the works of the English poets*, Clarendon Press, Oxford, 1905**,** 3 vol., Vol.1, 99-100; see also Ref. 56, No. 24, 9 June 1750; No.137, 9 July 1751.
155. Ref. 56, No.199, 11 February 1752; Ref. 22, No. 31, 18 November 1758.
156. Ref. 140; also Ref. 22, No. 88, 22 December 1759.
157. Ref. 10, p 25 and Chap.V, pp 120-45
158. P. H. Houston, *Doctor Johnson—a Study of 18th-Century Humanism*, Harvard University Press, Cambridge, MA, 1923. For an unfavorable commentary thereon, see Ref. 62.
159. Ref. 111. Indebted to Barnard for his part in his recent interview with the King, and for other privileges, Johnson wrote a very courteous and diplomatic letter, offering his advice in terms that would give no offense to a man who was obviously himself an expert in this business.

160. Ref. 23.
161. Ref. 24, p 121.
162. Ref. 9.
163. Ref. 58, Dobson.
164. W. K. Wimsatt, in *Philosophic words. A study of style and meaning in The Rambler and Dictionary of Samuel Johnson*, Yale University Press, New Haven, CT, 1948, 36: 'what may by courtesy be called Johnson's experimental activities.'
165. O. Krätz, *Goethe und die Naturwissenschaften*, Callway, Munich, 1992, 2nd ed.
166. Ref. 56, No. 5, April 3, 1750.

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ABOUT THE AUTHOR

Frederick Kurzer, Ph.D., D.Sc., FRSC, graduated in chemistry in the University of London. After 5 years' employment in a pharmaceutical research laboratory, he spent his working life teaching chemistry and biochemistry at the Royal Free Hospital School of Medicine. He is the author of numerous research papers and reviews dealing with synthetic organic chemistry and of several publications on historical aspects of science.

Appendix I. List of Johnson's Books on Chemistry and Cognate Subjects.

	Sale Cat.No.		
1.	346	-	Agricola,Georgius, *Opera* (Six named works), Frobenius, Basle, 1546.
2.	-	D	Arbuthnot, John. *An essay concerning the effects of air on human bodies*, J. & R. Tonson, London, 1733.
3.	-	D	Arbuthnot, John. *An essay concerning the nature of aliments* (Ref. 81).
4.	-	D	Bacon, Francis. *Apophthegms new and old* (Ref. 88).
5.	-	D	Bacon, Francis. *Sylva sylvarum* (Ref. 87).
6.	-	D	Bacon, Francis, *Philosophical Works* (Ref. 90).
7.	317	-	Bacon, Roger. *Opus majus ad Clementem Quartum*, fol., W. Bowyer, London, 1733.
8.	553	-	Béardé de l'Abbaye. *Essays in agriculture*, or *A variety of useful* hints for its improvement, with respect to air, water, earth, heat *and cold . . . for the improvement of natural knowledge*, 4to, T. Carnan, London, 1776.
9.	418	-	Becher, Johann Joachim, *Physica subterranea* (G. E. Stahl, Ed.), 4to, Weidmann, Leipzig, 1738.
10.	80	D	Boerhaave, Herman. *Elementa chemiae.Historia, artis theoria et* 398 *operationes chemicae*. 2. Vol. 4to, J. R. Imhof, Leyden, 1732. Two copies in Sale.
11.	562	D	Boyle, Robert. *Works* (T. Birch, Ed.) (Ref. 89).
12.	-	D	Boyle, Robert. *The sceptical chymist*. (Ref. 52.).
13.	-	D	Boyle, Robert. *Experiments and considerations touching colours*, 12mo, Henry Herringman, London, 1664.
14.	30	-	Boyle, Robert. (An unidentified single work).
15.	579	D	Browne, Sir Thomas. *Pseudodoxia epidemica* (Vulgar errors), Edward Dod, London, 1646.
16.	263	D	Butler, Samuel. *Hudibras*, D. Browne, London, 1726.
17.	417	-	Caesalpinus, Andreas, *De metallicis libri tres*, A. Zannetti, Rome, 1596.
18.	295	D	Celsus, Aurelius Cornelius. *De medicina libri octo*, with notes, Variorum, J. A. Langerak, Leyden,1746.

