Chemistry and the Universities in the Seventeenth Century*

*ALLEN DEBUS***

The appointment of de Renault as Professor of Chemistry at the University of Louvain in 1685 reflected more than a century of debate in European-learned circles (1). The followers of the Swiss-German reformer Paracelsus (1493-1541) had seen in chemistry - and alchemy - a new foundation for learning (2). Paracelsus had burned the *Canon* of Avicenna publically in 1527 at Basel and his followers rejected the Aristotelian-Galenic tradition of the universities. They saw little value in disputations or the study of logic and they sought an alternative to the four elements in Natural Philosophy and their attendant humors in medicine. They scorned the reading of the books of the ancient philosophers and saw truth primarily in the two books of Divine Revelation, the Bible and the Book of Creation or Nature.

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** *Allen Debus* é professor do Centro Morris Sishbein de História da Ciência e Medicina da Universidade de Chicago, nos Estados Unidos.

(1) As described in R. Aubert, A.D'Haenens, E. Lamberts, M.A. Nauwelaerts, J. Paquet and J.A. Van Houtte, *The University of Louvain 1425-1975* (Louvain: Leuven University Press, 1976), p. 105, the Faculty of Medicine reacted to chemical medicine slowly...

> in 1685, when the Council of State sought the Faculty's opinion as to whether a Chair of Chemistry should be established, many reasons were quoted in opposition to the plan: chemistry was already being taught, in part by the existing professors; the timetable was full enough as it was, premises and furnaces for chemical studies would be too costly; as a fifth examiner, the new professor would have to have a place in the *Collegium strictum*, which would mean an increase in examination-fees and would thus harm the less well-off students, who might then be tempted to transfer to a less expensive University. Moreover, the Faculty said, if the government did decide to go ahead with a fifth Chair, it must give a stipend including examination-fees. One de Renault was then appointed on 12 September 1685. He should automatically have become a member of the Inner College, but the Faculty refused him a place, and the governor had to send a special delegate to Louvain to complete the business. The college was forced to admit the new professor; examination-fees were put up. The chemistry courses met, in fact, with unexpected success, and no place in the Hall turned out to be large enough to accomodate the crowd of students interested.

(2) The following short account of the Chemical Philosophy is based largely on my own research which is brought together in *The Chemical Philosophy: Paracelsian Science and Medicine in the Sixteenth and Seventeenth Centuries* (2 vols., New York: Science History Publications, 1977), passim, and especially, 1, pp. 63-126.

The Paracelsians sought truth in Nature through fresh observations and they were convinced that chemistry - through the intelligent use of the fire - would be the best guide to this knowledge. They interpreted the account of God's Creation in *Genesis* as an alchemical separation and they presented their three chemical principles, salt, sulphur and mercury, as a new approach to the elements. Their questioning of ancient element theory was to call into question the whole framework of ancient natural philosophy and medicine.

The sixteenth-century Paracelsians for the most part accepted uncritically the concept of the macrocosm-microcosm universe which stated that man was a true microcosm of the great world about him.

Thus the study of nature and the Cosmos would lead to secrets about man. In practice this affected medicine and pharmacy since they believed that the study of nature would yield a rich bounty of medicines for mankind. Paracelsus had been a physician himself and his Chemical Philosophy was to be subscribed to primarily by physicians. In short, this was a philosophy of both nature and medicine. Its proponents were deeply immersed in religious thought which was often mystical and alchemical in outlook. All of this clashed with traditional education and one of the results of the ensuing debates surely was the acceptance of chemistry as a respected subject in the course of the next century and a half.

At first there was a question as to what chemistry really was. Even all those who were convinced of the importance of this subject did not subscribe to the broad claims of the most dedicated Paracelsians. Daniel Sennert (1572-1637) of Wittenberg warned that.

> Chymistry is not a peculiar Art, but belongs to Physick, and is the perfection of it, for it is the part only of the Physitian to use and apply Chymical medicines for cure, and [he] may be called then a Chymical Physitian, and the Medicines Chymical, which are the perfection of Physick ... [But some wish to] enlarge Chymistry, and dispute principles and labour to bring in new operations into all the parts of Philosophy and Physick, but it is not for Chymists, as such, to dispute of principles, but for Physitians and Philosophers (3).

(3) Daniel Sennert, De *chymicorum cum Aristotelicis et Galenicis consensu ac dissensu...* (Wittenberg: Apud Zachariam Schurerum, 1619; the cited edition is the third printed at Paris: Apud Societem, 1633), pp. 5, 7. The English translation is by Nicholas Culpeper and Abdiah Cole, *Chymistry Made Easie and Useful. Or, The Agreement and Disagreement of the Chymists and Galenists* (London: Peter Cole, 1662), pp. 3-4.

Sennert's call for the recognition of the benefits of chemistry offended both these Galenists who were opposed to chemical medicines and those devoted Paracelsians who hoped to reform the entire system of higher education to conform to their concept of chemistry as a key to all knowledge.

The English Paracelsian, R. Bostocke, complained in 1585 that

> ... in the scholes nothing may be receiued nor allowed that sauoreth not of *Aristotle, Gallen, Auicen,* and other Ethnickes, whereby the yong beginners are either not acquainted with this doctrine, or els it is brought into hatred with them. And abrode likewise the Galenists be so armed and defended by the protection, priuiledges and authoritie of Princes, that nothing can be allowed that they disalowe and nothing may bee receiued that agreeth not with their pleasures and doctrine... (4).

Fludd... deplored the fact that learning was still grounded on Aristotle in philosophy and Galen in medicine. They had been heathens and their doctrines had been demonstrated to be antithetical to Christianity

Robert Fludd (1574-1637) had studied at Oxford and abroad and he deplored the fact that learning was still grounded on Aristotle in philosophy and Galen in medicine. (1617). They had been heathens and their doctrines had been demonstrated to be antithetical to Christianity. For Fludd also it was essential that the universities be reformed so that the divine light of Christian teachings could flourish. It need hardly be added that Fludd believed that his own far reaching and mystical Chemical Philosophy should be the proper basis of academic learning (5).

Jean Baptiste van Helmont (1579-1644) is the author in whom we find the most detailed expression of seventeenth-century Paracelsism (6). In his short autobiography he wrote of his education at the University of Louvain. The story of his disillusionment with the traditional educational process and of his refusal to accept the degree, Master of Arts, need not be retold here. Nevertheless, he returned to the Louvain to immerse himself in philosophy and medicine. And

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(4) R. Bostocke, Esq., *The difference betwene the auncient Physicke...and the latter Phisicke* (London: Robert Walley, 1585), sig. Fiiv.

(5) For Fludd on educational reform see his *Tractatus apologeticus integritatem societatis de Rosea Cruce defendens* (Leiden: Godfrid Basson, 1617). This is summarized in Debus, *op. cit., 1,* pp. 215-224.

(6) On Van Helmont see Debus, *ibid., 2,* pp. 295-397 and the more recent Walter Pagel, *Joan Baptista Van Helmont: Reformer of Science and Medicine* (Cambridge et al.: Cambridge University Press, 1982).

although he still had not reached the certainty he so desired, he was not so foolish as to decline the doctorate in medicine he earned in 1599. It was only after some years of travel that van Helmont began to read the works of Paracelsus ... and it was then that he became convinced of the importance of chemistry as a key to nature, and especially man. Because of this conversion he became convinced of the necessity of educational reform.

