Social Support for Chemistry in Germany during the Eighteenth Century: How and Why Did It Change?

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Social Support for Chemistry in Germany during the Eighteenth Century: How and Why Did It Change?[1]

BY KARL HUFBAUER*

Chemistry, J. F. Gmelin reminded the reader of his massive *Geschichte der Chemie* in 1797, used to be misunderstood, contemned, and ridiculed. In his day, however, the science had become "the idol before which all peoples and all orders, princes and subjects, clergy and laymen, the educated and uneducated, high and low, bend their knees; the favorite science of the great . . . who reward it with royal generosity. . . ."[2] Though Gmelin exaggerated, esteem and support for chemistry did improve immensely during the century of Enlightenment. H. Guerlac has illuminated the crucial stage in the development of such support in France.[3]

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1. This essay pulls together ideas which were necessarily diffused in my study, "The Formation of the German Chemical Community (1700-1795)," unpublished dissertation (University of California at Berkeley, 1970). My aim here is to expose an explanation for changes in the social support for chemistry in eighteenth-century Germany. I seek to make this explanation plausible without marshalling all available evidence. The reader who desires further information should see the parent study and the host of publications cited there. In thinking about this essay's topic, I have been fortunate to receive comments and criticisms from R. Hahn, H. Rosenberg, P. Forman, A. Thackray, R. Multhauf, H. Snelders, E. Bowden, S. Turner, and R. McCormmach.

2. J. F. Gmelin, *Geschichte der Chemie seit dem Wiederaufleben der Wissenschaften bis an das Ende des achtzehenden Jahrhunderts,* photographic reprint (Hildesheim, 1965), *1,* 2.

3. H. Guerlac, "Some French Antecedents of the Chemical Revolution," *Chymia, 5* (1959), 73-112.

Unfortunately, comparable studies are lacking for other countries.[4] This paper seeks to correct this deficiency for Germany[5] by first tracing, then suggesting an explanation for, the development of social support for chemistry there between 1700, when German chemists were beginning to see their subject as an independent science, and 1800, when the independence of their science was beginning to be seriously questioned.

Social support for a scholarly discipline comes from two main sources—patrons and participants.[6] The support of the patrons is expressed in salaried positions, facilities, or budgets to promote teaching and pursuit of the discipline. The support of the participants is expressed in their number, their intelligence, their dedication, their productivity, and, if patronage is inadequate, their willingness to use personal resources. Since social support takes so many forms, there are many conceivable quantitative indices for tracing changes in its level. Few indices, however, can be used for looking at developments in the eighteenth century because of the difficulty or impossibility of obtaining the requisite data. For example, in tracing how social support for chemistry changed in Germany between 1700 and 1800, one must rest content with three rough indices—(1) the number of salaried positions in schools and academies whose occupants were partly or wholly responsible for chemistry, (2) the number of learned institutions with functioning

4. However, many of the materials needed for an examination of changing social support for chemistry in Britain are readily available in J. R. Partington, *A History of Chemistry* (London, 1961-1962), *2-3;* Archibald and Nan L. Clow, *The Chemical Revolution: A Contribution to Social Technology* (London, 1952); A. E. Musson and Eric Robinson, *Science and Technology in the Industrial Revolution* (Toronto, 1969); Robert E. Schofield, *Mechanism and Materialism: British Natural Philosophy in An Age of Reason* (Princeton, 1970); and Arnold Thackray, *Atoms and Powers: An Essay on Newtonian Matter-Theory and the Development of Chemistry* (Cambridge, Mass., 1970).

5. Since "Germany" was not a political entity in the eighteenth century, it is necessary to define the term. For the purposes of this essay, "Germany" means those parts of Europe where German was the predominant language—the Holy Roman Empire (less the Hapsburg possessions in The Netherlands and Italy) plus the German-speaking parts of Alsace, Switzerland, and Eastern Europe (e.g., old Prussia and western Hungary).

6. For an illuminating discussion of contemporary social support for science, see Alvin M. Weinberg, *Reflections on Big Science* (Cambridge, Mass., 1967), pp. 65-114.

laboratories, and (3) the number of fairly productive and renowned chemists.[7]

At the beginning of the eighteenth century, a few medical schools were the only learned institutions in Germany with salaried positions for chemistry.[8] In the 1720's the number of medical professors who were at least partly responsible for chemistry began to grow at a rapid rate. From the 1740's this growth was complemented by the rise of chemical positions in scientific academies[10] and several nonmedical schools.[11] Throughout the remainder of the century,

Salaried Positions for Chemistry in German Schools and Academies, 1700–1800[9]

	1700	*1710*	*1720*	*1730*	*1740*	*1750*	*1760*	*1770*	*1780*	*1790*	*1800*
Number new during preceding decade	1	2	0	7	5	6	5	9	9	8	14
Total number on given date	5	5	4	10	13	18	21	28	33	38	48

7. The evidence presently available is either too fragmentary or too unwieldy to permit one to follow quantitatively the development of support for chemistry outside of learned institutions, changes in overall financial support for the science, the growth in the number of chemical authors, variations in overall or average productivity, etc.

8. Thanks to the iatrochemists, who campaigned vigorously for the use of chemical products and concepts in medicine, courses on chemistry were offered at one time or another during the seventeenth century in most German universities with medical faculties. The term "medical schools" will be used in this essay for medical faculties in universities and upper schools and for medical-surgical colleges.

9. For information on which schools and academies had salaried chemical positions on the given dates, see Table I. In calculating the number of new positions during the preceding decade, I have counted those few which were established and disestablished in the same decade (the positions in this category are not listed in Table I) but excluded those which were merely transferred from a closing institution to a successor institution.

10. In 1744 the Chemists J. H. Pott and A. S. Marggraf began receiving salaries from the Berlin Academy *qua* academicians. However, a decade later, when Marggraf became Director of the Academy's laboratory, the number of salaried positions for chemistry in the Academy was reduced to one. I am indebted to Dr. Christa Kirsten, Director of the Academy's archives, for this information. Late in the century the Munich Academy charged one of its salaried members with chemistry as well as physics.

11. The first nonmedical schools with salaried chemical positions were the new schools for prospective mining administrators in Schemnitz (1763), Idria (1763), Prague University's Law Faculty (1763), Freiberg (1765), and Berlin (1770). Their example was soon followed by a few schools whose primary purpose was to prepare the sons of nobles and high officials for bureaucratic or military careers. Toward the end of the century, a few universities established salaried chemical positions in economics and philosophical faculties.

TABLE I

Salaried Chemical Positions and Laboratories in German Schools and Academies, 1700-1800*