19.	487	D	Chambers, Ephraim. *Cyclopedia* (The sale catalogue lists the1741 edition), (Ref. 101).
20.	124	D	Cheyne, George. *The English malady, or a treatise of nervous diseases of all kinds, with the author's own case*, G. Strahan, London, 1733.
21.	-	D	Cowell, John. *A law dictionary, or the interpretation of words and terms*. *Now very much augmented and improved up to the year 1708*, folio, D. Browne, etc., London, 1708.
22.	-	D	*Dictionnaire universel françois et latin* (vulgairement appelé Dictionnaire de Trévoux, 3 vol., folio, Trévoux, 1704.
23.	-	-	Dossie, Robert. *The laboratory laid open.* 1758. (Ref. 41).
24.	-	-	Dossie, Robert. *The handmaid to the arts.* 1758, (Ref. 41).
25.	-	-	Dossie, Robert. *Institutes of experimental chemistry*, J. Nourse, London, 1759, (Ref. 41).
26.	488	-	*Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des metiers*, par une société de gens de lettres. 7 vols Folio, M. Diderot et M. d'Alembert, Paris, 1751-9.
27.	225	-	Galenus, Claudius. *Galeni opera*. 5 vol., Frobenius, Basle, 1538
	470	-	*Galeni opera*, 7 vol., Frobenius, Basle, 1542. Two copies in Sale.
28.	464	-	Gerarde, John. *The Herball or generall historie of plantes, very much enlarged and amended by Thomas Johnson*, folio, A. Islip, J. Norton & R. Whitakers, London, 1633.
29.	358	D	Grew, Nehemia. *Cosmologia sacra, or a discourse of the universe*, folio, W. Rogers, London, 1701.
30.	44	-	Hales, Stephen. *Statical essays* (Ref. 134).
31.	-	-	Hales, Stephen. *Account of distilling . . . sea-water* (Ref. 135).
32.	-	D	Harris, John. *Lexicon technicum, or a universal English dictionary of arts and. sciences*. 2 vol., folio, D. Browne, London, 1704-10.
33.	412	-	Helmont, Johannes Baptista von. *Opuscula medica inaudita*. 4to, L. Elzevir, Amsterdam, 1648.
34.	272	D	Hill, John. *A history of the materia medica* (Ref. 102).
35.	-	D	Hill, John. *A general natural history*. (Ref. 103).
36.	592	-	Hoffmann, Friedrich. *Opera omnia physico-medica*, 6 vol. +2 vol. Supplements, folio, de Tournes, Geneva, 1748-53.
37.	-	-	Home, Francis. *Experiments on bleaching* (Ref. 131).
38.	-	-	Hooker, Richard. *Of the lawes of ecclesiastic politie eight bookes* (Ref. 49).
39.	211	-	James, Robert. *Medicinal dictionary* (Ref. 15).
40.	309	-	Juncker, Johann. *Conspectus chemiae theoretico-practicae in* forma tabularum . . . principia . . e dogmatibus Becheri et *Stahli potissimum explicantur . . . experimentis stabiliuntur*, 2vol. 4to, Impensis Organotrophei, Halle, 1730-8.
41.	615	-	Lewis, William. *A course of practical chemistry* (Ref. 27).
42.	601	D	Locke, John. *The works* (the first collected edition by J. LeClerk), 3 vol., folio, J. Churchill & S. Manship, London, l714
43.	-	-	Lucas, Charles. *Essay on waters* (Ref. 127).
44.	614	-	Macquer, Pierre Joseph. *Elements of the theory and practice of chymistry* (translated from the French), 2 vol. 2nd ed., A. Millar & J. Nourse, London, 1764.
45.	62	-	Macquer, Pierre Joseph. *Dictionary of chemistry. With full* explanations of . . . the fundamental principles of the arts, trades *and manufactures dependent on chemistry* (translated by James Keir, FRS), 2 vol., 4to, T. Cadell, London, 1771.
46.	260	-	Marggraf, Andreas Siegmund, *Opuscules chymiques*, 2 vol. 12mo, Vincent, Paris, 1762.
47.	-	D	Mead, Richard. *Mechanical account of poisons, in several essays*, Ralph Smith, London, 1702.
48.	-	D	Miller, Philip. *A short introduction to the knowledge of the science of botany*, John Rivington, London, 1760.
49.	-	D	Mortimer, John. *The whole art of husbandry, or the way of managing and improving of land*, 3rd ed., H. & G. Mortlock, R. Robinson, London, 1712.
50.	145	-	Musschenbroek, Pieter van. *Elementa physicae conscripta in usus academicos*, Apud Samuelem Luchtmans, Leyden, 1734.
51	624	-	Neri, Antonio. *De arte vitaria libri VII, et in eosdem Christophori Merretti observationes et notae*, 18mo, Andreas Frisius, Amsterdam, 1668.
52.	58	D	Newton, Sir Isaac. *Opticks* (Ref. 92).

