BULLETIN FOR THE HISTORY OF CHEMISTRY

Division of the History of Chemistry of the American Chemical Society

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The Verdict of the Balance

BULLETIN FOR THE HISTORY OF CHEMISTRY, NO. 3, 1989

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The Cover...

This issue shows an ad for Ivory Soap which appeared in *Harpers* in 1883. Entitled "The Verdict of the Balance", it claimed that the soap had been analyzed by "eight prominent professors of chemistry of national reputation" and had been found to be uniform and pure. The ad is also indicative of the increasing importance of the role of chemistry in the public mind as a guardian of product purity, an image which the ACS tried to project at the 1893 Chicago World's Fair, as described in this issue by James Bohning.

DEADLINES

The deadline for the next issue (Fall 1989) is 30 July 1989. All materials should be sent to Dr. William B. Jensen, Department of Chemistry, University of Cincinnati, Cincinnati, OH 45221, (513) 556-9308.

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FROM THE EDITOR'S DESK

As can be seen from the staff directory on the opposite page, the executive committee voted in Los Angeles to continue the *Bulletin* and has appointed Dr. James Bohning of Wilkes College as the Assistant Editor. In addition, the members of the current publications committee of the Division, consisting of Dr. J. L. Sturchio of AT&T Bell Laboratories, Dr. L. Fine of Columbia University, and Dr. O. T. Benfey of the Beckman Center, were appointed as the editorial board.

Since the increasing cost of attending national meetings makes it difficult, if not impossible, for the vast majority of the divisional membership to directly participate in symposia, it was felt that a demi-journal like the *Bulletin* was the best way of serving their interests in the history of chemistry. Indeed, the executive committee would like to increase this service by expanding the *Bulletin* to either three 36-page issues/year with a semi-stiff cover or to four 24-page issues/year. This is double the current size and would make it equivalent in print area and frequency to the British journal *Ambix*, which uses a smaller format and currently costs $24.00/year. In order to do this, the committee has voted to increase the membership fee to $10.00/year and the affiliate fee to $12.00/year. This cost would not only cover divisional membership and the subscription to the expanded *Bulletin*, but meeting abstracts as well, and is the absolute minimum necessary to expand this service. We hope you will support us in this move. The proposed increase will be voted on by the general membership at the divisional business meeting in Miami.

We would also like to establish a library subscription rate for the *Bulletin* of $15.00/year. This price difference for the libraries reflects the cost of maintaining a separate mailing and labelling scheme for these subscriptions, as they cannot be incorporated in the ACS labels provided for members and affiliates. Please show your support for the *Bulletin* by requesting that your school or departmental library subscribe (see subscription form inside the back cover). This is important not so much from the financial standpoint as from the standpoint of encouraging authors, as they would quite naturally like to see their efforts preserved in some permanent manner. In this regard, I might also report that articles in the *Bulletin* will now be reviewed for possible inclusion in the *Isis Critical Bibliography*.

William B. Jensen, University of Cincinnati

LETTERS

More Comments on the Bulletin

I've just finished reading my first copy of the *Bulletin* and it's terrific. It's great to have an American journal devoted to the history of chemistry!

Paul M. Lauren, Suffolk County Community College

I have recently received my copy of the second issue of the *Bulletin for the History of Chemistry*, and I wish to congratulate you and everyone involved for producing this excellent journal. The *Bulletin* is not only an attractive and enjoyable publication, but also one that will be very useful.

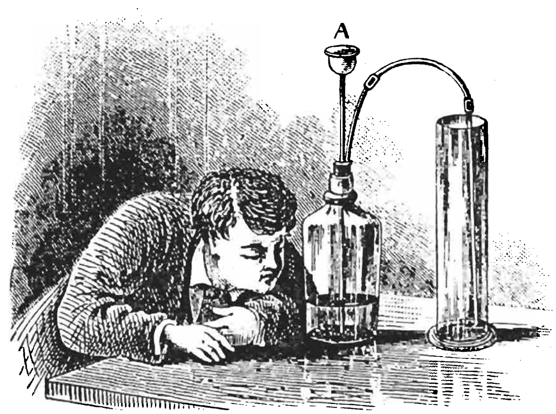
Harry E. Pence, State University College-Oneonta

I very much enjoyed the article in the latest *Bulletin* about "Mystery Editors of Early American Chemistry Texts" by William D. Williams. It is fascinating to see how chemistry has developed throughout American history, and is extremely unfortunate that students in high school history or chemistry courses do not get much exposure to this development.