	1700	1710	1720	1730	1740	1750	1760	1770	1780	1790	1800
1. MEDICAL SCHOOLS											
Altdorf U. Med. Fac.	1,L	1,L	1,L	1,L	1,L	1,L	1,L	1,L	1,L	1,L	1,L
Bamberg U. Med. Fac.	X	X	X	X	X	X	X	0	1	0	1
Berlin Med. Surg. College	X	X	X	2	1	1	1(2)	1(2)	1	1	1
Bonn U. Med. Fac.	X	X	X	X	X	X	X	X	X	1	X
Bonn Central Sch. Med. Fac.	X	X	X	X	X	X	X	X	X	X	1
Budapest U. Med. Fac.	X	X	X	X	X	X	X	1	1	1	2
Cologne U. Med. Fac.	0	0	0	0	0	0	0	0(1)	1,L	1,L	X
Duisburg U. Med. Fac.	0	0	0	1,L	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	1
Erfurt U. Med. Fac.	0	0	0	0	0	0	2	1	1,L	0(L)	1
Erlangen U. Med. Fac.	X	X	X	X	X	1,L	1	1	1	1	0
Frankfurt a.d.O. U. Med. Fac.	0	0	0	0	1	1	1	1	1	1	1
Freiburg i. Br. U. Med. Fac.	0	0	0	0	0	0	1	1	1,L	1,L	1,L
Fulda U. Med. Fac.	X	X	X	X	0	0	0	1(0)	1(0)	1	1
Giessen U. Med. Fac.	0	0	0	0	0	0	0	1	1	1,L	1(L)
Göttingen U. Med. Fac.	X	X	X	X	0	0	1	1	1	1,L	1,L
Graz Lyceum Med. Fac.	X	X	X	X	X	X	X	X	X	1	1
Greifswald U. Med. Fac.	0	0	0	0	0	0	0	0	1	1	1
Halle U. Med. Fac.	1	1	0	0	0	0	0	0	0	1	0
Heidelberg U. Med. Fac.	X	0	0	1(0)	1	1	1	1	1	1	1
Helmstedt U. Med. Fac.	1	0	0	1	1	1	1	1	1	1	1
Herborn High Sch. Med. Fac.	0	0	0	0	0	0	0	0	0	0	1
Ingolstadt U. Med. Fac.	0	0	0	0	0(1)(L)	0(1)(L)	2(L)	2(L)	1,L	1,L	1,L
Innsbruck U. Med. Fac.	0	0	0	0	1	1	1	1	1,L	X	1(L)
Innsbruck Lyceum Med. Fac.	X	X	X	X	X	X	X	X	X	1(L)	X
Jena U. Med. Fac.	1	1	1	1	1	1	1	1	1	1	1
Kassel Collegium Med. Fac.	X	X	X	X	0	0	0	0	1,L	X	X
Kiel U. Med. Fac.	0	0	0	0	0	0	0	0(1)	0(1)	0(1)	1
Königsberg U. Med. Fac.	0(1)	0	0	0	1	0	0	0	1	1	1
Leipzig U. Med. Fac.	0	0	0	1	1	1	1	1	1	1	1
Mainz U. Med. Fac.	0	0	0	0	0	1	0	0	0	1,L	X
Mainz Central Sch. Med. Fac.	X	X	X	X	X	X	X	X	X	X	1,L
Marburg U. Med. Fac.	0(1)(L)	0(L)	0(L)	0	0	0	0	0	0	0	1,L

Münster U. Med. Fac.	X	X	X	X	X	X	X	X	X	X	1
Olmutz Lyceum Med. Fac.	X	X	X	X	X	X	X	X	X	1	1
Prague U. Med. Fac.	0	0	0	0	0	1	1	1	1	1,L	2(1),L
Rostock U. Med. Fac.	0	0	0	0	1	1	0	0	0	0	0
Strasbourg U. Med. Fac.	1	1	1	1	1	1	1	1	1	1	X
Stuttgart U. Med. Fac.	X	X	X	X	X	X	X	X	1	1,L	X
Tübingen U. Med. Fac.	0	1	1	1	1(0)	1	1,L	1,L	1,L	1,L	1,L
Vienna U. Med. Fac.	0	0	0	0	0	1	1,L	1,L	1,L	1,L	1,L
Vienna Med. Surg. Acad.	X	X	X	X	X	X	X	X	X	1	1
Würzburg U. Med. Fac.	0	0	0	0	1	1	1	1	1	1,L	1,L
TOTALS	5,1L	5,1L	4,1L	10,2L	13,1L	16,2L	20,3L	22,3L	26,9L	30,12L	34,10L
2. OTHER SCHOOLS											
Berlin Artillery School	X	X	X	X	X	X	X	X	X	X	1
Berlin Mining School	X	X	X	X	X	X	X	1	1	1	1
Clausthal Mining School	X	X	X	X	X	X	X	X	X	1	1
Erlangen U. Phil. Fac.	X	X	X	X	X	0	0	0	0	0	1,L
Freiberg Mining Academy	X	X	X	X	X	X	X	1	1	1	1,L
Giessen U. Econ. Fac.	X	X	X	X	X	X	X	X	1	X	X
Halle U. Phil. Fac.	0	0	0	0	0	0	0	0	0	0	1(L)
Heidelberg U. State Econ. Fac.	X	X	X	X	X	X	X	X	X	1,L	1,L
Jena U. Phil. Fac.	0	0	0	0	0	0	0	0	0	1,L	1,L
Kaiserslautern Cameral High School	X	X	X	X	X	X	X	X	1,L	X	X
Kassel Collegium	X	0	0	0	0	0	0	1,L	0	X	X
Marburg U. State Econ. Fac.	X	X	X	X	X	X	X	X	X	1	1
Prague U. Law Fac.	0	0	0	0	0	0	0	1	0	0	0
Rostock U. Phil. Fac.	0	0	0	0	0	0	0	0	0	0	1
Schemnitz Mining School	X	X	X	X	X	X	X	1,L	1,L	1,L	1,L
Vienna Ritterakademie	X	X	X	X	X	0	0	0	1	X	1
TOTALS	0	0	0	0	0	0	0	5,2L	6,2L	7,3L	12,5L
3. ACADEMIES											
Berlin	0	0	0	0	0	2	1,L	1,L	1,L	1,L	1,L
Munich	X	X	X	X	X	X	0(1)	0	0(1)	0(1)(L)	1(L)
TOTALS	0	0	0	0	0	2	1,L	1,L	1,L	1,L	2,L

* This table is a revised and improved version of Appendix V-A in K. Hufbauer, *op. cit.*, pp. 364-367. Only those learned institutions are listed which had salaried chemical positions on one of the dates given. X = the institution was not in existence. 0,1,2 = the number of salaried chemical positions (laboratory assistants have not been included). (0),(1),(2) = a possible alternative number of salaried chemical positions. L = institutional laboratory probably in use. (L) = institutional laboratory existed but was probably not in use for one reason or another. The totals for salaried chemical positions equal the sums of the numbers not in parentheses. The totals for laboratories equal sums of those probably in use.

the pace of this combined growth never slackened. Consequently, the number of salaried chemical positions in German learned institutions had climbed to forty-eight by 1800, nearly ten times higher than in 1700.[12]

Just as remarkable was the growth in the number of schools and academies with functioning laboratories.[13] Before 1750 the men who controlled these institutions displayed little interest in providing adequate facilities for chemistry. But then the number of laboratories began to climb, reaching six by 1770 and sixteen by 1790. During

Functioning Laboratories in German Schools and Academies, 1700–1800[14]

	1700	*1710*	*1720*	*1730*	*1740*	*1750*	*1760*	*1770*	*1780*	*1790*	*1800*
Number new during preceding decade	0	0	0	1	1	1	3	2	6	8	4
Total number on given date	1	1	1	2	1	2	4	6	12	16	16

the 1790's growth ceased as the rate at which new laboratories were constructed fell to that at which old ones were abandoned. Still, as the century closed, the number of German schools and academies with laboratories was many times higher than in 1700.

Counting "chemists" is not such a straightforward task. Procedures are needed for identifying them and specifying their periods of activity. Using a variety of approaches, I have developed a list of seventy-one chemists who were active in Germany during the eighteenth century and who enjoyed at least a modicum of con-

12. The occupants of many of these positions, it must be emphasized, encountered such difficulties as very low salaries, responsibilities that went far afield of chemistry, and a lack of facilities. Still, over half these men were provided some opportunities and incentives to participate in the development of chemistry. As of 1800, around two-thirds of the chemical representatives had at least one publication on a chemical topic to their credit.

13. Most of these laboratories were used by chemical representatives for their research and preparation of classroom experiments. Only a few were teaching laboratories open to all serious students—e.g., those at the Schemnitz and Freiberg mining schools.