53.	111	-	Paracelsus, Theophrastus Bombast (ab Hohenheim). *Opera ogmia*, 3 vol., folio, I. Antonius & S. de Tournes, Geneva, 1658.
54.	609	-	Plinius, Secundus Caius. *Historiae mundi libri XXXVII*. Ex postrema ad vetustos codices collatione, cum (S.Galenii) annotationibus, Folio, Froben, Basle, 1539.
55.	306	-	Plinius, Secundus Caius. *Naturalis historiae libri XXXVII*. Interpretatione et notis illustravit J.Harduinus in usum. Delphini. 5 vol., 4to, F. Muguet, Paris, 1685.
	350	-	Editio nova emendatior ac auctior, 3 vol., folio, Impensis Societatis, Paris, 1741
56.	-	D	Quincy, John. *Lexicon physico-medicum* (Ref. 97).
57.	354	D	Savary des Bruslons, Jacques. *The universal dictionary of trade* and commerce, translated from the French . . . with large *additions ... by M.Postletwayt*, 2 vol., folio, J. & P. Knapton, London, 1751-5.
58.	132	-	Schelhammer, Günther Christoph. *Tractatus de nitro, vitriolo, alumine et atramentis*, Apud Janssonio Waesbergios, Amsterdam, 1709.
59.	380	-	Watson, Richard. *Chemical essays* (Ref. 46).
60.	262	D	Watts, Isaac. *Logick* (Ref. 83).
61.	-	D	Watts, Isaac. *The improvement of the mind, or a supplement to the art of logick*, James Brackston, London, 1741.
62.	-	D	Woodward, John. *Fossils of all kinds, digested into a method*, suitable to the mutual relation and affinity, with the names by *which they are known to the Ancients . . . and also several* papers tending to the future advancement of the knowledge of *minerals*, William Innys, London, 1728.
63.	23	D	Woodward, John. *Natural history of the fossils of England* (Ref. 105).

Notes to Appendix I

The appended list is an attempt to register all works on chemistry and closely related subjects that can be shown to have been owned by, or known to Johnson. The books that formed part of his library, as recorded by its sale catalogue (Ref. 60, 61), are identified by their original catalogue number. All those cited by Johnson as sources of his Dictionary quotations, are marked D. Titles lacking either designation were traced through his miscellaneous writings.

Several major works of this list were primarily concerned with medicine but, according to the prevailing usage, included substantial sections on chemistry (and materia medica), as did the large encyclopaedias. Works on physics, botany, agriculture, and philosophy provided incidental chemical information. A few titles not obviously chemical or scientific (No. 16, 38, 60, 61) did contain suitable passages used by Johnson for his scientific entries.

Bibliographical details of volumes are not repeated in the Appendix, when they have already appeared in the footnotes of the text, to which reference is made instead. The very verbose titles of several of the early books are, except for the more obscure works, suitably abbreviated.

Appendix II. List of Books on Chemistry and Cognate Subjects in the Thrales' Library at Streatham

	Sale Cat. No.	
1.	87	Barry, Sir Edward, FRS. *Observations historical, critical and medical,* on the wines of the ancients, and the analogy between them and *modern wines etc*.,4to, T. Cadell, London, 1775.
2.	212	Becher, Johann Joachim. *Physica subterranea* (As No. 9, Appendix 1).
3.	79	Boerhaave, Herman (translated by Peter Shaw), *A new method of chemistry,* 2 vol., 4to, London, 1753 (Ref. 26).
4.	127	Boyle, Robert. *Works* (As No 11, Appendix 1).
5.	88	Combrune, Michael. *The theory and practice of brewing,* 4to, R. & J. Dodsley, etc., London, 1762.
6.	79	Experimental chemistry (unidentified work).
7.	229	Hoffmann, Friedrich. *Opera omnia* (As No. 36, Appendix I, but 4 vol., 4to, Genevae, 1740.
8.	117	Lucretius, T.Carus. *De rerum natura libri VI*. 2 vol., 4to, Apud Janssonios van der Aa, Leyden, 1725.
9.	79	Macquer, Pierre Joseph. Dictionary of chemistry (As No.45, Appendix 1).
10.	210	Newton, Sir Isaac. *Optice sive de reflexionibus . . . libri III*. Latine reddit Samuel Clarke DD, 4to, Sam. Smith & Benj. Walford, London, 1706.
11.	217	Plinius, Secundus C. *Naturalis historiae libri XXXVII* (As no.55, Appendix I, but folio, Leyden, 1606).
12.	98	Royal Society. *Philosophical Transactions*. *Abridgement* by Lowthorp et al., 7 vol.
13.	79	Miscellaneous texts on chemistry, unidentified (5 vol.).