Karen M. Morris, University of Notre Dame

Yet More on the Grotta del Cane

A recent issue of *Discover* magazine (October 1988, p. 6) contains a short item on yet another example of massive carbon dioxide buildup in a poorly ventilated cave. Located next to the ruins of the Temple of Apollo in Pamukkale, Turkey, it is called the Temple of Doom and was described by the Greek Historian Strabo around the time of Christ. Microbiologist Sheldon Aaronson of the City College of New York has recently unraveled its mystery and discovered that, like the Grotta del Cane, its sinister reputation is also due to the buildup of carbon dioxide, this time escaping from underground streams supersaturated with the gas as a result of having come into contact with carbonate rock at high temperatures.



Preparing carbon dioxide sans safety glasses, circa 1887

THE 1988 DEXTER ADDRESS

Historians and the Chemical Industry

Lutz F. Haber, Bath, England

THE
CHEMICAL INDUSTRY
DURING THE
NINETEENTH CENTURY

A Study of the
Economic Aspect of Applied Chemistry
in Europe and North America

BY
L. F. HABER

OXFORD
AT THE CLARENDON PRESS
1958

A few personal reminiscences will serve to introduce the subject of my lecture. My education did not lead me, half a century later, to the Dexter Award. At school I began with the classics, and later turned to history. While at college, the London School of Economics, I read some economics (now mostly forgotten) and rather more economic history. I noticed that industrial history, naturally British only, was a minor subject and restricted to the mainsprings of the Industrial Revolution: coal, iron and steel, textiles. I did not think that was the complete story.

As the son of a well-known chemist, I was supposed to have "science in my blood", though a geneticist might not believe this. At any rate, my first job was in a lubricating oil refinery! I'll spare you the details of my clerical duties, nowadays performed more quickly by IBM or National Cash machines, but they left me with enough spare time to become familiar with the surroundings. I learned about the equipment and materials - the refinery used acids and alkalis to produce high grade oils. I also did a spell in the laboratory and taught myself some elementary chemistry in the evenings and on weekends. Manchester, where I worked, was not a cheerful place towards the end of the war and so, perhaps for want of something better to do, I began to write a dissertation on *The Growth and Development of the Chemical Industry*. I hoped, as they say, to fill a gap, and I wrote in the Introduction: "... this study is not a chemist's history of chemical technology, but an economic historian's attempt to cut a path through a neglected aspect of industrial history."

As soon as practicable, I went to consult Williams Haynes (1886-1970), without doubt *the* authority on the American chemical industry. This small, dapper man of just over 60, lived in a beautifully restored colonial house near Stonington, Connecticut, and had recently finished two volumes of his six-volume history. It was completed in the early 1950s, and he received the second Dexter Award, in 1957, for his monumental *American Chemical Industry*. Bill, as everyone called him, was immensely knowledgeable, had excellent contacts, and went out of his way to be helpful and encouraging. He was sure I was working along the right lines. There was, as he saw it, nothing mysterious about the phenomenal growth of the industry, which - in his lifetime - had become an important and dynamic part of the American economy. His job was to describe these developments and write history. Haynes was not a scholar, but a publicist and a pioneer in what is nowadays called cross-disciplinary writing; he combined history with industrial chemistry. I followed his advice and persevered with the dissertation. I got my Ph.D. and shall always be grateful for his help then and later.

I resigned from the refinery, which was turning to petrochemicals, and then worked for many years with I.C.I. and rather more briefly with Exxon (in the oil as well as in the chemical branches of the company). My jobs, which were on the planning and marketing side, provided a "feel" for modern chemical manufacture which those who work as teachers or in academia may not have had the good fortune to acquire. Certainly this practical experience of chemical business was of great value in my spare time activities as author and lecturer. The latter eventually, and well past middle age, became a full-time job teaching applied economics in an English "technological university", where cross-disciplinary research was highly regarded.

Despite Haynes' books, my own efforts and those of a small number of academic and business historians, I still think that the history of chemical manufacture is neglected by comparison with that of other industries or of services. To ensure that this was not an unfounded assertion by an out-of-touch retired British university teacher, I turned to the *Journal of Chemical Education* and looked at every number from 1983 to mid-1988. There are, as one would expect, scores of entries in the index under "History", but I found only two articles which had a predominantly industrial content (1). Further search among the 66 issues consulted by me showed that only three publications were reviewed which had an industrial connection, and only one of them had a specifically historical approach (2). I do not claim that this quick literature survey, deliberately restricted to a single publication, though an important one in chemistry education, is necessarily conclusive. But the results are interesting and they reinforce an opinion I have long held - chemistry and history do not make good bedfellows.