Van Helmont proposed a seven-year educational program, the first three years of which would be devoted to traditional subjects such as mathematics, geography and natural history. But then, he wrote,

> ... let them come to the Study of Nature, let them learn to know and seperate the first Beginnings of Bodies. I say, by working, to have known their fixedness, volatility or swiftness, with their seperation, life, death, interchangeable course, defects, alteration, weakness, corruption, transplanting, solution, coagulation or co-thickning, resolving. Let the History of extractions, dividings, conjoynings, ripenesses, promotions, hinderances, consequences, lastly, of losse and profit, be added. Let them also be taught, the Beginnings of Seeds, changing, motion, and disturbance of things to be altered.
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> And all those things, not indeed by a naked description of discourse, but by handicraft demonstrations of the fire. For truly nature measureth her works by distilling, moystening, drying, calcining, resolving, plainly by the same meanes, whereby glasses do accomplish those same operations. And so the Artificer, by changing the operations of nature, obtains the properties and knowledge of the same. For however natural a wit and sharpness of judgment the Philosopher may have, yet he is never admitted to the Root, or radical knowledge of natural things, without the fire. And so every one is deluded with a thousand thoughts or doubts, the which he unfoldeth not to himself, but by the help of the fire. Therefore I confess, nothing doth more fully bring a man that is greedy of knowing, to the knowledges of all things knowable, than the fire. Therefore a young man at length, returning out of those Schooles,

> truly it is a wonder to see, how much he shall ascend above the Phylosophers of the University, and the vain reasoning of the Schooles (7).

Van Helmont's views were echoed by a number of educational reformers who could see little more than stagnation in the traditional educational system. In England a broad spectrum of reforms were proposed during the Civil War years and the chemists were among those hoping to change the curricula at Oxford and Cambridge. John French (1616-1657) wrote of the nobility of chemistry and noted that.

> I once read or heard, of a famous University beyond Sea, that was faln into decay, through what cause I know not: but there was a general counsel held by the learned, how to restore it to its primitive glory: the *Medium* at last agreed upon, was the promoting of Alchymie, and encouraging the Artists themselves: But I never expect to see such rational actings in this nation till shadows vanish, substances flourish, and truth prevail...(8).

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The following year Noah Biggs (dates unknown) questioned

> Wherein is our Universities reformed, or what amendment of her Fundamental Constitutions... Or wherein do they contribute to the promotion or discovery of Truth... Where have we any thing to do with Mechanick *Chymistrie* the handmaid of Nature, that hath outstript the other Sects of Philosophy by her multiplied real experiences? Where is there an examination and consecution of Experiments? encouragements to a new world of Knowledge, promoting compleating, and actuating some new Inventions. Where have we constant reading upon either quick or dead *Anatomies,* or an ocular demonstration of *Herbs*? Where a Review

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(7) John Baptista van Helmont, *Oriatrike or Physick Refined. The Common Errors therein Refuted, And the whole Art Reformed & Rectified. Being a New Rise and Progress of Phylosophy and Medicine, for the Destruction of Diseases and Prolongation of Life,* trans. J(ohn) C(handler) (London: Lodowick Loyd, 1662), p. 45. In the Latin original this is to be found in the tract, "Physica Aristotelis et Galeni ignara", (sects 9-11) in the *Ortus medicinae, Id est, initia physicae inaudita. Progressus medicinae novus, in morborum ultionem, ad vitam longam* (Amsterdam: Ludovicus Elsevir, 1648), pp. 49-50.

(8) John French, *The Art of Distillation* (4th ed., London: T. Williams, 1667), sig. A3r. From the dedication to Tobias Garband dated London, November 25, 1650.

> of the old Experiments and Traditions, and casting out the rubbish that has pestered the Temple of Knowledge (9).

And in 1654 in his *Academiarum Examem* John Webster (1610-1682) launched a blistering attack on the educational system at Oxford and Cambridge when he considered to be inimical to Christianity (10). He turned to Francis Bacon for his emphasis on new observations and the inductive method, for his mystical interpretation of the universe which he considered to be both Christian and chemical, and to van Helmont for his views on educational reform through the Chemical Philosophy.

I believe that it is clear that the English debate over the place of chemistry in higher education follows directly from the discontent of the Paracelsians. And yet we know that higher learning was not reformed on the basis of their Chemical Philosophy. Indeed, the traditional university curriculum may have found its strongest champions among the new mechanical philosophers who found the mystical world views of the Paracelsians and their fellow travellers, the alchemists, far more repugnant than Aristotelian philosophy or Galenic medicine. John Webster had been answered by the Oxford dons, Seth Ward (1617-1689) and John Wilkins (1614-1672), who accused Webster of plagiarizing Bacon and van Helmont. They ridiculed his belief in magic and mystical chemistry and countered that true chemistry was indeed being taught at Oxford along with all of the most recent advances in the sciences. Ward and Wilkins were members of the educational establishment and while they promoted the work of Harvey and Copernicus as well as the corpuscularian philosophy, they believed that this could best be done by adding this material to the existing curriculum rather than turning to the works of the Chemical Philosophers.

University lectures in chemistry were not being given at Oxford in 1654 although it was in the summer of that year that Robert Boyle (1627-1691) moved there where he established a chemical laboratory

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(9) Noah Biggs, Chymiatrophilos, *Mataeotechnia Medicinae Praxeos. The Vanity of the Craft of Physick. Or, A New Dispensatory. Wherein is dissected the Errors, Ignorance, Impostures and Supinities of the SCHOOLS, in their main Pillars of Purges, Blood-letting, Fontanels or Issues, and Diet, &c. and the particular Medicines of the Shops. With an humble Motion for the Reformation of the Universities, And discovering the Terra incognita of Chymistrie. To the Parliament of England* (London: Ciles Calvert, 1651), sig a2r.

(10) See my introduction to *Science and Education in the Seventeenth Century. The Webster-Ward Debate* (London: Macdonald; New York: American Elsevier, 1970), pp. 1-64. The tracts of John Webster, Seth Ward and John Wilkins and Thomas Hall are reprinted in this work.

with several assistants (11). He was later to bring to Oxford the chemist, Peter Sthael of Strasbourg, who began to give classes in the subject privately in 1659 (12). Olaus Borrichius (1626-1690) found much interest in chemistry at Oxford during his visit in June and July, 1663 (13). However, by this time there were a number of chemical laboratories in England. R.T. Gunther lists those owned by Prince Rupert, George Wilson (1631-1711), Cornelis Drebbel (1572-1633) and his son, Jonathan Goddard (1617-1675), and the laboratory at St. James Palace presided over by Nicolas Lefèvre (1664-1665) (14). There were additional laboratories administered by the Royal College of Physicians and numerous pharmacists who specialized in chemical oils and waters.