Appendix III. List of Chemical Terms quoted in Johnson's Dictionary

The authors and cross references quoted refer to the works listed in Appendix I.

Absorbent	Arbuthnot 3; Quincy 56
Acid	Arbuthnot 3; Quincy 56
Acidity	Arbuthnot 3
Adept	Boyle 11
Adulteration	Bacon 6
Agate	Woodward 62
Aggregate = Mixture	Woodward 62
Air	Watts 60
Alcahest	Quincy 56
Alchemy	Hooker (Ref. 49, b V, para.58)
Alcohol	Arbuthnot 3, Boyle 11, Quincy 56
Alembick	Boyle 11
Alkali	Arbuthnot 3; Boyle 11; Newton 52
Alloy	Locke 42
Aludel	Quincy 56
Alum	Boyle 11; Chambers 19
Amalgam	Bacon 6, Butler 16
Amber	Chambers 19; Trévoux 22
Ambergris	Chambers 19; Trévoux 22
Ammoniacal Salts	Chambers 19; Trévoux 22; Savary 57
Analysis	No quotation
Anodyne	Arbuthnot 3
Antimony	Chambers 19
Aqua Fortis	Chambers 19; Locke 42
Aqua Regia	Chambers 19
Aqua Vitae	Chambers 19
Ardent Spirit	Newton 5
Arsenick	Chambers 19
Asa Foedica	Chambers 19
Asbestos	Chambers 19
Asphaltum	Chambers 19
Assay	Cowell 21
Athanor (a furnace)	Quincy 56
Attraction	No quotation
Balance	Chambers 19
Balloon	No quotation
Bath	Quincy 56

Benzoin	Chambers 19; Trévoux 22
Bismuth	Quincy 56
Bitumen	Savary 57
Bleaching	No quotation
Borax	Quincy 56
Calamine	Locke 42
Calcination	Quincy 56
Calx	No quotation
Carmine	Chambers 19
Caustic, lunar	Arbuthnot 3; Quincy 56
Ceruse (White lead)	Quincy 56
Chalk	Chambers 19; Mortimer 49
Chalybeate	Arbuthnot 3
Charcoal	Bacon 5, No. 775
Chemistry	Arbuthnot 3; Boerhaave 10
Cinnabar	Newton 52
Clays	Hill 35
Coagulation	Arbuthnot 3
Cobalt	Hill 35
Cochineal	Hill 35
Cohobation	Quincy 56
Combination	Boyle 11
Combustion	No quotation
Compound	Bacon 5, No.798; Boyle 12,
Concentration	Arbuthnot 3
Congelation	Arbuthnot 2, 3
Copper, Copperas	Chambers 19; Hill 35
Coruscation	Bacon 5, No.114; Newton 52
Crucible	No quotation
Crystal	Chambers 19; Hill 35
Crystallization	Quincy 56
Cucurbite	Boyle 13; Mortimer 49
Cuppel, Cuppellation	Harris 32
Decantation	Boyle 11
Decoction	Bacon 5, No.308
Decomposition	No quotation
Decrepitation	Quincy 56
Deflagration	Quincy 56; Boyle 11
Deliquescence	Boyle 11
Dephlegmation	Quincy 56
Detonation	Arbuthnot 2; Boyle 11; Quincy 56
Diamond	Hill 35; Woodward 62
Diaphoretick	Arbuthnot 3
Digestion, Digester	Bacon 5, No.326; Quincy 56
Distillation	Boyle 12; Newton 52
Earths	Hill 34; Woodward 62
Ebullition	Quincy 56
Effervescence	Arbuthnot 3; Grew 29; Mead 47
Effluvia	Quincy 56
Electrum	Bacon 5
Element	Boyle 12; Watts 60
Empyreuma	Quincy 56
Emulsion	Arbuthnot 3
Enamelling	Woodward 62
Essential Oils	Arbuthnot 3
Ether	Newton 52
Evaporation	Boyle 11; Quincy 56
Explosion	Newton 52
Extract	Bacon 5, No.645; Boyle 12; Woodward 62
Fat	Arbuthnot 3; Quincy 56
Fermentation	Harris 32; Quincy 56
Filtration	No quotation
Flame	Newton 52
Fulmination	Boyle 11
Furnace	Bacon 5
Fusion	Newton 52
Gas	Harris 32
Glass	Quincy 56
Gold	Bacon 5; Boyle 11; Hill 35
Granulation	Quincy 56
Gun Powder	No quotation
Heat	Locke 42
Incineration	Boyle 11
Indigo	Miller 48
Inflammable (spirits)	Arbuthnot 3
Infusion	Bacon 6
Inspissate	Arbuthnot 3
Iron	Hill 34, 35
Isinglass	Hill 34
Ivory	Hill 35
Jelly	Arbuthnot 3
Kali	Bacon 6
Laboratory	Boyle 13
Lead	Grew 29; Hill 35
Levigation	Quincy 56
Lime, Lime Water	Hill 34; Mortimer 49
Liquefaction	No quotation
Lixivium	Boyle 11
Lute	Bacon 5
Maceration	Quincy 56
Madder	Hill 34
Magistery =Precipitate	Browne, 15; Quincy 56
Manganese	Hill 35
Matrass	Quincy 56
Menstruum	Newton 52; Quincy 56
Mercury	Arbuthnot 3; Hill 34, 35
Metals	Hill 34
Muriatick	Arbuthnot 3; Quincy 56
Naphtha	Hill 34; Woodward 62
Nitre	Bacon 5; Hill 35
Ochre	Hill 34
Oil (Dipple, ethereal)	Boyle 11; Harris 32
Opium	Hill 34
Ores	No quotation
Petrification	Boyle 11