Why should that be so? And why should "cross-disciplinary" work, which many people consider extremely valuable, have only such modest achievements to its credit in this area? Historians of industry, economic historians, or indeed any historian interested in science and technology, explain this by their lack of a technical background and their ignorance of chemistry. Chemists, on the other hand, profess ignorance of history and lack of time so that in practice they are restricted to biographical studies or the description of a particular discovery. I have some sympathy for them and can understand their reluctance to tackle a difficult objective. Nevertheless, I do feel they both underrate their capabilities, and the schoolmaster's traditional comment on the unwilling pupil sums up the situation perfectly - "Could do better if he tried harder!".

It is now time to step down from my lofty perch and face up to the nitty-gritty of the situation. Among the many problems confronting the enterprising researcher, whatever his particular educational background, is that industrial history must deal with the proliferation of sectors or sub-sectors, their uneven growth and the varying structural patterns which have emerged in the principal countries. What of it? In these respects industrial chemistry, treated historically, is not so very different from, say, the development of urban transport, joint stock banking, or (in the 20th century only) aircraft engine manufacture. All three have their technical aspects (often very complex), are subject to constraints specific to them, and are characterized by differing evolutionary patterns in different countries.

Recrystallizing alum, circa 1850 (4)

That being so, where does the particular difficulty of dealing with the history of chemical manufacture lie? I should like to suggest that it is, above all, not a straightforward sort of history which fits snugly into an uncomplicated chronology. It is, on the contrary, a topsy-turvy sort of growth, difficult to come to grips with and impossible to reconcile with the historical determinism of Marx and of those who look at the course of events with his eyes. Furthermore, at the national level, the industry's development does not usually accord with that of the country or of one of the regions. In short, it would appear that the growth of chemical manufacture is not directly related to the general environment (economic, social or political), but follows a course dictated by research and development and by the vagaries of a particular market sector. The listing of research achievements and the analysis of patents can yield some valuable insights, but that is not enough. More work needs to be done to explain the interval between discovery and industrial scale production which is puzzling by its variability. And just to complicate matters further it may well be true that some chemicals, or products made by the industry, have that remarkable economic characteristic of supply creating its own demand.

Practicing chemists, on the other hand, may be less handicapped by these difficulties. After all, they will be familiar with failure at an early stage of their work, and also with serendipity which has been the origin of so many important advances. They will not be surprised by the delays between laboratory success and market success. Above all, scientists, academic or industrial, cannot fail to be aware of technological change and its jerky progress. Their problems, as industrial historians, are the result of their training and their working methods: they are not encouraged to pursue subtle associations or to engage in speculative interpretations of an event. They are better at describing *how* things happened than *why* they happened. In an effort to compensate for these weaknesses, historians, like other writers, pile detail on detail. The relevant is overwhelmed by the "nice to know" (as they used to say at Exxon): no stone is left unturned, there is confusion and the author cannot see the wood for trees, while the reader soon becomes bored.

All this does not add much to our understanding of the industry's development. There is also, in my opinion, a surfeit of studies on the 18th and 19th centuries, interesting, but archaic rather than modern. We now have the distance and also much data to examine events from the outbreak of the First World War to the removal of European tariff barriers in the late 1960s. These 50 years or so have witnessed the development of contemporary chemical technology and its proliferation throughout the world. Hence, if we want to understand change and to orientate ourselves, we need a different perspective. In particular, the traditional approach of recording events and of analysis based on the experience of a few firms or of a single country no longer suffices. It leads to a kind of chemical jingoism which, like political jingoism, is usually wrong as to facts and generally misleads. It does so for two reasons: by preventing us from observing what goes on elsewhere, and by its blinkered approach which fails to spot turning points of potentially great significance. An example will illustrate my point: wartime circumstances operated like a forcing house on plastics manufacture and use in Italy and France. German technology and know-how (promoted by I. G. Farben) were introduced and adapted to replace materials no longer available. After 1945, the wartime stimulus, often pretty crude, continued, but gradually became more sophisticated. In continental Europe it influenced production and foreign trade in the late 1940s and during the 1950s to a much greater extent than was the case in Britain. The study of a single country or of one firm would therefore not shed light on the experience of others and would fail to identify factors making, on the one hand, for growth and, on the other, for retardation. Naturally, if the change can be quantified and statistics produced to show the scale, so much the better. But quantitative industrial history can lead to the building of econometric models based on a weak foundation of unreliable and incomplete data. Far better in that case to make a qualitative judgement and interpret change descriptively. In the process much detail will be lost. But that is acceptable, provided a general comparison is attempted and, with hindsight as well as judgement, the principal turning points are identified.