14. For details, see Table I.

temporary renown.[15] I have established their periods of activity by assuming (1) that a man became an "active chemist" by publishing three short essays or a book on chemistry and (2) that he ceased being an active chemist three years after his last publication on a chemical topic, unless, of course, he died first.[16] The upshot is that

"Active Chemists" in Germany, 1700–1800[17]

	1700	*1710*	*1720*	*1730*	*1740*	*1750*	*1760*	*1770*	*1780*	*1790*	*1800*
Number new during preceding decade	2	0	1	6	2	5	5	5	16	13	11
Total number on given date	7	5	4	9	8	8	12	12	23	31	30

the number of chemists, after declining in the first two decades, jumped somewhat beyond its starting level in the 1720's and then remained essentially stable until the 1750's. The number then began to climb, reaching twelve by 1760 and, thanks to the influx of well over one new chemist per year during the 1770's and 1780's, thirty-one by 1790. During the 1790's, however, the number crested at thirty-five and then, as the rate of influx slowed, fell somewhat.[18]

15. In developing this list of chemists, I started with a list consisting of all those who received more than half a column in Gesellschaft für Geschichte der Pharmazie, *Chemisch-Pharmazeutisches Bio- und Bibliographikon,* ed. Fritz Ferchl (Mittenwald, 1937). Then, on the basis of more than two dozen contemporary lists of notable chemists, I removed and added several names. Finally, on the basis of my own knowledge of eighteenth-century German chemistry, I made a few more adjustments. The basic trends for the numbers of chemists are essentially the same, regardless of whether one uses the fairly "arbitrary" list based on Ferchl's work or this more "natural" list. The trends might well be altered, however, if one only counted those few chemists who made *significant* contributions to the development of chemical theory or technique.

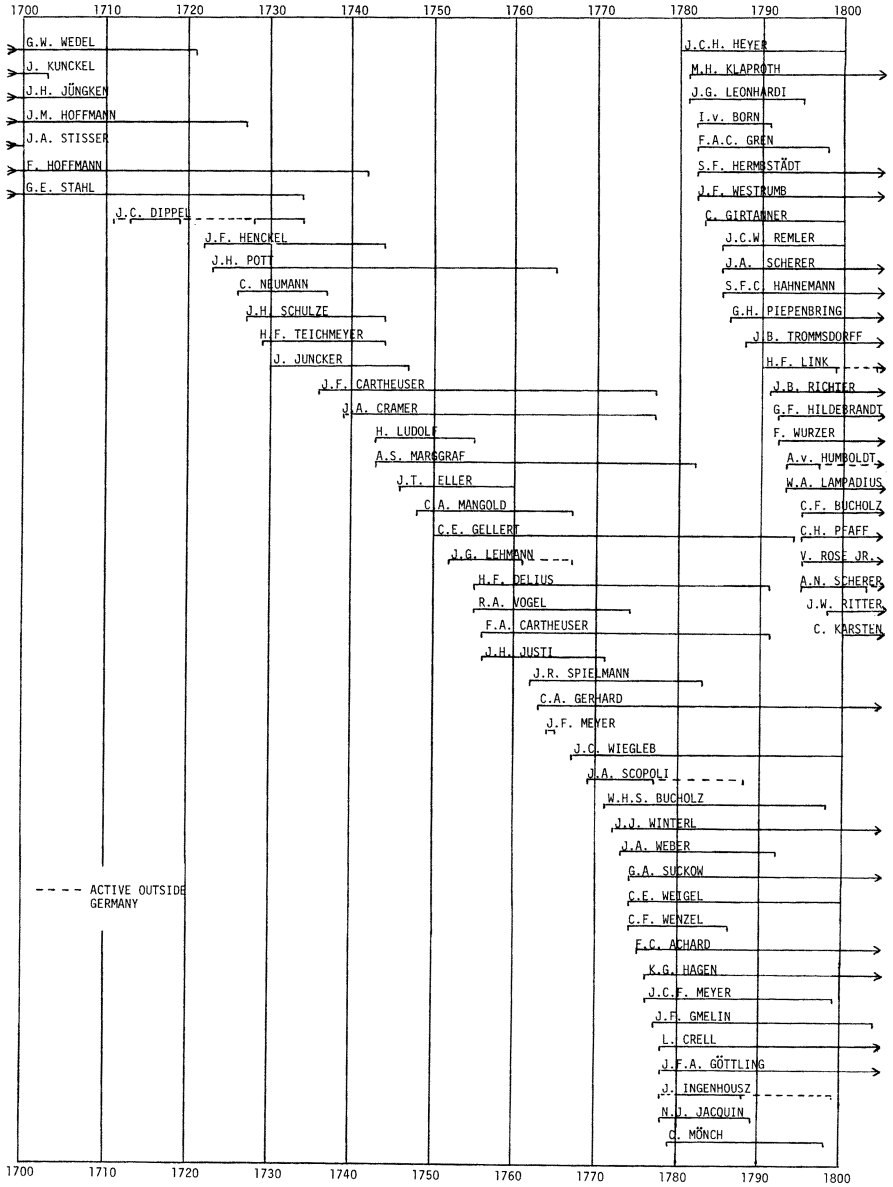
16. These criteria for establishing a chemist's years of activity do something to improve on the arbitrary procedure of saying that a man was active from age twenty-five or thirty until his death.

17. For a chart which reveals the names and active periods of the chemists, see Table II.

18. Additional evidence of declining activity in chemistry during the 1790's is provided by the fact that the number of contributors to Germany's chief chemistry journal, L. Crell's *Chemische Annalen,* fell from over forty in 1789 to under twenty in 1797. In 1800 J. B. Trommsdorff complained that "the spirit of experimental investigation is beginning to get drowsy in Germany"—*Journal der Pharmacie, 7:2* (1800), 246.

TABLE II

"Active Chemists" in Germany, 1700-1800



Nevertheless, there were thirty chemists in Germany at the end of the century, more than four times as many as at the start.

To sum up, during the first five decades of the century, the number of salaried chemical positions climbed significantly, but the numbers of laboratories and chemists registered only slight gains. By contrast, all three indices made quite impressive gains between 1750 and 1790, especially between 1770 and 1790. Finally, during the 1790's, while the number of positions continued to rise, the number of laboratories leveled off and the number of chemists declined slightly.

Social support for a scholarly discipline depends, I have suggested, upon the decisions of the discipline's potential patrons and participants. The higher the prestige (status, standing, esteem) of the subject in the eyes of such men, the greater the possibility that their decisions will be supportive. But what determines the prestige that a social group (e.g., the potential patrons) assigns to a discipline?[19] Apparently, two factors are crucial—(1) the group's image of the subject, which need not be and often is not accurate, and (2) the group's values. If the perceived attributes of the discipline are incompatible with or irrelevant to the group's goals, the group will have little esteem for the subject. On the other hand, if the perceived attributes harmonize with the group's values and aspirations, the group will grant the subject high status. Clearly, a change in either or both factors can affect the group's ranking of and inclination to provide support for the discipline. Indeed, I wish to suggest that the development of social support for chemistry in eighteenth-century Germany depended upon coinciding changes in *both* the image of chemistry *and* the values held by its potential patrons and participants.[20]

19. For a useful discussion of the prestige of scholarly disciplines, see Warren O. Hagstrom, *The Scientific Community* (New York, 1965), pp. 167-176. He examines how contemporary scientists assign prestige to "disciplines" (e.g., physics, chemistry, biology) and "specialties" (e.g., elementary particle physics, nuclear physics, solid-state physics), finding that they tend to esteem those fields which are fundamental (the net-flow of information is outwards) and theoretical. He does not, however, discuss how nonscientists assign prestige to disciplines or why the prestige of disciplines changes with time.