Pewter	Bacon 6
Phlogiston	No quotation
Phosphorus	Cheyne 20
Pitch	Ecclesiasticus, 13, 1
Pneumatick	Boyle 11
Potash	Hill 34; Woodward 62
Precipitate	Grew 29; Bacon 6
Principle	Watts 60
Purification	Boyle 11
Putrefaction	Arbuthnot 3; Quincy 56
Pyrites	Woodward 62
Quartation	Boyle 11
Quicklime	Hill 34
Quicksilver	Chambers 19; Hill 34
Quintessence	Boyle 11
Receiver	Arbuthnot 3
Rectification	Boyle 11; Grew 29; Quincy 56
Refrigeratory	Quincy 56
Regulus	Quincy 56
Resin	Quincy 56
Retort	Arbuthnot 3
Salt	Boyle 11; Harris 32; Woodward 62
Saltpetre	Bacon 6
Saponaceous	Arbuthnot 3
Saturation	Woodward 62
Scoria	Newton 52
Silver	Watts 60
Smelting	Woodward 62, 63
Soap	Arbuthnot 3
Solubility	Arbuthnot 3
Solvent	Boyle 11
Spelter	Newton 52
Spermaceti	Quincy 56
Spirit	Arbuthnot 3; Boyle 11
Steel	Arbuthnot 3; Chambers 19; Hill 34
Still	Arbuthnot 3; Newton 52
Stones (Calculi)	Hill 34
Storax	Wyclif Bible, Ecclesiasticus 24, 21
Sublimation	Bacon 6; Newton 52; Quincy 56
Sugar	Boyle 11; Quincy 56
Sulphur	Newton 52; Woodward 62
Tartar	Boyle 11; Quincy 56
Tin, Tinning	Woodward 62
Tincture	Boyle 11
Torrefaction	Boyle 13
Touchstone	Bacon 4
Trituration	Browne 15
Urine	Arbuthnot 3
Vapour	Arbuthnot 3; Newton 52
Verdigris	Bacon 5
Vinegar	Bacon 6
Vitriol	Bacon 6; Grew 29; Woodward 62
Volatility	Arbuthnot 3; Newton 52
Water	Arbuthnot 3; Quincy 56
Wax	Arbuthnot 3
Weld or Woald (dye)	Miller 48
Yeast	Butler 16

Notes to Appendix III

The list of chemical terms cannot be claimed to be exhaustive, not having been compiled by an item-by-item scrutiny of the Dictionary itself but by the indirect approach described (see “Retrieval of Chemical Entries”). Relevant terms may therefore have occasionally escaped capture.

The references attached to the chemical terms listed in Appendix III link them to the works arranged alphabetically by author in Appendix 1. A few of the quoted terms lacking such cross references were defined or described without further illustrative quotations.

Chemistry in everyday life is a very interesting topic. You yourself are a big bag of chemicals! While some may be obvious, some other might surprise you.Â You find chemistry in daily life in the foods you eat, the air you breathe, cleaning chemicals, your emotions and literally every object you can see or touch. While some may be obvious, some other might surprise you. Letâ€™s find out the Chemistry in our everyday life: Your body- Your body is mostly water which is hydrogen and oxygen. Almost 99% of the mass of the human body is made up of six elements: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. Only about 0.85% is composed of another five elements: potassium, sulphur, sodium, chlorine, and magnesium. All are necessary to life.