Although there is no perfect method of writing history, a good approach would be one which combines technical change with economic and social developments. For practical reasons the time span should be restricted and the product range limited (though plastics, fibres and agricultural chemicals must be included). But I would not confine the story to a single country - on the contrary I would aim to cover the world. Descriptions will be supplemented by analysis and, at all times, comparisons play an essential role. Some of the work calls for cross-disciplinary expertise, some for the careful collation of available trade and production statistics. The project will fail unless the authors (the plural is deliberate!) ask the right questions and ruthlessly cut irrelevancies. In short, we have here the job description of a major enterprise. Is it worth the considerable effort in terms of resources, thought and time?

I am sorry to have to ask this question at all; I am convinced that it is worthwhile, but nowadays individual endeavor will not succeed without the material blessing of those in charge of money. I managed without funding and in my own time (except for a month's special leave), but that is no longer possible, and scholarly initiative has to be justified by future benefits.

It is, I know, a platitude, but one that needs to be repeated - anything which helps people better to understand change is worthwhile. Where ignorance prevails, there misconceptions flourish and remain uncorrected. This is not controversial stuff. But my next argument may be; a history which compares, even if the comparison is incomplete and only partly numerical, is useful because it enables people to relate developments in one sector or one country with another sector or country during a given period of time. And that may lead to action. Although history does not invariably have lessons for the future, there have been occasions in my experience where it has helped to change attitudes. For example, almost 30 years ago when I was at I.C.I., I read an investigation of the growth of new products (notably fibres and plastics) which compared them with the company's traditional products - alkalis, other inorganic chemicals, dyestuffs and explosives. The former had been held back by cautious investment policies, a tendency to go for small unit sizes and inadequate technical sales service. By contrast the latter had benefitted, perversely, from the inertia that afflicts many large enterprises. The case was presented so convincingly that the report contributed within less than ten years to the implementation of major policy changes. This shows that past failures or missed opportunities can serve as signposts to alternative developments.

An argument applicable to a company or even a sector of the chemical industry cannot simply be extrapolated to the situation of the entire industry at national level. It has and continues to be done by journalists and brokers' analysts more often than by serious historians. There are, however, good reasons for dealing with industrial history on a national, indeed international, scale. One is the benefit to administrators, the other the needs of educationists and of those they teach.

The advice given to legislators (who are politicians and therefore partisan and superficial) is often incomplete and wrong, and affords every scope for argument and special pleading. But at the end of the day, the laws and regulations, once made, have to be implemented. The officials do their best, but their knowledge of the industries with which they deal is often minimal. Anyone who has looked at tariff history in Britain in the 1930s and 1940s cannot fail to have noticed that the "national interest" so often referred to in public was, in fact, the particular interest of producers which rarely coincided with that of their customers or the public at large. The manufacturers prevailed because those who administered the legislation did not know enough about the industry. Do they now?

And then there are the teachers and their students - if only the former would get away from the "Great Chemists" and their deeds to the development of the chemical industry, the latter might be rather better informed about their future employers. Cross-disciplinary means spanning the gap between the disciplines of chemistry and history. It does not mean the odd lecture on the founding fathers. Nor does it mean (as far as historians are concerned) a short course on "major industries" which ends abruptly in 1914, given by lecturers who would not recognize technical change if they saw it. It is in their educational role that historians have failed most signally to convey the significance of change in the modern chemical industry. What is the evidence that a more realistic message is getting across to students?

I have spiced my talk with personal reminiscences, general criticism and well-meant advice which will be difficult to implement. But I feel strongly about the neglect of industrial history and would like to see more of it along the lines I have suggested. *The Chemical Industry* books have caused me a lot of work, but they have also given me much personal satisfaction. Rather late in the day I have come to recognize that they could have been done better. Last, but not least, the books have led, quite unexpectedly, to the Dexter Award which gives me very great pleasure.

Dr. Sydney Milton Edelstein, the founder and head of the Dexter Chemical Corporation, has sponsored the award since the 1950s (3). I am proud to have been the recipient for 1988, and I take this opportunity of thanking him through the History of Chemistry Division of the ACS. I hope that in the future, others will be honored for work leading to a better understanding of those two great disciplines - history and chemistry.

References and Notes

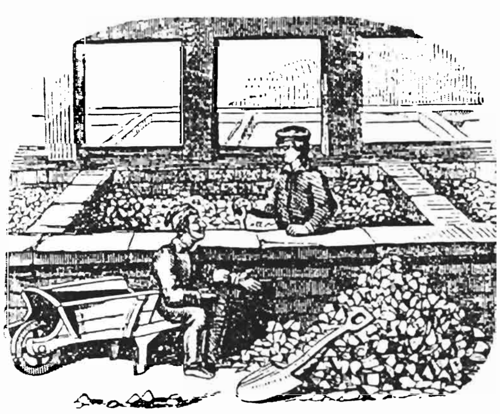
1. H. Witcoff, "Unleaded Gasoline: Its Impact on the Chemical Industry", *J. Chem. Educ.*, **1987**, *64*, 773-76.