20. To establish this, or any other explanation of the development of social support for chemistry in eighteenth-century Germany would be an immense undertaking. The potential patrons—the professors, academicians, high officials and rulers who, during the course of the century, controlled Germany's many

1. 1700–1750

The prevailing image of chemistry during the first half of the eighteenth century is reflected in three important lexicons published in this period. The first was J. Hübner's *Curieuses und reales Natur-Kunst-Berg-Gewerck- und Handlungs-Lexicon* (1712). Its main article on chemistry appeared under the heading of *"Alchymia,"* to which readers who looked up either *"Goldmacherey"* or *"Chemia"* were referred. Alchemy was described as

> an art by virtue of which the pure is separated from the impure, or an art [for acquiring] an active and working knowledge (*Wissenschaft*) of natural things. It may be called practical physics (*Physica Practica*) because it resolves and dissolves all sublunary bodies into their first seeds or prime matter and recoagulates these into their former bodies so that the medicines which can be made from these [bodies] will be safer and healthier. . . . One can divide the chemical art into the vulgar or common [chemistry] known by apothecaries and physicians and the secret [chemistry] called alchemy which concerns itself with the preparation of the stone of wisdom upon which the transmutation of metals depends.

Elsewhere in the lexicon, the article on medicine identified chemistry as one of five branches of medicine, defining it as "the art which teaches how the best force can be drawn from natural things by means of fire." And under *"Lapis Philosophorum,"* it was observed that "most" of those who devoted themselves to "chemistry" believed in the stone, even though it could not be produced according to existing recipes which resulted from either "vain hope" or "plain fraudulence."[21]

A similar picture of chemistry emerges from J. T. Jablonsky's

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schools and academies—probably numbered over two thousand. The potential participants—physicians and, as the century progressed, pharmacists and others who learned something of the science as youths—were far more numerous. Even if one focused on the actual patrons (roughly 350 men for the salaried chemical positions and 100 men for the laboratories) and the actual participants (71 men according to my criteria), the task of relating their images of chemistry and their values to their patronage and their careers would be formidable.

21. J. Hübner, *Curieuses . . . Lexicon . . .* (Leipzig, 1717), pp. 47-49, 383, 723, 931, 1039. I have not seen the first edition but there is no reason to presume that it was very different. This popular lexicon went through many editions, the last appearing in 1792.

Allgemeines Lexicon der Künste und Wissenschaften (1721). He described *"Chymie, Alchymie, Chymia,"* which he regarded as one of the six branches of medicine, as

> an art which teaches how one should dissolve natural substances, separate them from one another, combine them, and prepare wholesome medicines out of them; or [how one should] analyze mixed, compound, or aggregate bodies into their fundamental parts or synthesize the same bodies out of such fundamental parts. . . . Chemistry, insofar as it investigates the powers and properties of nature and teaches the preparation of drugs is very useful and necessary to the doctor. However, one must not go further, nor allow oneself to be seduced by it [chemistry], to try to make the notorious philosophers' stone and thereby gold and silver.

Anyone who did so, Jablonsky warned his readers, would soon be just as impoverished as "many poor chemists."[22]

The third lexicon was J. H. Zedler's *Grosses vollständiges Universal-Lexicon aller Wissenschaften und Künste* (64 vols., 1732–1750). Its main article on chemistry appeared in 1742 under the heading *"Scheidekunst."* After giving all the synonyms for chemistry, this article, in contrast to those in the earlier lexicons, clearly pointed out that one should distinguish *"Chymie"* from *"Alchymie"* since the one belonged to medicine, the other to gold-making. The article went on to give a brief history of chemistry, then defined it as the

> art which uses fire and adept manipulations to decompose substances that are precisely and firmly united by nature whether they belong to the metal, mineral, animal, or vegetable realms; which recombines the separated substances into a single substance; and which prepares wholesome medicines from these substances to preserve and restore the health of mankind.

The article then gave all the operations of chemistry, described the traditional artistic symbol for alchemy and chemistry—an old woman whose age represented experience—and closed with an etymology of the word.[23]

22. J. T. Jablonsky, *Allgemeines Lexicon . . .* (Leipzig, 1721), pp. 50, 137-138.
23. J. H. Zedler, *Grosses vollständiges Universal-Lexicon . . .*, photographic reprint (Graz, 1961), *34*, 1110-1111.

The treatment of chemistry in these three lexicons indicates that during the first half of the eighteenth century it was seen as being immediately concerned with the analysis and synthesis of natural substances. In addition, chemistry's popular image had three other prominent features. First, the subject was viewed as a manipulative art, not an experimental science. Second, it was linked with alchemy, quite closely in the early decades of the century and then, judging from Zedler's lexicon, less closely. And third, it was associated with medicine, especially pharmacy.

These three attributes of chemistry's image, much more than its immediate subject-matter, influenced how educated Germans rated the discipline. To an age that looked down upon manual labor, chemistry's association with craft-like empiricism was demeaning. Indeed, many thought of chemists as "charcoal boys," as "filthy cooks, laboratory helpers, and generally useless riff-raff,"[24] or as mere "artisans."[25] To an age that condemned swindling, chemistry's association with alchemy was dubious. This was small wonder, for alchemists, both fraudulent and sincere, had long been arousing hopes for great riches, hopes which they failed to fulfill. To an age that was beginning to abandon resignation to sickness and early death, chemistry's association with medicine gave rise to mixed feelings. On the one hand, powerful chemical drugs (usually metallic compounds) were known to bring about remarkable cures. On the other hand, these powerful drugs were unreliable, sometimes exacerbating the illness they were supposed to cure. And the claims for drugs were so exaggerated that many people were suspicious. How could they wholeheartedly accept the word of physicians as to the value of drugs when so many doctors boasted about "their fountains of youth, their incombustible oils, their hermetical anti-

24. These terms are from a debate about the merits and faults of chemistry in a rambling novel of the late seventeenth century—J. C. Ettner, *Des getreuen Eckharts entlauffener Chymicus, in welchem vornemlich der Laboranten und Process-Krämer Boseheit und Betrügerey, wie dieselben zu erkennen und zu fliehen; hernach bewärteste Artzney-Mittel in allerhand Kranckheiten und Zufällen menschlichen Leibes zu gebrauchen; dann sonderliche, philosophische, politische, medicinische am meisten aber chymische Anmerckung und Process . . .* (Augsburg and Leipzig, 1697), pp. 48-54.

25. The influential philosopher C. Wolff lumped "chemists, alchemists, and artisans" together as men whose unexplained experiments needed investigation. See his *Vernünfftige Gedancken von den Würckungen der Natur,* 3rd ed. (Halle, 1734), p. 567.

dotes, their elixirs of gold, their snake-powders, and precious stones, their remedies for snake bites, their tinctures and panaceas, and their six hundred other remedies out of Arabia. . . ."[26] Consequently, even chemistry's association with drugs was not regarded as an entirely positive one.

In sum, the educated public's attitude toward chemistry was strongly colored with contempt and suspicion in the early decades of the eighteenth century. Though the fairly favorable treatment of the subject in Zedler's lexicon suggests that this attitude was dissipating by the 1740's, the layman did not yet have much reason to esteem chemistry and its devotees. This, it would seem, was why the numbers of laboratories and productive chemists in Germany failed to increase appreciably during the first half of the century.

The only sizable group that did not share the prevailing attitude toward chemistry was the physicians.[27] They had a different estimate of the subject because both their background and values were different. Most doctors had learned enough about chemistry as students to avoid confusing it with alchemy. Moreover, most placed a much higher value on empiricism and good health than their contemporaries. Some doctors, still enamored with the ambitious claims of the iatrochemists, regarded chemistry as the "principal and most noble part of medical study."[28] A growing majority, though they held a more moderate estimate of chemistry's merits, esteemed it

26. J. B. Mencke, *The Charlatanry of the Learned,* trans. by F. E. Litz and notes by H. L. Mencken (New York, 1937), p. 59. Mencke, a distant relative of the American pundit, also commented in his essay of 1715 that "although they [the doctors] are profoundly ignorant about the real effect of their medicines, they administer pills, syrups, drops and I cannot tell what other panaceas to their patients with an assurance so overwhelming that sometimes they even promise to restore the dead to life" (p. 165).