There was, however, no official instruction in chemistry at Oxford or Cambridge until the 1680s. Seeking a permanent home for his extensive collections, Elias Ashmole (1617-1692), antiquarian, alchemist and member of the Royal Society, planned the Museum at Oxford which would include a chemical laboratory, a display area, and a lecturer (15). Dr. Robert Plot (1640-1696) was appointed the first Professor of Chemistry on the recommendation of John Evelyn who had been impressed by his book, *The Natural History of Oxfordshire* (1677) (16). The building was opened in 1683 and Plot's chemical lectures began the same year. Chemical experiments were carried out in the laboratory by mid-summer with the assistance of Plot's operator, Christopher White (17). A text of Plot's lectures which existed earlier is now lost, but other manuscripts at the British Library indicate that he accepted the traditional belief in the great Elixir, the Grand Arcanum and the Alkahest (18). Thus, although Plot's students may have used Nicolas Lemery's *Cours de chymie* (1st edition, 1675) as a text, they were being taught by a chemist whose personal beliefs were still closely connected with traditional alchemical and Helmontian concepts. Plot resigned his post in 1689 and it was not

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(11) Louis Trenchard More, *The Life and Works of The Honourable Robert Boyle* (London, New York and Toronto: Oxford University Press, 1944), p. 82.

(12) R.T. Gunther, *Early Science in Oxford* (15 vols., Oxford: Printed for the Subscribers, 1923-1967), *1*, p. 22.

(13) Olaus Borrichius, *Itinerarium 1660-1665...*, edited with Introduction and Indices by H.D. Schepelern (4 vols., Copenhagen: Danish Society of Language and Literature, 1984), *3*, pp. 26-29 (discussion of Dickinson's chemical laboratory).

(14) Gunther, *op. cit.*, *1*, pp. 39-43.

(15) *Ibid.*, pp. 43-44.

(16) *Ibid.*, pp. 44-46.

(17) *Ibid.*, p. 46.

(18) See F. Sherwood Taylor, "Alchemical Papers of Dr. Robert Plot," *Ambix*, *4* (1949), 67-76.

until the early years of the new century that chemical instruction at Oxford took on a Newtonian tinge with the work of John Friend and John Keill.

Regular chemical lectures were offered first at Cambridge in 1683 also. The lecturer, John Francis Vigani (c. 1650-1713) had spent years travelling on the Continent and his text, the *Medulla Chymiae* had been published in Danzig the year before (19). In contrast with the situation at Oxford, the laboratory facilities available to Vigani were very limited. He taught at his humble quarters at Queen's College without the benefit of a chemical operator and one of his early students, Abraham De la Pryme, complained that he had "little or no good" from the course "by reason of the abstruseness of the art" (20). Nevertheless, Vigani was named "Honorary Professor of Chemistry" in 1703 and an elaborate chemical laboratory was set up for him at Trinity College in 1710, three years before his death.

There is more information available on Vigani's teaching than that of Plot. The young Stephen Hales took his course as did John Yardley whose notes do survive (21). But it is Vigani's *Medulla Chymiae* that gives us the best idea of the content of his course. The *Medulla* is a short text of some seventy pages and of relatively little distinction when compared with the works of Lemery or Lefèvre. In the preface the author emphasized the importance of atomism in regard to chemistry and he assured the reader that this would serve as a satisfactory means of explanation of all of the ancient and modern systems of elementary theory (22). Vigani then proceeded to a general introduction discussing the etymology of the word chemistry, the antiquity of the art, and its object. A short section on the principles was then followed by the expected descriptions and preparations of chemical substances arranged according to the mineral, vegetable and animal kingdoms. The book closed with a short description of chemical equipment and three plates. Vigani's work is perhaps most interesting for the fact that it does not emphasize the linkage with medicine as exclusively as do many others of the period.

There is an unbroken line of chemical instruction at Cambridge and Oxford dating from the lectures of Vigani and Plot in 1683. But what

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(19) On Vigani see R.T. Gunther, *Early Science in Cambridge* (Oxford: Printed for the Author at the University Press, 1937), p. 221.

(20) Gunther, *Early Science in Oxford, 1*, p. 51.

(21) The Yardley notes are summarized by Gunther in *Early Science in Cambridge*, p. 222.

(22) Johannus Franciscus Vigani, *Medulla Chymiae, Variis Experimentis aucta, multisq; Figuris illustrata* (London: Henry Faithorne and John Kersey, 1683), sig. a8r.

of the rest of Europe? Twenty years ago Hubicki came to the conclusion that in fact chemistry had been taught in many European universities in the sixteenth century (23). He pointed to Martin Stampeis' *Liber de Modo Studendi seu Legendi in Medicina* published in Venice in 1517 which recommended that medical students be familiar with the chemical tracts in the *Opera* of Arnald of Villanova. He also pointed to the very large number of sixteenth-century alchemists and Paracelsians who had studied at the University of Basel. He concluded that "such a great number of active alchemists... is very significant and may point to the fact that in the University of Basel lectures on chemical practice must have been given", (24). This conclusion may be somewhat forced, but in fact there were as unusually large number of students at Basel in the late sixteenth century who were to show a special interest in alchemy, chemistry or chemical medicine.

The purpose of Hubicki's research was to show that chemistry was being taught at universities prior to the appointment of Johann Hartmann (1568-1613) to the chair of Chymiatria at the University of Marburg in 1609 (25). This has repeatedly been referred to in the literature as the first university appointment in chemistry, a claim in which there is only partial truth because of the likelihood of earlier chemical instruction through medical courses elsewhere and because of the frequent confusion among historians of science between chemistry as we understand it and the chemical medicine of the Early Modern Period.

Vigani's work is perhaps most interesting for the fact that it does not emphasize the linkage with medicine as exclusively as do many others of the period.

When we look at the work of Hartmann we see a Renaissance polymath with broad interests. He had been educated at Marburg and had been appointed Professor of Mathematics in 1592. However, his interests changed and he took his M.D. degree there in 1606 and was appointed Professor of Chymiatria three years later. His first publication in his new field of interest was the *Disputationes Chymico-Medicae* of 1611 which included his inaugural address and seven disputations by his students. In his address he took issue with all those who might argue that medicine could be complete without chemistry. This, he said, "pernego & pernegabo, dum vixero " (26).

(23) Wlodzimierz Hubicki, "The Beginnings of Chemistry as a University Science", *Actes du XIe Congrès International d'Histoire des Sciences. Varsovie-Cracovie 24-31 Août 1965* (5 vols., Ossolineum: Académie Polonaise des Sciences, 1968), 4, pp. 41.45.

(24) *Ibid., 4*, p. 43.

(25) On Hartmann see Lynn Thorndike, *A History of Magic and Experimental Science* (8 vols., New York: Columbia University Press, 1923-1958), 8, pp. 116-117; J.R. Partington, A *History of Chemistry* vol. 2 (London: Macmillan and Co., Ltd.; New York: St. Martin's Press, 1961), p. 177.

(26) Johann Hartmann, "Disputationes Chymico-Medicae" in *Opera omnia Medico-chymica...*, ed. Conrad Jarhenius (Frankfurt am Main: Impensis Viduae Seylerianae, Typis Balthas. Christophori Wustii, Junioris, 1684), p. 5 (separate pagination).

