collaboration with Joseph Needham, published the results of laboratory studies of a sixth-century A.D. Chinese recipe for the solubilization of cinnabar[1] and of a fourth-century A.D. Chinese recipe for the production of mosaic gold, tin (IV) sulfide.[2] The latter study led to the probable identification of the Chinese term *han yan* or "cold salt" as ammonium chloride and to the verification of a method of preparation for tin (IV) sulfide quite different from that found in Western chemical literature.

Even earlier, Truman Schwartz and George B. Kauffman reported modernized laboratory versions (suitable for freshman chemistry, no less!) of some common alchemical preparations, as well as several based on the recipes of so-called "hyperchemists" of the late-nineteenth century.[3] I'm sure that the number of examples of similar investigations could be increased substantially.

As closet historians, we are frequently viewed with a mixture of suspicion and pity by our chemical colleagues—as wayward beings who have deserted the sacred stinks and odors of the laboratory for the dust of the library. Perhaps this small, but growing, body of experimental work in the history of chemistry may be our salvation—though I suspect that most of us are rather unrepentant sinners. In any case, I am sure that it forms the nucleus of a potentially fascinating symposium at some future national meeting, and that it awaits only the coming of a qualified and enthusiastic organizer.

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References

1. A. R. Butler, C. Glidewell, and J. Needham, *Journal of Chemical Research*, S (1980), 47; ibid., M (1980), 817–832.

2. A. R. Butler, C. Glidewell, J. Needham, and S. Pritchard, *Chemistry in Britain*, 19 (1983), 132–135.

3. A. T. Schwartz and G. B. Kauffman, *Journal of Chemical Education*, 53 (1976), 136–138, 235–239.

DEXTER AWARD ADDRESS

SOME OBSERVATIONS ON THE HISTORY OF CHEMISTRY

I

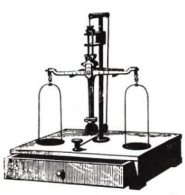
In the 1925 volume of *Isis*, George Sarton asked if any of his readers could identify one Giovanni Fontana, whose unpublished Renaissance treatise on military instruments ("Bellicorum instrumentorum") had been described in S. J. von Romocki's *Geschichte der Explosivstoffe* (1895). Sarton's request was published as a "query," this being a feature of *Isis* in those days, and was answered four years later by the redoubtable Lynn Thorndike, then a professor of medieval history at Western Reserve. Since 1927 Thorndike had been sweeping like an intellectual vacuum cleaner through old European libraries, and now reported on the Vatican Library, which contained a manuscript of another treatise by Fontana, "On the Nature of Things." The next summer Thorndike turned up still another work of Fontana's in the Bodleian Library at Oxford, and in 1931 he published an article on a printed book that he had found in both the British Museum and the Bibliotheque Nationale, and which he suspected, because of the author's autobiographical remarks, was written not by "Azatus" (the otherwise unknown name appearing on the title page), but by Giovanni Fontana.

This flurry of activity from the provinces finally roused one of the patriarchs of Old World scholarship, Alexander Birkenmajer of Cracow, to send *Isis* an article (1931) pointing out that Giovanni Fontana had been anything but unknown when Sarton had encountered him. Birkenmajer went on to cite a succession of literary references beginning in 1418, when Fontana was in his twenties. But the provincials were no longer so easily cowed, and in 1934 Thorndike treated Fontana at even greater length in the fourth volume of his *History of Magic and Experimental Science*.

What does this have to do with the history of chemistry? Well, Fontana, like so many in his time, wrote on just about everything, including alchemy. But he has never been a household name, even among alchemists. I've related this episode to epitomize a watershed in the history of science, and in the history of chemistry in particular. It marks the beginning of the end of the period when the history of science was in the main a by-product, an avocation, a hobby—and the beginning of its "professionalization."