27. Some of the early cameralists recognized the great technical potential of chemistry; see U. Troitzsch, "Ansätze technologischen Denkens bei den Kameralisten des 17. and 18. Jahrhunderts," *Schriften zur Wirtschafts- und Sozialgeschichte, 5* (1966), *passim.* So did some men associated with the mining industry; see, for instance, W. Herrmann, "Bergrat Henckel. Ein Wegbereiter der Bergakademie," *Freiberger Forschungshefte: Kultur und Technik, D37* (1962), *passim.* And some natural philosophers and natural historians recognized chemistry's relevance to their fields; see, for example, A. Harnack, *Geschichte der königlich preussischen Akademie der Wissenschaften zu Berlin* (Berlin, 1900), *passim.* These men, however, played but a secondary role in the transformation of chemistry's public image which is discussed below.

28. R. Klüpfel, *Geschichte und Beschreibung der Universität Tübingen* (Tübingen, 1849), p. 163.

as an important auxiliary discipline because of its relevance to pharmacy. Indeed, as doctors, especially professors of medicine and physicians to rulers, became increasingly committed to public health, they took steps to insure that chemistry, which had been haphazardly taught in most medical schools, occupied a regular place in the curriculum. In most cases, their goal was to prepare the physician for the important task of testing prospective apothecaries and inspecting pharmaceutical shops. The result of these efforts was, as we have seen, that the number of medical schools with salaried positions for chemistry grew from four in 1720 to sixteen in 1750. Another consequence of the doctors' favorable attitude toward chemistry and their increasing contact with the subject was that most of the men who became chemists before 1750 were trained physicians.

Those doctors and occasional others who became chemists must have found the prevailing lack of respect for their discipline quite discouraging. They could not deny that most chemists of the past had relied upon crude empiricism, pursued alchemical fantasies, and tried to prepare miracle drugs. But, influenced by Pietism and Western European rationalism, they came to think that their subject could be a great deal more than it had been. That is, in the early decades of the eighteenth century, they came to entertain and to want the public to entertain a new image of chemistry.

First, they had to dissociate themselves and their subject from simple artisans and avaricious alchemists. G. E. Stahl, the most influential proponent of the chemists' new position, complained in 1726 that the writers of dictionaries, unaware that alchemy and chemistry had parted company, still equated the two. He then characterized alchemy as a "bewildering," "incomprehensible," and "futile" undertaking to make gold. Chemistry, by contrast, was "a rational, deliberate, and comprehensible investigation and processing [of substances which] leads to fundamental knowledge."[29] On another

29. G. E. Stahl, "Bedencken von der Gold-Macherey," in J. J. Becher, *Chymischer Glücks-Hafen . . .* , 3rd ed. (Leipzig, 1755). For Stahl's influence in Germany, see W. Strube, "Die Auswirkung der neuen Auffassung von der Chemie in Deutschland in der Zeit von 1745 bis 1785," unpublished dissertation (Karl-Marx-University in Leipzig, 1961) and "Die Ausbreitung der Naturanschauung G. E. Stahls unter den deutschen Chemikern des 18. Jahrhunderts," *Zeitschrift für Geschichte der Naturwissenschaften, Technik und Medizin, 1:2* (1964), 52-61.

occasion, he indignantly insisted that "bungling is characteristic of day-laborers, not chemists."[30] One of Stahl's disciples grumbled that "people generally call those men chemists who know how to carry out a task with fire according to a prescribed recipe. . . ." He also warned that anyone who approached Stahl's work as "a mere recipe-monger or greedy goldgrub" would find nothing of interest.[31] Another of Stahl's followers, J. Juncker, urged the reader of his text (1730) not to confuse "true" or "philosophical" chemistry with the "common chemistry" of pharmacists and artisans which was "purely empirical or mechanical." He also insisted that a recommendation to pursue chemistry was not the same as advising someone to embark "on the wild sea and open ocean of alchemy or goldmaking where . . . many a man has already been shipwrecked and lost his capital, his profession and standing, his health, honor, and life, yes, his temporal and probably even his eternal well-being." True chemistry did not deserve, therefore, the "great fear and contempt" with which many regarded it.[32]

In attempting to dissociate chemistry from the crafts, however, chemists did not deny the necessity of work in the laboratory. Rather, they portrayed experimentation as the means, not the end, of chemistry. Stahl went so far as to claim that "chemistry is a science, a science of causes in which the laboratory operations are the least part. . . . "[33] Likewise, in their denunciations of alchemy, the chemists did not deny the possibility of transmuting metals. Rather, they maintained that transmutation must be approached with the hope of enriching knowledge, not making a quick fortune. They stressed the importance of first determining the composition of gold and silver before trying to produce these metals.[34] In brief, though chemists sought to set themselves apart from artisans and alchemists,

30. Quoted in Partington, *op. cit., 2,* 664.

31. Translator's preface to G. E. Stahl, *Chymia rationalis et experimentalis; oder gründlicher, der Natur und Vernufft gemässe und mit Experimenten erwiesene Einleitung zur Chymie,* 2nd ed. (Leipzig, 1729).

32. J. Juncker, *Conspectus Chemiae Theoretico-Practicae . . . ,* 3rd ed. (Halle, 1749-1753), *1,* 1-3, 45, 52. I have not seen the first edition, but the third is probably not greatly changed.

33. Quoted in Partington, *op. cit., 2,* 664.

34. For Stahl's views on how the transmutation of metals should be approached, see his "Bedencken . . . ," *op. cit.,* and Partington, *op. cit., 2,* 685-686.

they continued to affirm the importance of experimentation and the possibility of transmutation.

Chemistry's association with medicine, it will be remembered, was the most favorable feature of the subject's popular image in the early eighteenth century. Throughout the century, chemists continued to call attention to their discipline's importance to medicine. However, Stahl and an increasing number of chemists argued that the subject should be more than a handmaiden to medicine. They came to see that chemistry's "true nature, effectiveness, attractiveness, and usefulness"[35] qualified it to be an independent and broadly applicable science.

For one thing, a growing number regarded chemistry as a penetrating tool of the natural philosopher. Some, like F. Hoffmann and H. F. Teichmeyer, put the chemical approach to nature on a par with the mechanical approach.[36] Others went further. Stahl, for example, maintained that chemistry penetrated much deeper than the highly touted mechanical philosophy which "scratches the shell and surface of things and leaves the kernel untouched."[37] In a similar vein, Juncker insisted that chemistry, not mathematics, was the "true key for penetrating the deepest secrets of natural objects." Only chemistry reveals their "essential, real, and original constituents."[38]

Not only did more and more German chemists regard their science as a fundamental part of natural philosophy, but they also came to believe in its *general* usefulness. In recognition of its many uses, both real and potential, they divided chemistry into various branches. One of the first to do so was Teichmeyer who, in his chemistry text of 1729, partitioned the field into "physical chemistry" (concerned with understanding nature), "medical chemistry" (concerned with therapy and drugs), "metallurgical chemistry" (concerned with assaying), "transmutational chemistry" (concerned with transmuting metals), "mechanical chemistry" (concerned with crafts

35. Translator's preface to G. E. Stahl, *Zymotechnia Fundamentalis* . . . (Frankfurt and Leipzig, 1734). The translator gave Stahl credit for bringing chemists to adopt this new attitude toward chemistry.

36. F. Hoffmann, *Opuscula Pathologico-Practica* . . . (Venice, 1739), p. 275, and H. F. Teichmeyer, *Elementa Philosophiae Naturalis Experimentalis* . . . , 3rd ed. (Jena, 1733), preface to first ed. (1716).