He accepted the great antiquity of the art as a valid proof of its truth, he approved of the Paracelsian tria prima, salt, sulphur and mercury, and the use of the macrocosm-microcosm analogy (27). These mystical views were also to be elaborated in his *Introductio in Vitalem Philosophiam*. But although Hartmann was critical of Aristotle and Galen, he did not condemn all of the ancients. Like many Paracelsians he approved of Hippocrates and for this reason he preferred to speak of a "Nov-Antiqua Medicina", which drew selectively from the ancient medical sources as well as the new chemical medicine (28).

Hartmann's views were supported by those of his students. Thus Henricus Crollius wrote that "Medicine and Chemistry can not be separated." Indeed, "Chymia est solidae philosophiae fons, clavis sapientiae, anima & medulla physices, medicinae radix, & meta, in quam viri sapientes collimant." (29) Johannes Rhenanus discussed chemical equipment (30) and operations while Henricus Petraeus sought to conciliate the major points of difference between the Chemical Physicians and the Galenists (31).

Hartmann's interest in the practical aspects of chemistry may best be seen in his *Praxis Chymiatrica* (1633) which appeared two years after his death and then frequently throughout the remainder of the century ... often along with Oswald Croll's *Basilica Chymica* (1609). Here was to be found a large number of chemical preparations for medical usage along with Hartmann's commentary on three other iatrochemical tracts (32). But if his *Praxis* served as a standard book of chemical preparations, Hartmann's interest in teaching may be seen also in his notes to Jean Beguin's *Tyrocinium Chymicum* (1610) which first appeared under the pseudonym of Chrisoph Glückradt in 1618 (33). The *Tyrocinium* was the earliest in the celebrated series of French

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(27) *Ibid.*, pp. 5, 10, 11.

(28) *Ibid.*, p. 13.

(29) Henricus Crollius, "DeNatura Catarrhorum" in *ibid.*, p. 31.

(30) Johann Rhenanus, "Dissertatio Chymiotechnica, In qua totius operationes Chymicae methodus practica clarè ob oculos ponitur" *in ibid.*, pp. 32-39 (included is a fine folding plate of chemical equipment between pp. 32-33.

(31) Henricus Petraeus discusses these apparent contradiction in scholastic fashion giving the opposing points of view and then a conciliating solution. Examples are his discussions of the opposing viewpoints on the elements and the principles and the question whether or not medicine can be divorced from chemistry (*ibid.*, p. 43).

(32) Hartmann's *Opera omnia* begins with his "Praxis Chymiatrica". However, this work was frequently printed separately and with Crollius. I have both the Latin edition printed at Geneva in 1659 edited by Johann Michaelis and the English translation made anonymously by Richard Russel in 1670 as *The Practise of Chymistry* and printed along with his translation of Oswald Croll's *Basilica Chymica*.

(33) Reprinted as the third tract in Hartmann's *Opera omnia*.

chemical textbooks which culminated in the *Cours de Chymie* of Nicolas Lemery in 1675.

There is little doubt that many seventeenth-century students of chemistry learned the subject with the aid of the many editions of the Hartmann version of Beguin's work, but his teaching bore fruit as well through his many gifted students. Johann Rhenanus found employment at the court of the Landgrave Moritz of Cassel and his *Solis* e *Puteo Emergentis* went through at least four editions during the century (34). The renowned alchemist, Johann Daniel Mylius, was Hartmann's brother-in-law as well as his student (35). He, too, was to prepare a widely read book of chemical compositions. Hartmann's son-in-law, Henricus Petraeus, was later to become Professor of Medicine at Marburg while another pupil, Daniel Beckher, became Professor of Medicine at the University of Königsberg.

...the University of Jena is of special interest because of the relatively early introduction of chemistry there and because of the widespread influence of Werner Rolfinck.

The rapid growth of interest chemistry in Germany in the course of the seventeenth century may be ascertained by even a cursory look at the second volume of Partington's *History of Chemistry* or the final volume of Thorndike's *History of Magic and Experimental Science.* However the University of Jena is of special interest because of the relatively early introduction of chemistry there and because of the widespread influence of Werner Rolfinck (1599-1673). As in the case of Hartmann at Marburg we see here the close connection of chemistry and medicine. Recent research has shown that chemical lectures at Jena were inaugurated by Zacharias Brendel (1553-1617) who had studied philosophy at Jena where he had taken his master's degree in 1576 before going on to Padua for an M.D. (1581) (36). On his return to Germany he was appointed Professor of Philosophy at Jena in 1583 and then - nearly thirty years later (1612) - Professor of Medicine. There is little doubt that he was convinced of the importance of chemistry for medical students for he gave lectures on this subject the following year and again in 1615.

The elder Brendel's son, Zacharias Brendel, Jr. (1592-1638), also studied at Padua, but he then returned home to take his medical degree at Jena in 1617 (37). Ten years later he was appointed Professor of Medicine and the following year he gave a series of

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(34) On Rhenanus see Partington, *op. cit., 2,* p. 180.

(35) Hubicki discusses Mylius, Petraeus and Becker in *op. cit.,* p. 45.

(36) Ernst Ciese and Benno Von Hagen, *Geschichte der medizinischen Fakultät der Friedrich-Schiller-Universität Jena* (Jena: VEB Gustav Fischer Verlag, 1958), pp. 96-98.

(37) *Ibid.,* pp. 99-100.

lectures on chemistry for medical students. These were to be the basis of his textbook, *Chimia in Artis formam redacta* which appeared first in 1630 and then in another four editions between 1641 and 1671. Here we read that "chimia est ars nobilissima, verissima, certissima,", but at the same time it was understood that chemistry was but a servant to its master, medicine (38). Brendel's book is practical and based on four determined levels of heat fixed by the water bath, the ash bath, flame and the blast furnace. Descriptions are given of the various preparations that are possible with these heat sources.

Werner Rolfinck (1599-1673) was to be the younger Brendel's successor and the first Professor of Chemistry at Jena (39). He had been taught by Daniel Sennert at Wittenberg from whom he had surely been initiated into the ongoing debate between the Galenists and the Paracelsians. He had also studied for two years at Leiden before taking his M.D. at Padua in 1625. Four years later he was at Jena as Professor of Anatomy, Surgery and Botany - and in 1641 he was appointed the first Professor of Chemistry at that University.

In all Rolfinck was to be at Jena for forty-four years and he taught actively throughout that period. Rolfinck is important as an early German proponent of the Harveyan circulation, but our interest is primarily in his chemical work. The final editions of Brendel's textbook were revised by Rolfinck and he also wrote his own textbook giving it the same tittle, *Chimia Artis formam redacta.* The work appeared in seven editions between 1661 and 1686.

Rolfinck believed that the student should be aware of the history of chemistry and the current debates over its relationship to medicine (40). He was convinced that a knowledge of the subject could be traced back to Adam, but that medical chemistry was invented by Paracelsus and then spread by his followers over the past century. He argued that chemistry - important though it was - should be considered an art rather than a science and that it was properly a part of medicine (41). As did other text book authors of the period,

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(38) Zacharias Brendel, *Chimia in Artis Formam Redacta, ubi praeter Methodum addiscendi Chimicas facilimam, disquisitio curata de famosissima praeparatione Auri Potabilis instituitur,* Second edition corrected and amplified after the death of the author by Werner Rolfinck (Jena: Johannes Reiffenberger, 1641), p. 1. And "...Medicinam & Chimiamm ceu DOMINAM & SERVAM." (p. 7).