II

In the United States the appearance of an avocational interest in the history of science more or less coincided with the foundation of the American Chemical Society. And the ACS originated in an atmosphere of enthusiasm for history that is now difficult to realize. Recall the famous photograph of a table piled high with the relics, mostly glassware, of Joseph Priestley. There were not a few collectors of old chemical books among the early leaders of the ACS, and some (like Edgar Fahs Smith) actually did research in what was quaintly called "old chemistry." That this was not an aberration peculiar to chemists is indicated by an almost exactly contemporary event, the foundation of the Johns Hopkins University in 1876. The famous "big four" (H. A. Kelly and the three Williams—Halsted, Osler, and Welch) who headed the hospital that was so important a part of that institution were all book collectors. They too found history—the history of medicine—a fascinating avocation, and that fascination bore fruit in the early 1930s, when Welch promoted the foundation of an Institute for the History of Medicine at Hopkins, to which Adolf Hitler contributed virtually the entire staff of the preeminent institu-



Analytical balances from the 1877 catalogue of the firm of J. J. Griffin & Sons, London. The collection, preservation, and exhibition of historically interesting analytical balances was discussed by W. J. Blaedel at the HIST symposium on the "History and Preservation of Chemical Instrumentation" at Chicago.

tion for the history of medicine at Leipzig. The chemical library founded by Smith has so far had less impact (although its recent incorporation into a Center for History of Chemistry suggests that we should continue to withhold judgment), but the patriarchs of the ACS made their convictions felt in another way, in the extraordinary historical bias of their *Journal of Chemical Education* (1924).

The enthusiasm of these American scientists for history was very probably a reflection of a fashion in Europe, where most of them had been trained. Although there may have been some earlier "proto-histories," the enterprise that we call "science" seems first to have become substantial enough to be worth celebrating at the end of the eighteenth century. J. F. Gmelin's *Geschichte der Chemie* appeared in 1797–99 in three massive volumes, a remarkable bulk considering the state of the science—but hardly to be compared with physics, which got nine volumes in the same collection of histories of which Gmelin's was a part.

Thereafter, a half-century of further "progress" was followed by another outburst of historical publication, which included a history of chemistry by the celebrated Hermann Kopp of Heidelberg. Enthusiasm for the history of science was general in late-nineteenth century Europe, but Germany led, as she also did in most of the sciences, and especially in chemistry, the most spectacularly successful science of the time. Kopp, like most others who then wrote on the history of science, was not only a professional scientist, but also an acknowledged master of his science. The idea that the history of science could be written by a "layman" was hardly thought of, even by the professional historians, who were not inclined to waste time on minor activities such as science.

III

Returning to the time of Sarton, Thorndike, and the "professionalization" of the history of science, we find our pioneers of professionalization in something less than full agreement. Sarton seems to have regarded the history of science as a branch of science, which he defined as "organized positive knowledge." He also appeared to believe that its application to the solution of virtually all problems —of which there were plenty in the 1930s—waited only the key, the understanding of science through its history. But despite his tireless advocacy, and the compatibility of his extreme positivism with the conventional attitude of scientists, Sarton seems to have talked to an audience mostly deaf. And why not? His personal research (exemplified by his giant bibliography, *An Introduction to the History of Science*) was pretty remote, and his shrill denunciation of the amateurish efforts of the scientist-historians (not least the chemists who wrote about alchemy, that "wretched subject," as he called it) can't have been very helpful.

Thorndike, unlike Sarton a professional historian, does not appear to have thought that the scientist could be trusted with history. A reader of his history might be justified in thinking that he would have defined science as disorganized negative superstition. The book might have remained little known were it not for its title, and had it not gone on and on for nearly thirty years and eight great volumes, a recurring contradiction of the image preferred by the scientists.

One wonders what the chemists made of this. Indeed, the average chemist could reasonably have thought that he had more important things to think about, for his exploits in dye synthesis, nitrogen fixation, and the like had finally forced people to pay attention to him. The chemists had become "relevant." Indeed, they came increasingly to be seen as universal problem-solvers, a position they still occupy, if not entirely comfortably. Chemists also became more numerous, and as their numbers increased they found themselves willy-nilly members of an occupational group. In the fateful decade of the 1930s they encountered the problems of such groups, and the scientific society was forced to concern itself with employment—not for the last time.