37. Quoted in Partington, *op. cit., 2,* 665.

38. Juncker, *op. cit.,* p. 10.

such as glass-making, dyeing, printing, and salt-making), and "economical chemistry" (concerned with agriculture).[39]

During the first half of the eighteenth century, therefore, most German chemists came to regard their discipline as an experimental science which was both fundamental and generally useful. They disseminated this view primarily as teachers and as text-writers. Though their courses and texts were oriented toward pharmaceutical chemistry, they often opened with general observations about the science's great potential. Some students most likely embraced these general notions about chemistry, passing them on to others after leaving the universities. Even before 1750, therefore, the chemists must have made some headway in their campaign to replace the prevailing image of chemistry as a menial, alchemical, and pharmaceutical subject with their image of it as a fundamental and useful experimental science.[40] However, it was after 1750, as educated and powerful Germans embraced new values and aspirations, that the science's prestige really climbed.

2. 1750–1790

During the 1750's and 1760's, the Enlightenment triumphed in Germany. This triumph had long been in the making. Early in the century many Germans had been persuaded by the Pietists

39. H. F. Teichmeyer, *Institutiones Chemiae Dogmaticae et Experimentalis . . .* (Jena, 1729), p. 4.

40. Indeed, in 1746 the Berlin chemist J. H. Pott wrote that "rational chemistry and its further investigation presently awakens such general approval from most of the learned and reasonable men within not only the cultured nations but probably also the barbaric peoples that they always receive its experiments and endeavors with gratitude." See his *Chymische Untersuchungen welche fürnehmlich von der Lithogeognosia oder Erkäntniss und Bearbeitung der gemeinen einfacheren Steine und Erden ingleichen von Feuer und Licht handeln* (Potsdam, 1746), preface. So far as I know, this is the first time that a member of the Stahlian school spoke favorably of the educated public's opinion toward chemistry. Pott was not without reason for this high appraisal, since patronage for his work had been increasing steadily since the 1720's. Nevertheless, I believe Pott's appraisal was too optimistic. For instance, in 1755 J. C. Zimmermann, a chemist-physician in Schneeberg, wrote that "very few people know what chemistry actually is. In general either they equate chemistry and alchemy, calling the chemist an alchemist, gold-cook, or swindler, or they assume that chemistry deals only with smelting and assaying, only with the mineral and not the vegetable and animal realms." See his *Allgemeine Grundsätze der Theoretisch-Practischen Chemie . . .* (Dresden, 1755), p. 2.

and the "moral weeklies" to abandon traditional otherworldly Christianity with its pessimistic acceptance of the evil *status quo*. They were to seek, instead, the improvement of private and public morality by living as productive and socially useful Christians. Somewhat later many Germans were won to the gospel of rationalism by C. Wolff and his disciples. In the 1740's these two currents coalesced into a single movement dedicated to achieving social betterment through economic growth, medical progress, educational reform, and the advance of knowledge. During the 1750's and 1760's, thanks to state encouragement and, after the Seven Years' War (1756–1763), unprecedented prosperity, this popular Enlightenment gained the allegiance of most educated Germans.

Meanwhile, the ideal of "enlightened" despotism was gaining the allegiance of ruling elites in Germany. Rulers and their close advisors had long been striving to consolidate and strengthen state power. Prussia's Frederick II and Empress Maria Theresa, both of whom came to the throne in 1740, were among the first to recognize that the growing commitment of educated Germans to the Enlightenment could be used to this end. Thus, though the ultimate goal of these rulers and a growing number of emulators was usually greater power rather than social meliorism, they too began to promote material and intellectual progress. At first they proceeded at a leisurely pace. But after the Seven Years' War, with its legacy of immense debts and uneasy peace, ruling groups approached the task of creating "enlightened" despotisms with urgency and dedication.

Thus, enthusiasm for material and intellectual progress came to the fore in the 1750's and 1760's. This enthusiasm—it remained important through the 1770's and 1780's—created a favorable climate of opinion for all the natural sciences. Enlightened men looked to these sciences to promote economic growth by increasing the efficiency of existing productive activities and suggesting new ones. Moreover, they counted on the natural sciences to improve medicine. Last, and probably least, they saw the natural sciences as an important source of profound and exciting insights about the world.

Chemistry was one of the natural sciences which attracted the attention of enlightened men. Physicians, because of their contact with the subject as students, were among the first to broadcast its

virtues. In 1752, for instance, F. Börner introduced a biography of the chemist J. H. Pott with the following remarks:

> . . . it cannot be denied that there has never been a lack of persons who conduct themselves as the declared and sworn enemies of chemistry and its admirers and who have banned it as completely useless or unnecessary from the republic of letters. On the other hand, there has never been a lack of men who, as experienced judges of useful knowledge, have counted it among the sciences which are indispensable for a true doctor and perform the most beneficial services for people of nearly all ranks. For it is chemistry alone which unlocks the secrets of nature and leads us to the very heart of things, discovering the most wonderful contrivances which otherwise would be eternally hidden from us . . . ; it contributes much to the commonweal; it delights, entertains, and benefits; it is indispensable.[41]

Though this paean indicates that many people still entertained serious doubts about chemistry, it also suggests that esteem for the subject was beginning to climb.

Nine years later, the chemist J. G. Lehmann introduced a collection of A. S. Marggraf's treatises with a preface which further illuminates public attitudes toward chemistry. He opened by remarking that

> There has probably never been a century richer in chemical authors than the present and it goes with chemistry as with medicine, *Fingunt se Chymicos omnes.* The state official, the financier, the barber and surgeon, the brewer and distiller, the dyer, the tanner, the old woman, the charcoal-carrier and woodcutter, and, yes, the project-maker (oh, what a deplorable name), all are clever enough to count themselves among the chemists. Thousands, who have been ruined by such people, are the sad witnesses to this fact.

He went on to insist that Marggraf had nothing in common with such frauds, warning alchemists that they would find nothing of interest in the book. Then, he condescendingly furnished those "narrow" men who were only interested in chemistry's practical applications with some ideas for using Marggraf's results. Finally, he declared his pride in being a midwife for "such a useful and impor-

41. F. Börner, *Nachrichten von den vornehmsten Lebensumständen und Schriften jeztlebender berühmter Aerzte und Naturforscher in und um Deutschland* (Wolfenbüttel, 1752), *2,* 485-487.

tant work," one that he believed needed no recommendation for true scholars.[42] While Lehmann's preface reveals that chemistry still retained something of its old reputation as a risky subject, it also indicates that the science had numerous followers. Moreover, both his haughty treatment of the cameralists—an important group of allies—and his confidence in the general scholar's interest suggest a new self-assurance on the part of chemists.

Lehmann and his fellow chemists had good reason to be more confident than their predecessors. Not only were physicians like Börner portraying chemistry as an important subject, but so were influential proponents of economic development. In 1763 the cameralist D. G. Schreber gave chemistry a prominent place in an article recommending the establishment of scientific-technical schools for prospective administrators. He thought such schools should have five professors, one of whom would be responsible for mineralogy and chemistry. This man would teach

> *physical chemistry* in its entirety, demonstrating the requisite experiments in the laboratory;
> *economic chemistry,* which rests on the former, explaining the theory and practice of its various parts, namely, dyeing, salt and saltpeter works, glass making, lime and brick firing, ceramics, porcelain making, economic metallurgy (steel making, gold and silver work, wire making);
> *mining science,* namely mining metallurgy, smelting, assaying, etc., by exhibiting the necessary models of ovens, etc. in the model collection.