(39) Giese and Von Hagen, *op. cit.,* pp. 101-121.

(40) Werner Rolfinck, *Chimia in Artis Formam Redacta* (Jena: Samuel Krebs, 1661), pp. 7-16.

(41) *Ibid.,* p. 28.

Rolfinck devoted most of his work to specific preparations, but it is from the other subjects he discussed that we will gain greater insight into his approach to the subject. He accepted the tria prima, Salt, Sulphur and Mercury (42), but he questioned the Paracelsian doctrine of the macrocosm and the microcosm (43). He further criticized the current widespread belief in the powder of sympathy (44), palingenesis or the resuscitation of plants from their ashes (45), the concept of a universal medicine (46), the transmutation of base metals to gold (47), and the chemical production of the homunculus (48).

Also of interest is Rolfinck's discussion of the teaching of the subject. He noted that Angela Sala had written that a six month course in chemistry was sufficient for the physician to become proficient in the subject while Anthony Gunther Billich had recommended a six week course in which the student first learned about chemical equipment and the structure of furnaces and then went on to study the distillation of plants and parts of animals before turning to salts, stones and metals (49). Rolfinck preferred to give his students a broader introduction to the subject. He began with a defence of the nobility of chemistry, vindicating it from the attacks of the Galenists. He then went on to a discussion of the chemical principles before proceeding to the classes of substances arranged according to tradition: vegetable, animal and mineral.

This early development of chemistry as a part of medical education in Germany may be ascribed to the strong Paracelsian influence in Central European Medicine and it may be contrasted with the situation in France. There the medical faculty in Paris remained opposed to chemically prepared medicines until late in the seventeenth century (49a). Nevertheless, chemistry flourished both through independent instruction at the Jardin des Plantes and elsewhere - as well as at the University of Montpellier.

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(42) *Ibid.*, p. 37

(43) *Ibid.*, p. 61.

(44) *Ibid.*, p. 417.

(45) *Ibid.*, p. 422.

(46) *Ibid.*, p. 432.

(47) *Ibid.*

(48) *Ibid.*, p. 426.

(49) *Ibid.*, p. 17.

(49a) L.W.B. Brockliss, "Medical Teaching at the University of Paris, 1600-1720", *Annals of Science, 35* (1978), 221-251. Brockliss is more concerned with the teaching of physiology and theories of disease, but he discusses the new chemicals in a section on "Conceptions of therapy" (239-245).

The *Greater Surgery* of Paracelsus had been translated into French by Pierre Hassard of Armentières as early as 1566 while Jacques Gohory had prepared a *Compendium* of Paracelsian theory the following year (50). At this time there was already an indication of the forthcoming debate when the Medical Faculty and the Parlement of Paris forbade the internal use of antimony. The following decade witnessed a lively debate between Joseph Duchesne (c. 1544-1609) and Jacques Aubert on the origin of metals and their internal use. The work of Paracelsus and the role of chemistry in medicine proved to be a key element of this exchange. Concurrently Roch le Baillif (d. 1605) published his summary of Paracelsian medicine (1578) and then moved to Paris from Brittany where he actively promoted this new medical heresy. The reaction from the Medical Faculty was swift and predictable. Le Baillif was ordered to halt his practice as well as his lecturing. On his refusal to do so he was summoned before the Parlement where he openly defended Paracelsian medicine. The Medical Faculty won this case and le Baillif was ordered to return to Brittany.

After this time publications on chemical medicine increased rapidly in France reaching a peak in the flood of works debating the new medicine that resulted from Duchesne's theoretical *De priscorum philosophorum verae medicinae materia* (1603). Once again the members of the Medical Faculty banded together to refute the chemists, this time led by the Jean Riolans, father and son.

Early in the new century Jean Beguin arrived in the capitol where he set up a laboratory and gave lectures on pharmaceutical preparations (51). Permission for this was granted not from the members of the Medical Faculty, but from Court physicians among whom were several iatrochemists (52). Beguin's lectures were to result in his *Tyrocinium chymicum* (1610) which saw more than forty editions through the end of the century. In the course of its publishing history it was greatly expended and we have already noted the edition prepared by Johann Hartmann.

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(50) The present short account of sixteenth century French Paracelsism is bases upon Debus, *Chemical Philosophy, 1*, pp. 145-173.

(51) The standard account of Beguin remains T.S. Patterson, "Jean Beguin and His *Tyrocinium Chymicum;" Annals of Science, 2* (1937), 243-298.

(52) Hugh Trevor-Roper, "The Sieur de la Rivière. Paracelsian Physician of Henry IV" in Allen G. Debus, editor, *Science, Medicine and Society in the Renaissance: Essays to honor Walter Pagel* (2 vols., New York: Science History Publications and London: Heinemann, 1972), *2*, pp. 227-250.

(53) Henry Guerlac, "Guy de la Brosse and the French Paracelsians" in *ibid., 1*, pp. 177-200. Rio Howard has also prepared several papers on de la Brosse in addition to her study of his library: *La Bibliothèque et le Laboratoire de Guy de la Brosse au Jardin des Plantes à Paris* (Geneva: Librairie Droz, 1983).

The details of the chemical debate in France have yet to be studied in depth. Certainly there is little doubt that this continued to be a subject of contention for over a century. Guerlac has investigated the work of Guy de La Brosse (1586-1641) and the foundations of the *Jardin Médicinal des Plantes.* First proposed in 1616, this project was seen by the Parisian Medical Faculty not only as a threat to their monopoly of medical teaching, "but an overt criticism of their whole approach to medical study and practice, their neglect of botany and their hostility to the chemists", (54). Indeed, de La Brosse's chief work, *De la nature, vertu et vutilité des plantes* (1628) includes a general treatise on chemistry while a portrait of Paracelsus graces the title page. And although the *Jardin des plantes* was not formally opened until 1640, it was to become a center for chemical teaching. The first Professor of Chemistry was William Davidson (1648), already a well known chemical author. He was to be succeeded by Nicolas Lefèvre, Christophe Glaser and Moyse Charas in the course of the century (55). All were to write important chemical works.

...chemistry flourished both through independent instruction at the Jardin des Plantes and elsewhere - as well as at the University of Montpellier.