None of this was conducive to an increased interest in the history of chemistry. And yet when the boom of the 1950s led to a great expansion of higher education, something called "history of science" turned up in the curriculum, sometimes in the midst of philosophy, sometimes in history departments where the professorial troika of ancient, medieval, and modern history was losing control, sometimes even as an independent department of the history of science, but rarely as part of the science curriculum. How could such a thing have happened? Perhaps Sarton's long advocacy had taken effect after all. Perhaps the public fascination with science had generated a degree of interest in where it came from. Perhaps "educators" thought it an appropriate way of inducing in the lay public an appreciation of science: this was clearly the case at Harvard, under the presidency of James Bryant Conant. Whatever the case, the historians of science encountered in the mid-1950s, if not a "boom," at least what in the jargon of the 1980s could be called a "window of opportunity."

But there had scarcely been any historians who were academically certified as such and who practiced the history of science. Neither Sarton nor Thorndike had many graduate students. The former had been able to come up with a position of sorts, for himself and then for a successor, I. Bernard Cohen. More surprising was the appearance of Marshall Clagett, a student of the history of science under Thorndike, for Clagett's attitude toward the subject had hardly more resemblance to that of Thorndike than it did to Sarton's. And then there was Henry Guerlac, whose Harvard education does not appear to have been much influenced by Sarton. It is remarkable that these three, teaching at Harvard, Wisconsin, and Cornell, were to show themselves able to supply creditable candidates for a large number of academic posts, to make a doorway of the window of opportunity, and to establish the history of science as more or less a fixture in the academic environment.

I was myself more of a witness to than a participant in these events. When I finished at Berkeley in 1953, with a fresh degree in medieval history and a distant degree in chemistry, I traveled across the country job-hunting, including visits to Harvard, Cornell, and Wisconsin. This dubious venture in academic self-help ended at Madison, in an interview with Clagett. Although sympathetic, Clagett saw no future in the history of science as a source of employment. He had a number of students, all of whom, he assured me, had been advised that there was no future in the field. And yet they wouldn't go away. "No jobs, no jobs," he kept repeating, even as my interview ended with our walking together to his bus stop. It was a cold, windy March night, as bleak as his message. "No jobs," he repeated, as his bus arrived and my mind drifted off to contemplate how much better the weather is in Berkeley at that time of year. This was two years before it was decided at many of the large universities, including Berkeley, to accept the history of science.

IV

Professionalization was at last achieved, in the most meaningful sense of the term; that is, some people were *paid* to practice the history of science. With it went the apparently inevitable side effect of professionalization, the invention of a terminology unintelligible to the out-

sider. This is unlikely to have strengthened the chemist-historians within the ACS, for it reduced the active, if not the actual, membership. One thinks of Erwin Hiebert, Marie Boas, Robert Siegfried, Charles Gillispie, Robert Schofield, and Martin Levey, all of whom began as chemists—and this at a time when the average professional chemist, busier than ever, seems to have reacted to this "brain drain" much as the pianist Liberace is said to have reacted to criticism of his musicianship.

The history of chemistry flourished within the history of science, thanks to the former chemists just mentioned, who filled many of the positions which opened in the 1950s. Yet the history of science has not become a cornerstone of education, as Sarton (and Conant) had hoped, but another specialty, whose practitioners have tended to emulate Sarton, if in nothing else, in shutting out the amateur, including the chemistry professors who offer a course in the history of the science.

It is now a generation since the acceptance of the history of science by the universities, and its consequent establishment as a "profession." And the chemist-historians have pretty much on their own promoted the establishment of that *sine qua non* of serious history, an institute—the Center for History of Chemistry. I am somewhat embarrassed at the insignificance of my own contribution to the historical effort of this organization over the years. But I was for those years up to my ears in trying to contribute to the success of other organizations not irrelevant to the history of chemistry. We are in two different professions: the chemist-historian is paid to be a chemist, the historian of science to be an historian. Our daily work is different. But altogether we are few, when one considers the potential for research and publication in our field.