In addition to his teaching, this professor would manage any of the school's factories which depended upon chemical operations

42. J. C. Lehmann, foreword (dated 25 March 1761) to A. S. Marggraf, *Chymische Schriften,* 2nd edition (Berlin, 1768), *1.* "Fingunt se medicos omnes" was apparently an old saying; see J. B. Mencke, *op. cit.,* pp. 37-38, 168. According to the *Deutsches Theatrum Chemicum . . . ,* ed. F. Roth-Scholtz (Nuremberg, 1730), *2,* 290, the following verse appeared in a work by Pantaleon of 1676:

> Es will fast jedermann ein Alchimiste heissen,
> Ein grober Idiot, der Junge mit dem Greissen,
> Ein Scherer, altes Weib, ein kurzweiliger Rath,
> Der kahl-geschorne Münch, der Priester und Soldat.

and would investigate the uses of local earths, stones, and minerals.[43]

Again, in 1776 J. G. Krünitz defined *"Chemie"* in his highly successful *Oeconomische Encyclopädie* as "that science which has as its subject the study of the nature and properties of all substances by decomposing and combining them. . . . Chemistry not only acquaints us with the nature and properties of substances, but also teaches us the correct handling of substances in order to make them useful in the world." He then went on to discuss its wide range of applications in agriculture and the crafts.[44]

Two years later the *Bergmännisches Wörterbuch* defined *"Chymie"* as "a science which investigates, purifies, transforms, decomposes, combines, and determines the natural character and effect of natural substances and makes these useful to various sciences and crafts." Significantly, it was only after giving this general definition that the article mentioned assaying and smelting, the two branches of chemistry most relevant to the intended reader.[45]

Even men whose interests were quite distant from chemistry were beginning to have favorable things to say about the subject. In 1768 the orientalist J. D. Michaelis described natural history, chemistry, and physics as the three main branches of natural science. He believed that the well-born student should give special attention to each of these subjects. Without chemistry, Michaelis claimed, one could not go far in the study of nature, especially the mineral realm. Moreover, this science was essential for mining and smelting, dyeing, minting, and other things which a man of quality should understand. Finally, nothing prevented infection from the alchemical disease better than a sound knowledge of chemistry.[46]

In 1774 the poet Klopstock also mentioned chemistry. At the beginning of his *Die deutsche Gelehrtenrepublik,* in which he

43. D. G. Schreber, "Entwurf von einer zum Nutzen eines Staats zu errichtenden Akademie der ökonomischen Wissenschaften," in his *Sammlung verschiedener Schriften, welche in die ökonomischen, policey- und cameral-auch andere Wissenschaften einschlagen* (Halle, 1763), *10,* 417-436. For evidence of Schreber's influence, see W. Stieda, "Das Projekt zur Errichtung einer 'Kameral-Hohenschule' in München im Jahre 1777," *Forschungen zur Geschichte Bayerns, 16* (1908), 91-93.

44. J. G. Krünitz, *Oeconomische Encyclopädie* . . . (Berlin, 1776), *8,* 53.

45. *Bergmännisches Wörterbuch* . . . (Chemnitz, 1778), p. 123.

46. J. D. Michaelis, *Raisonnement über die protestantischen Universitäten in Deutschland* (Frankfurt and Leipzig, 1768), *1,* 243,

sought to dramatize the need for a genuine national culture, Klopstock divided his Republic's inhabitants into various orders. Creative thinkers and scholars constituted the ruling order, which was made up of eleven guilds. The "great and venerable guild" of the natural scientists included the chemists. Klopstock commented, however, that the chemists could just as well have had their own guild, for in contrast to the natural scientists who merely described nature, they acted upon it through synthesis and analysis.[47]

Four years later the poet Wieland drafted a reform proposal for ailing Erfurt University. From this proposal, it is clear that Wieland regarded chemistry as a natural science which could only be taught in a laboratory by a man with special expertise. It, along with the other natural sciences, was indispensable to the physician. However, because it and natural history were also of interest and importance to "philosophers, cameralists, and many other scholars," they should be taught every year.[48]

That Michaelis, Klopstock, and Wieland, men whose central interests were so far from chemistry, should have held such favorable attitudes about the science testifies to its attainment of respectability by the 1770's. Since the 1740's the subject had changed in the eyes of educated and influential Germans from a menial and possibly dubious source of drugs to a useful and fundamental science. During this same period, such men had come to prize those activities which promoted material and intellectual progress. The combined result of these two developments was a tremendous improvement in chemistry's prestige by the 1770's. Indeed, during this and the next decade, the prevailing image of chemistry harmonized so closely with prevailing values and aspirations that the discipline came to enjoy the status of a *Lieblingswissenschaft*.[49] It appealed to "the friends of natural science, medicine, economy, and manufacturing,"[50]

47. F. G. Klopstock, *Die deutsche Gelehrtenrepublik* (Hamburg, 1774), p. 15.

48. W. Stieda, "Erfurter Universitätsreformpläne im 18. Jahrhundert," Akademie gemeinnütziger Wissenschaften zu Erfurt: *Sonderschriften, 5* (1934), 178, 186, 211-212.

49. So far as I know, chemistry was not called a "favorite science" before the 1790's. In that decade, however, there were many in the younger generation who believed it did not merit such esteem. See below.

50. This phrase is from the title of Crell's chemical journal—*Chemisches Journal für die Freunde der Naturlehre, Arzneygelahrtheit, Haushaltungskunst und Manufakturen* (1778-1781). After publishing a quarterly with a quite different title from

to not only doctors but also "scientists, metallurgists, cameralists, and economics and finance officials,"[51] and in Berlin to "persons of all orders [including] distinguished persons of the fair sex."[52]

The developments that enabled chemistry to become a *Lieblingswissenschaft* between 1750 and 1790 underlay the growth and diversification of patronage for the science during the period. As the chemists' image of their subject spread, justifications for patronizing chemistry broadened beyond its relevance to pharmacy. And as the deepening commitment to material progress led to the founding, expansion, and reorganization of medical schools and, after the Seven Years' War, mining and administrative schools, institutional opportunities for patronizing chemistry became more numerous and diverse. Other developments, to be sure, also played a role in the growth of patronage. For instance, the sustained prosperity after the Seven Years' War and, in Catholic lands, the confiscation of Jesuit properties provided ruling elites with new resources. Still, it was their increasingly favorable estimation of the science which led them to devote some of these resources to the support of chemistry teachers and laboratories. Similarly, both the rising competition between and mounting respect for specialized scholarship in German universities redounded to the advantage of chemistry precisely because the science was esteemed for its potential contributions to learning, health, and the economy.

The favorable transformation of chemistry's public image and standing between 1750 and 1790 also underlay the growth in the number of chemists during this period. As awareness of the science's relevance to desired goals spread, public spirited men became more desirous of contributing directly to its development. And as the prestige of chemistry and its devotees climbed, men anxious for social recognition must have found participation in the science more attractive. Indeed, pharmacists, who as a group had ready access to laboratories and tended to be both public spirited and, on account

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1781 to 1784, he returned to nearly the same form when shifting to monthly publication in 1784—*Chemische Annalen für die Freunde. . . .* This journal was usually referred to simply as the *Chemische Annalen.*

51. P. L. Wittwer, "Lebensgeschichte Dr. Jac. Reinbold Spielmann, der Arzneygelahrtheit Prof. in Strassburg," *Chemische Annalen, 1* (1784), 563.

52. H*** in Berlin to Crell, *ibid.,* p. 342.

of doctors' snobbism, status conscious, entered chemistry at an unprecedented rate.[53] Similarly, eagerness to contribute to the commonweal, desire for recognition, plus a touch of nationalism led L. Crell to found a periodical for chemistry in the late 1770's and induced numerous others to help him make it one of the first successful discipline-oriented journals in science.