It seems clear that a medical student seeking chemical instruction in seventeenth-century Paris would have had to go beyond the circle of medical professors from Sorbonne. If a student sought more than the chemistry taught at the *Jardin des plantes* he could turn to the medical curriculum taught at the University of Montpellier. There he would find a more independent approach to the medical classics. In the fourteenth century Arnald of Villanova had been associated with the medical school and his chemical tracts remained widely read two centuries later. Nor did the Medical Faculty at Montpellier resist Paracelsian chemical medicine in the unyielding fashion of their Parisian colleagues. They may have looked on Paracelsian mysticism with caution, but they certainly accepted many of the new chemically prepared remedies. One of the most distinguished seventeenth-century proponents of chemical medicine was Theodore Turquet de Mayerne (1573-1655) who had taken his medical degree at Montpellier in 1597 (56). Both through his active defence of Joseph Duchesne's work against the Medical Faculty of Paris in 1603 and through his influence in incorporating chemical remedies in the *Pharmacopoeia Londinensis* (1518) Mayerne played a significant role in the acceptance of the new chemical medicine in the seventeenth century. The Montpellier physician, Théophraste Renaudot (1586-1653), promoted the new medicine as well, and he was supported by Cardinal Richelieu

(54) Guerlac, *op. cit.*, p. 181.

(55) On the French chemical textbooks - which were prepared primarily by the instructors at the Jardin des plantes - see Hélène Metzger, *Les Doctrines Chimiques en France du début du XVIIe à la fin du XVIIIe Siècle,* Tome I (Paris: Les Presses Universitaires de France, 1923).

(56) On Mayerne see Debus, *Chemical Philosophy,* 1, p. 186.

who saw here an opportunity to lessen the medical monopoly of the Parisian doctors (57).

For the Galenists of Paris the University of Montpellier seemed a hotbed of chemical radicalism. In 1644 both physicians and professors of Montpellier were forbidden to hold assemblies or to practice medicine in Paris. Jean Riolan (1577-1657) wrote that there was a need to purge Paris of the " *Hermétiques et Emétiques* de l'Eschole de Montpellier", physicians who claim to know a thousand secrets of medicine, but who in reality do not even know the old method of curing taught by Hippocrates and Galen (58). No one should be deceived, he added, Théophraste Renaudot was a disciple of Paracelsus. And what of the other chemists? Mayerne had wished to give medical lessons to apothecaries and barber surgeons and to make public anatomies (60) ... Johann Guinter von Andernach who had written on both the old and new medicines stood condemned as a Lutheran (61) ... and Pierre Palmier who had wished to introduce chemistry to medicine had been condemned (62). The use of metals as purgatives in medicine - and especially the pernicious use of antimony internally was to be firmly rejected (63). How could the law rigorously punish the crime of homicide while ignoring those physicians who proceed to kill their patients with these new poisonous medicines (64)?

But although the physicians of Montpellier were associated with chemical medicine from an early period they made no appointment in chemistry until relatively late. Antoine d'Aquin, Doctor of the Medical Faculty at Montpellier and First Physician to Louis XIV, became convinced that the study of this science should be established at Montpellier (65). The position was given to Sebastian Matte, called La Faveur, who had already been giving lectures on the subject at Montpellier for some years and whose *Pratique de Chymie* had been

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(57) Howard M. Solomon, *Public Welfare, Science and Propaganda in Seventeenth Century France: The Innovations of Théophraste Renaudot* (Princeton: Princeton U.P., 1972).

(58) Jean Riolan, *Cvrievses Recherches svr Les Escholes en Medecine, de Paris, et de Montpellier, Necessaires d'estre sçeuës, pour la conseruation de la vie. Par vn Ancien Docteur en Medecine, de la Faculté de Paris* (Paris: Gaspar Metvras, 1651), sig. āiiiiv.

(59) *Ibid.*, p. 2.

(60) *Ibid.*, p. 7.

(61) *Ibid.*, p. 230.

(62) *Ibid.*

(63) *Ibid.*, p. 246.

(64) *Ibid.*, sig. viiir.

(65) Jean Astruc, Mémoires pour servir à *l'Histoire de la Faculté de Médecine de Montpellier...*, Revus & publiés par M. Lorry (Paris: P.G. Calalier, 1767), p. 69.

published two years earlier. His Lettres-patentes of 1675 permitted him to give a public lecture course every year in the Faculty of Medicine (66). However, he was given a salary commensurate with that of a Professor with similar rights, prerogatives, exemptions and immunities. These privileges came as a shock to the members of the Medical Faculty who had no wish to see a chemical operator whom they considered to be illiterate raised to their own status (67). Arguing that this was a medical subject they recommended that a new Chair in Chemistry be established and given to a medical doctor who would then be set over and above the chemical demonstrator. This suggestion was approved and Arnaldus Fonsorbe (d. 1695), a Doctor Aggrégé of the Faculty since 1665, was appointed the first Professor of Chemistry at Montpellier (68). There is no evidence that he published anything of significance in the field, but on the other hand there is no evidence that there was any undue friction between him and Matte.

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Matte's *Pratique de Chymie* gives a good indication of his teaching of the subject. He defined chemistry in its relation to medicine. It is "l'Art de séparer les parties du corps naturel, de les purifier, & de les rejoindre, pour les usages de la Médecine." (69). His elementary substances are phlegm, spirit, sulphur, salt and "terre morte", the most commonly accepted group from this period (70). After a description of chemical operations and equipement he devoted the remainder of the book to chemical preparations which he divided into the customary categories of mineral, vegetable and animal. There is little new here and perhaps the most novel aspect of the book is the author's preface in which he asked why another chemical text is needed at all. He cited the excellent texts of Beguin, Hartmann, Crollius, Duchesne, Schroeder, Davidson, Lefèvre and Glaser which some might argue "leave nothing further to be said on this matter", (71). His only defence was that he would add some preparations not to be found in the other authors and that occasionally he would present the subject matter in a different fashion.

Montpellier continued to be in the forefront of the teaching of

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(66) *Ibid.*, pp. 268-270.

(67) *Ibid.*

(68) *Ibid.*

(69) S. Matte La Faveur, Distillateur & Démonstrateur ordinaire de la Chymie en la Faculté de Médecine de Montpellier, *Pratique de Chymie...Avec un avis sur les eaux minérales* (Montpellier: Daniel Pech, 1671), p. 1.

(70) *Ibid.*, p. 9.

(71) *Ibid.*, sig. ã2v.

chemistry in the eighteenth century. After death of Fonsorbe in 1695 Antoine Deidier (d. 1746) was appointed Professor of Chemistry in 1697, a position he was to hold for nearly half a century. Although not a widely known figure among either historians of chemistry or historians of medicine, he deserves attention since he published widely in both chemistry and medicine (72). This may be illustrated by two of his books, the *Chimie Raisonnée* (1715) and the *Institutiones Medicinae Theoricae* (1711).

Deidier's chemical text based on his Latin lectures presented at Montpellier, but printed in French to be more useful "aux jeunes Médecins, aux Chirurgiens, & aux Pharmaciens dans les Provinces éloignées ..." (73) In his introductory letter to the volume Dr. Pestalossi of Lyon noted the lingering public suspicion of chemistry due to the prevalence of charlatans and impostors who promised cures for all illnesses with a single universal remedy. However, he added, true medicinal chemistry is an art of which the utility is known to all people of learning and good sense. (74). Deidier wrote in the tradition of seventeenth-century medical chemistry. His text differed from those of his predecessors primarily in that he spent no time on the history and definition of the subject, nor did his book present the reader with the familiar descriptions of chemical equipment and operations, topics that were standard in most other accounts. Deidier turned first to the chemical principles: water, earth, salt, sulphur and spirit -essentially the same five adhered to by most chemists over the past half century (75). Deidier made the point that these elements - which he defined as the simple bodies of which all things are composed - are not the same as the elements of Descartes (76). The latter form the basis of Cartesian cosmology, but they are of little value to the chemist who seeks his elements through laboratory separations and distillations. This preliminary material completed, Deidier then turned to the heart of the book, the chemical preparation of substances of medicinal value and most of these were of inorganic materials.