And that is the point, which brings me back again to Sarton and Thorndike, but from a different point of view. Whatever their views on theoretical matters, like Kopp and Partington they were prolific contributors to the literature. Let he who has published a multi-volume history, I say (somewhat tardily), cast the first stone! Obviously no one will who decides in advance that multi-volume histories are no longer publishable. But the universities have accepted the history of science and the ACS has established a Center for History of Chemistry, so the ball is surely now in our court.

The History Division of the ACS has been able to organize sessions on abstruse topics, such as modern polymers, that are simply beyond the ken of anyone not still a practicing chemist. Given the editing that multiple-author sessions always require, these could yield publications not only of importance but of particular interest to the general chemical community. It is not so easy to find a corresponding innovation among the historians of science, whose feet perhaps need to be held to the fire, for they are the ones paid to do history. Their most obvious potential contribution would seem to be an improvement of the quality of the literature. Indeed, here is where we could improve on Kopp, Partington, Sarton, and Thorndike, none of whom has ever been charged with excessive readability. What better could we do than write something that people would actually enjoy reading? There is plenty of evidence that there is an audience for that.

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MY FAVORITE CHEMISTS

Names of 123 great chemists (some may be physicists or metallurgists, but their contributions are significant to chemistry) can be found among the letters in this "word search puzzle." The names appear forward, backward, up, down, or diagonally. There are no spaces between names for those whose names have two words.

KEITH BERRY
University of Puget Sound

P I C T E T A L F R E S E N I U S R Y E L E S O M S L E I D L
E R E P M A X W E L L E I N A D R A E M E K C A D D O N E N I
C G N U O Y K S V O R Y E H I D V A N T H O F F N B R I G A E
T T O I L O J O U L E S I W E L E C H A T E L I E R G K N L B
A L E L U K E K N W R S L C O U E B L O K A D W R E F R I E I
D J O S M U L L I K A N G S T A S M Y T T O T I N I L E L W G
K L T D S Q D A E O M Y O Y E N A R G E R S U S C V O P U U A
C C O E N E A P W P S Z R E M S E N Z O T M N K L D R E A E D
I S A G L A H R R P A T B N H Y S B B I G C K R O I Y T P I O
W V W L N L L O E E Y R E U E Y E F P N R E L H E O W I R N L
D A B O B I O T E Q U E D M C H Y D A M O I S S A N F T O S I
A N E Z T L O H M L E H N G A H O L A J B U T L E R O V U T N
H D R O F R E H T U R E O N N T N E R U A L L A U E Y E S E R
C E T W I N B O H R L A V O I S I E R J E N T N A N N E T I O
A R H K S I P H D R E U A B Z L Y T R Y S M S I Y R W L H N B
R W E H C C A C E H A B E R Z E L I U S C H E E L E O E O I C
O A L W H O S E T E R U C E A U A V O G A D R O K W R D M E A
U A O T E L T L S I R N T B R R O D P N A M A I A M B N P B V
T L T U R O E S N S H S L U O E D F A D S L U L C F D E S N E
H S G O N I U I O E E E G A R Y T A P V S A V D T H R M O E N
E S I R O A R U R N N N I L T L L A D N Y T G A D O A A N O D
R E A P E S M S B B I R E G N I D E O R H C S E N N N R S H I
S C U R I E T L Y E U E F G O W M R A O U L T Y R I G E D C S
C A Q A L V N W I R S I G N I L H E F C H A R L E S I B L S H
H L U W U Z B R A G G Y A D A R A F R A N K L A N D R E E S A
I V E E A L E B E L R M R E Y E M A C A S S U L Y A G G B I L
F I N D P G N O L U D D E N M A R S H I T T O R F F A R O E L
F N O N H A H I L D E B R A N D O B E R E I N E R A M A N Z E