3. THE 1790's

During the last decade of the eighteenth century, the patrons of chemistry—generally men who came to maturity along with the triumph of the Enlightenment—continued to value the science as a useful and enlightening subject. J. C. Fabricius represented their viewpoint when he wrote in 1796 that chemistry "has become a favorite science (*Lieblingswissenschaft*) and also exerts considerable influence on the various productive endeavors of the inhabitants. Therefore, it merits greater support at universities."[54] J. F. Gmelin represented the same viewpoint when he wrote in 1797 that chemistry was

> the favorite science (*Lieblingswissenschaft*) of the great, to whom it promises golden mountains, the rapid restoration of ruined finances as well as ruined health, and who reward its devotees with royal generosity; the mainstay of all medicine which underlies all that happens in living man, healthy as well as sick, including the effects of drugs; the refuge of the wise who seek light and instruction; the most important auxiliary science of the naturalist, which gives him information where other disciplines desert him; the key to many secrets of nature; the chosen guiding star in the labyrinth of countless trades which nourish, bless, and enrich peoples and states; and the rational basis of smelting, metal working, the arts, and the crafts. . . .[55]

And so did Goethe when that same year he wrote Duke Carl August of Weimar urging him to employ the young chemist A. N. Scherer. Goethe began by informing the Duke of his conviction that "You

53. Of the twenty-nine men to "qualify" as chemists between 1770 and 1790, thirteen were apothecaries or assistants of apothecaries.

54. J. C. Fabricius, *Ueber Academien, insonderheit in Dännemark* (Copenhagen, 1796), p. 105.

55. Gmelin, *op. cit., 1,* 2.

will reap much that is useful and enjoyable from this acquisition [Scherer]." He concluded by telling the Duke that both he and A. v. Humboldt were convinced that "Your Highness can expect much good for Yourself and Your District and also perform another service for science with this acquisition."[56]

Valuing chemistry, the Duke and other potential patrons continued to establish salaried positions for chemistry during the 1790's. Indeed, they did so at a more rapid rate than ever before. This fact suggests that the concomitant decline in laboratory construction was not the result of ambivalence toward chemistry. Rather, this decline must have been due to a relative shortage of funds in the troubled decade of the French Revolution.

By contrast, it seems that the decline in the number of new chemists in the 1780's and 1790's did reflect a new ambivalence toward chemistry among its potential participants. The generation coming to maturity in this period was swept up by the Romantic and Idealist movements.[57] Those in step with these movements found the Enlightenment approach to the world unappealing, even repulsive. Many, for instance, rejected the prevailing utilitarianism, the idea of voluntarily engaging in "useful" activities, the desire to be "useful acquisitions." Wilhelm von Humboldt, Alexander's elder brother, put it succinctly when he wrote his fiancée in 1790, shortly before resigning his government post, that "the idea of usefulness is a conceit (*Eitelkeit*)."[58] Such hostility to utilitarianism must have reduced this generation's respect for chemistry since, as we have seen, material utility was the most prominent feature of the science's popular image.

Chemistry's reputation as an independent science which, because

56. *Briefwechsel des Herzogs-Grossherzogs Carl August mit Goethe,* ed. H. Wahl (Berlin, 1915-1918), *1,* 215-218. Scherer received a stipend for travel to Britain. Upon his return, he was made a Mining Councilor and charged with giving public lectures on chemistry in Weimar.

57. For an illuminating discussion of the high Enlightenment and the subsequent rebellion against this worldview, see H. Brunschwig, *La crise de l'état prussien à la fin du xviii^e siècle et la genèse de la mentalité romantique* (Paris, 1947).

58. Quoted in R. E. Goldsmith, "The Early Development of Wilhelm von Humboldt," *The Germanic Review, 42* (1967), 45. A. N. Scherer displayed a similar hostility to utilitarianism in his praise for Gren's text as a work which properly subordinated "all mercantilistic aims." See his "Friedrich Albrecht Carl Gren," *Allgemeines Journal der Chemie, 2* (1799), 375.

of its analytical approach, yielded fundamental insights about nature also detracted from its appeal to many in the younger generation. They revolted against the notion that any one specialty or approach held the key to nature, embracing instead a holistic approach to the world. At least one of the older generation, the physicist G. C. Lichtenberg, understood and sympathized with this new feeling. He captured it in a fictitious "dream" which he published in 1794. The dream opened with Lichtenberg high above the earth, facing an old man who inspired his devotion and trust. He gave Lichtenberg a small mineral sphere, asked him to determine its nature in a nearby laboratory, and disappeared. Lichtenberg inspected the mineral, wiped it off, tested its electrical and magnetic properties, and determined its hardness and specific weight. Then he analyzed it, finding argillaceous earth, calcareous earth, silicious earth, iron, salt, and one unknown substance. He knew he had been very accurate in his analysis, for when he tallied up the components they came out exactly to a hundred. Just as he finished, the old man reappeared, studied the results with a smile, then informed Lichtenberg that the mineral sphere was really the Earth. Astounded, Lichtenberg asked what had happened to the ocean and learned that he had wiped it off. The man went on to tell Lichtenberg what his various tests had done to the Earth, then gave him a bag, told him to test its contents chemically, and again vanished. Thinking that the bag might contain the sun or a planet, Lichtenberg resolved to proceed more carefully this time. But when he opened the bag, he found only an old book in an incomprehensible script. All he could read was the title page: "Test this chemically my son and tell me what you find." Lichtenberg wondered how he could test the meaning of a book by chemical means. A chemical analysis would only reveal rags and printers ink. Suddenly, the light dawned on him. He shouted out, "I understand, I understand, Immortal Being; oh forgive, forgive me; I accept your good reproof!" Then he awoke.[59]

Such dissatisfaction with the Enlightenment's approach to nature

59. G. C. Lichtenberg, *Vermischte Schriften,* 2nd ed. (Göttingen, 1844-1853), *6,* 48-60. A. Schneider has shown that elements of the "dream" can be traced back to 1774 in Lichtenberg's notebooks; see his *G. C. Lichtenberg, Precurseur du Romantisme* (Nancy, 1954), *2,* 233-234.

greatly reduced the appeal of devoting oneself to a single discipline such as chemistry. Many of those who did get involved in chemistry did so only in order to be able to develop an integrated picture of nature. Some, such as A. v. Humboldt, proceeded cautiously with this enterprise, trying to weave the results of eighteenth-century specialization into a coherent whole. Others, F. Schelling for example, plunged impetuously into the task, creating a whole new *Naturphilosophie*. Hence, as the Enlightenment waned in Germany during the 1790's so did the enthusiasm of many young Germans for chemistry.

To recapitulate, I have suggested that social support for chemistry was low in early eighteenth-century Germany because its popular image as a menial, alchemical, and pharmaceutical subject was at odds with prevailing values. Only the physicians, who could distinguish it from alchemy and appreciate its empirical approach and pharmaceutical applications, esteemed chemistry. From the 1720's, they managed to secure the establishment of a growing number of salaried chemical positions in medical schools. Meanwhile, led by G. E. Stahl, the chemists were coming to see their discipline as a fundamental and broadly useful natural science. Soon they were disseminating this image of chemistry in classrooms and textbooks from their bases in the medical schools. From the 1750's, due to the spread of this new image *and* to the increasing importance attached to material and intellectual progress, social support for chemistry expanded on all fronts. During the 1770's and 1780's, when the Enlightenment and "enlightened" despotism were at their peak, patronage of and participation in this useful and fundamental science improved dramatically. In the last decade of the century, chemistry's patrons—men of the Enlightenment—continued to value and support the science much as before. By contrast, some potential participants—young men who rejected the Enlightenment—found chemistry unappealingly utilitarian, narrow, and analytical. Nevertheless, because there were others who did not go so far in rejecting the values and aspirations of the past, the turn of the century found the level of social support—participation as well as patronage—for chemistry in Germany far above its low starting point in the early eighteenth century.