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(72) This was first pointed out by Lester S. King who compared Deidier's *Institutiones Medicinae Theoricae* (1711) with Nicholas *Lemery's Cours de chymie* (here he used the English translations of 1677 and 1720). However, although the *Institutes* shows the interest of the author in chemistry, it was essentially a medical textbook. It would have been better to have compared Lemery's chemical textbook with Deidier's *Chimie raisonnée* (1715).

(73) Antoine Deidier, *Chimie raisonnée. Où l'on tache de découvrir la nature & la manière d'agir des Remèdes Chimiques les plus en usage en Médecine & en Chirurgie* (Lyon: Marcellin Duplain, 1715), sig. *vr.

(74) *Ibid.*, sig. *ixv-*xr (dated Lyon, 23 November 1714).

(75) *Ibid.*, pp. 1-9.

(76) *Ibid.*, pp. 9-11

As a member of the Medical Faculty Deidier did not hesitate to publish on purely medical subjects. Here his *Institutiones Medicinae Theoricae* is divided into discussions of physiology, pathology and therapeutics. In the section on physiology he noted that this subject had been altered due to the modern discoveries in physics, chemistry and anatomy. This new information has "led to the more perfect knowledge of the nature and structure of the human body", (77). Deidier divided the subject into three parts, the principles, the fluids, and the solids (78). And again he presented the Cartesian position on the three sizes of elementary particles and their cosmological significance (79). But he turned to chemical tradition when he stated that all substances are mineral, vegetable or animal in origin. These, he assures us, are composed of the five chemical principles (80).

Deidier's long tenure at Montpellier helped to assure a continued influence of chemical medicine at that institution. And if it is evident that he was well aware of Cartesian philosophy, it is also clear that his work reflects the French chemical text book authors. The history of chemistry at Montpellier deserves detailed research because of the development of vitalistic medicine there in the eighteenth century. The roots of this school may well be based in the continued influence of seventeenth-century iatrochemistry at a time when that medical philosophy was being supplanted by a more mechanistic approach to medicine elsewhere.

In the Netherlands the leading university of chemical instruction was eventually to be Leiden in the eighteenth century due to the enormous influence of Hermann Boerhaave (1668-1738) whose courses were attended by students from many countries and whose textbook of chemistry was translated into numerous languages. We will not be concerned with his work, but the background to the appointment in chemistry at Leiden is important to us. Here, once again, we find chemical instruction rooted in the iatrochemistry of the seventeenth century. In his paper on early chemistry at Leiden Van Spronson has discussed the first appointments in chemistry. The noted iatrochemist, Franciscus de la Boë Sylvius (1614-1672) was appointed Professor of Clinical Medicine in 1658 and when Anton Deusing was being considered for an appointment to the Medical Faculty in 1666 Sylvius threatened to resign unless given a chemical laboratory and a

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(77) Antoine Deidier, *Institutiones Medicinae Theoricae Phisiologiam & Pathologiam complectentes* (Montpellier: Honore Pech, 1711), sig. ã2r.

(78) *Ibid.*, sig. ã2r-ã2v.

(79) *Ibid.*, pp. 4-6

(80) *Ibid.*, pp. 8-14.

Professorship in Chemistry (81). But although this was promised to him by the Board, nothing came of it immediately. Only three years later did the Board confirm its earlier decision in noting that "nothing was lacking to make the distinction of the Medical Faculty complete but the preparation of medicaments in a chemical manner and the performance of experiments in the field of chemistry", (82).

The first appointment by the University was Carel de Maets (1640-1690) who had been trained by Glauber in Amsterdam and then had gone on to the University of Utrecht as an unsalaried Docent (83). But there he had had no laboratory and he was attracted to the new position at Leiden where the chemical laboratory was opened in 1669. He was appointed without salary, but by 1672 he was Ordinary Professor in the Faculty of Philosophy and seven years later was given the same appointment in the Medical Faculty. De Maets had some competition from Jacob Le Mort (1650-1718) and Christian Margraaf (1626-1687) (84). The former had also worked in Glauber's laboratory and then he had set up his own laboratory in Leiden. He had also gone to Utrecht for an M.D. (1678). Margraaf's doctorate had been taken at the University of Franeker in 1659. He then moved to Leiden where he gave chemical lessons to students much to the annoyance of Sylvius, De Maets, and Le Mort. At the death of De Maets in 1690, Le Mort was given the management of the chemistry laboratory at Leiden, but other recognition was slow to come. Approval of his promotion to Professor of Chemistry was obtained in 1697, but the appointment was not made official until 1702. At his death Boerhaave added the Chair of Chemistry to those in medicine and botany that he already held.

The Professorship in Chemistry at Leiden had been established because of the recognized need of this subject for medicine and the seventeenth-century publications connected with the early instructors bear this out. De Maets wrote two books, the *Prodromus chymiae rationalis* (1684) and the *Chymia rationalis et praxis chymiatricae rationalis* (1689), whose titles indicate a familiar medical orientation Le Mort's *Chimia, Rationibus et Experimentis...* of 1688 was also aimed at medical students. The five chemical principles are mercury or

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(81) J.W. Van Spronsen, "The Beginnings of Chemistry" in *Leiden University in the 17th Century: An Exchange of Learning*, ed. Th. H. Lunsingh Scheurleer and G.H.M. Posthumus Meyjes. With the assistance of A.G.H. Bachrach (Leiden: University Press, Brill, 1975), pp. 329-143 (335).

(82) *Ibid.* p. 337.

(83) *Ibid.*

(84) *Ibid.*, pp. 338-340.

spirit, sulphur or oil, salt, phlegm and earth (85) and the reader is presented with the expected description of chemical processes and equipment before going on to the chemical recipes. The medical tenor of the volume is modified only in the opening pages where Le Mort discussed the goal of chemistry. Here the medical or pharmaceutical goal is only the second of four. The first is contemplative chemistry which deals with the chemical anatomy of bodies through the use of fire. The third is metallurgy and the last is transmutation or alchemy (86).

The most comprehensive document from the seventeenth-century Leiden chemists is the *Collectanea chymica Leydensia, Maëtsiana, Margraviana, Le Mortiana* which was put together from notes taken by an English medical student, Christopher Love Morley (b. ca. 1646, M.D. 1679) and first published in 1684. This is a book of some six hundred pages in the 1693 edition and it includes long sections by the three Leiden teachers from whom Morley took courses (87). The first Prolegomena is attributed to Margraaf, the second to Le Mort, and the bulk of the volume is the customary collection of recipes - in this case arranged alphabetically. Marginal notes indicate Morley's sources. More popular than any of the books published by his instructors, Morley's volume was not appreciated by them. De Maets attacked Morley in his *Prodromus* while the others complained that they were not responsible for Morley's statements.

We still know far too little of the origins of the teaching of chemistry in European universities. Surely the few institutions I have touched on here represent only a fraction of those we might have referred to. We have already mentioned Utrecht where De Maets had taught prior to moving to Leiden. This was to become the home of Johann Conrad Barchusen (1666-1723) who taught chemistry there from 1694 and who was to become Extra-ordinary Professor of Chemistry in 1703 (88). Johann Kunckel (1630 or 1638-1703) was appointed Professor of Practical Chemistry at Wittenberg in 1677 (89) while at Helmstedt Johann Andreas Stisser (dates unknown) taught chemistry and

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(85) Jacobus Le Mort, *Chymia, Rationibus et Experimentis Auctoribus, Iisque Demonstrativis Superstructa, In Qua Malevolorum Calumniae modesté simul diluuntur* (Lugduni Batav.: Apud Petrum Vander Aa, 1688), p. 7.

(86) *Ibid.*, p. 2.

(87) Christopher Love Morley, *Collectanea Chymica Leydensia, Maëtsiana, Margraviana, Le Mortiana...* (Lugduni Batavorum: Sumpt. Cornelii Boulesteyn & Frederici Haaring, 1693).

(88) Partington, *op. cit.*, pp. 700-702: Owen Hannaway, "Johann Conrad Barchusen (1666-1723) - Contemporary and Rival of Boerhaave," *Ambix, 14* (1967), 96-111.

(89) Partington, *op. cit.*, pp. 361-377.

published three volumes of *Acta* based upon the work at his laboratory (1690-3-4) (90). At Erfurt Caspar Cramer (1648-1682) was another Professor of Medicine who taught chemistry. His lectures, the *Collegium Chymicum* were published posthumously in 1688 (91). Cramer taught Friedrich Hoffman (92) (1660-1742) who had also spent some time at Jena where he had studied chemistry under Georg Wolfgang Wedel, himself a student of Rolfinck. Hoffman was to be given the first Chair in Medicine at Halle. His colleague at Halle, Georg Ernst Stahl (1660-1734), was to develop the theory of phlogiston and he too had studied under Wedel and had taught chemistry at Jena as early as 1684 (93). The situation was similar at Leipzig where the high influential Professor of Medicine, Michael Ettmuller (1644-1683) also taught chemistry. His chemical lectures were published as the *Chymia rationalis ac experimentalis curiosa* (1684) and went through a number of editions in several languages (94). Recognition of the importance of chemistry for medicine was granted at Leipzig in 1700 with the approval of a fifth Chair in the Medical Faculty. However, the appointment of a Professor of Chemistry was not made until ten years later in Professor Scheider (95).

There seems little doubt that chemistry was widely discussed in an academic setting in the Renaissance. However, it is difficult to pinpoint the actual introduction of actual chemical courses because of the broad spectrum of definitions of chemistry. For some it was a total system of man and nature proposed as a replacement for Aristotelian natural philosophy and Galenic medicine. For others it was considered as little more than a handmaiden to medicine through the preparation of chemically prepared remedies. It was only in the

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(90) *Ibid.*, p. 378.

(91) *Ibid.*, pp. 319-320.

(92) *Ibid.*, pp. 691-700.

(93) Partington notes that the lectures printed in Stahl's *Fundamenta Chymiae Dogmaticae & experimentalis* (1st edition, 1723) go back to Stahl's Jena lectures of 1684. When examined in this light - and the development of chemistry at Jena - they should add to our knowledge of the teaching of academic chemistry in the late seventeenth century. Partington, *ibid.*, p. 661.

(94) I used the French translation: Michael Ettmuller, *Nouvelle Chymie Raisonnée* (Lyon: Thomas Amaulry, 1693). Ettmuller gave Paracelsus credit for having established the five principles, " *le Souphre, le Sel, & le Mercure;* & deux passifs, qui sont le Phlegme & la Teste morte..." (p. 2). However, he accepted the common belief that Paracelsus had borrowed the three principles from Basil Valentine, Isaac Hollandus and Raymond Lull (p. 3).

(95) Wilhelm Treibs, " Zur Geschichte der Entwicklung der Chemie an der Universität Leipzig" in *Karl-Marx-Universität Leipzig 1409-1959*, ed. Ernst Engelberg (2 vols., Leipzig: Verlag Enzyklopäedie Leipzig, 1959), pp 464-480(464).

course of the seventeenth century that chemistry came to be widely accepted academically. But as this occurred the far ranging cosmological claims of the Paracelsians were gradually rejected. The academic recognition of chemistry came about because of its practical value for the physician.

It is customary to view seventeenth-century chemistry as a subject divorced from the educational establishment. Surely the Paracelsians had complained bitterly that students had no opportunity to study chemistry. And Hélène Metzger's detailed study of the French textbook tradition has centered on the Jardin des plantes where chemistry flourished rather than the hostile Parisian Medical Faculty. The English scene has been examined primarily from the standpoint of Robert Boyle and the Royal Society rather than the developments at Oxford and Cambridge.

It was only in the course of the seventeenth century that chemistry came to be widely accepted academically.

However, as we have seen, by the 1680s chemistry was being taught widely throughout the universities of Europe. But university appointments had been made throughout the century. The appointment of Johann Hartmann as Professor of Chymiatria at Marburg in 1609 points to the close connection of chemistry and medicine in this period - and therefore to the importance of the Paracelsian tradition. The chemical lectures of Zacharias Brendel the elder at Jena followed those of Hartmann by only a few years and here again they introduced specifically for the benefit of medical students. From Brendel we can follow a succession to his son, to Rolfinck and Wedel - and then to Georg Ernst Stahl's chemical course of 1684. By this time courses were available at a number of other German universities including Wittenberg, Helmstedt, Erfurt, Altdorf and Leipzig.

Nor were chemical courses in France confined to the succession of talented instructors at the Jardin des plantes. In contrast with the Faculty of Medicine at Paris, the equally distinguished Medical Faculty of Montpellier looked with favor on the chemically prepared remedies of the Paracelsians. Certainly the Montpellier students, Theodore Turquet de Mayerne and Théophraste Renaudot, stood in the forefront of defenders of chemical medicine in the seventeenth century. In the case of Montpellier it may seem surprising only that actual appointments in chemistry were not made until 1675.

The universities in the Low Countries reflect the situation in rest of Europe at this time. De Maets taught at Utrecht prior to taking the newly established position in chemistry at Leiden in 1669. Both he and his successor, Le Mort, had been trained in the laboratory of

Glauber in Amsterdam. The textbook of De Maets appeared in 1684, the same year as Morley's *Collectanea chymica Leydensia*. That the University of Louvain should have made an appointment of a Professor of Chemistry through the Faculty of Medicine in 1685 should then be looked upon less as a major innovation than as an expression of the recognized importance of the field at this time. In the late seventeenth-century chemistry was widely accepted in the universities of Europe. It was, however, a subject that was accepted as a part of medicine rather than the basis of a new philosophy of nature as the sixteenth-century Paracelsians would have wished. Only in the course of the eighteenth century was the subject to establish itself as one independent of medicine.