2. R. S. Seymour and Tai Cheng (Eds.), *History of Polyolefins: The World's Most Widely Used Polymers*, D. Reidel, 1985, referred to in *J. Chem. Educ.*, **1986**, *63*, 181.

3. A. Ihde, "The History of the Dexter Award. Part I", *Bull. Hist. Chem.*, **1988**, *1*, 13-14 and *Dexter Chemical Corporation: A Company Documentary*, n.d.

4. Anon., *Encyclopedia of Chemistry*, Vol. 1, Lippincott, Philadephia, 1877, p. 168.

Lutz F. Haber, winner of the 1988 Dexter Award, is a retired Reader in Economics at the University of Surrey at Guildford. He lives in Bath and is currently working on a study of the Emperor Haile Selassie's exile in Bath in the late 1930s.



Alum manufacture, circa 1850 (4)

BOOKS OF THE CHEMICAL REVOLUTION

Part I: Méthode de Nomenclature Chimique

Ben B. Chastain, Samford University

Though we celebrate 1989 as its bicentennial, the chemical revolution was actually a complicated process which extended over many years. In this new series, Dr. Chastain provides the modern chemist and teacher with an introduction to some of the key books of the revolution.

In the spring and summer of 1787 a group of statesmen met in Philadelphia and, after much discussion and compromise, produced a document which, despite some early opposition and a continuing series of minor modifications, has become the foundation upon which this nation has been built. We celebrated, and continue to celebrate, the bicentennial of our Constitution's creation (1787), ratification (1788), and implementation (1789).

In Paris, that same spring and summer of 1787, another series of meetings took place which, after discussion and compromise, produced a document - a document which, despite some early opposition and a continuing series of minor modifications, has become one of the foundations upon which our science is built. Its title page reads: *Method of Chemical Nomenclature, proposed by Messrs. de Morveau, Lavoisier, Berthollet, and de Fourcroy; together with a new system of chemical characters [symbols], adapted to this nomenclature, by Messrs. Hassenfratz and Adet. At Paris, the house of Cuchet, bookseller, rue and hotel Serpente, 1787. Under the privilege [sponsorship] of the Academy of Sciences.*

Is a book on nomenclature really as important to chemistry as the Constitution is to the United States? Almost. In 1787, chemistry was in the midst of a revolution (the bicentennial of which we celebrated, and continue to celebrate). Lavoisier and his disciples were winning more and more converts to the "new" chemistry. And contrary to the sentiments expressed earlier by a Miss Juliet Capulet - "that which we call a rose by any other name would smell as sweet" - the leaders of the revolution were convinced that chemical names must be carefully chosen, and that they should convey information about the substances named. The Abbé Bonnot de Condillac, a philosopher who greatly influenced Lavoisier, put it very strongly: "We only reason well or reason badly insofar as our language is well or badly constructed ... The progress of the sciences depends entirely on the progress of their languages" (1). A brief look at the state of chemistry's language in the late 18th century would seem in order.

We can hardly fault the ancients for giving substances names which convey no information on composition; they *had* no information on composition. They had enough problems just in identifying as the same substance specimens prepared in different ways. Names were derived from many and varied sources (2):

* *astrology*: lunar nitre (silver nitrate), sugar of Saturn (lead acetate), martial chalk (iron carbonate)

* *people and places*: Glauber's spirit of nitre (fuming nitric acid); terra anglica rubra (ferric oxide), Epsom salts (magnesium sulfate)

* *color*: magnesia alba (magnesium carbonate), magnesia nigra (manganese dioxide), red precipitate of mercury (the oxide)

* *form*: milk of lime (calcium hydroxide suspension), flowers of zinc, phosphorus, sulfur (oxide, oxide, sublimed element).

Most of these were still in use in the 18th century! As an example of the chaos which could result, consider the following list: "alkali of wine lees, cineres clavellati, fixed nitre, offa Helmontii, pearl ashes, salt of tartar, vegetable alkali." How many substances are listed here? One. Potassium carbonate.

Some names were quite misleading: "mercurius vitae" (antimony oxychloride) was a deadly poison, "red precipitate of mercury" was not obtained by precipitation, "calx of gold" was really the metal, "fixed sulfur of antimony" contained no sulfur (it was an oxide). You get the idea.

Complaints and criticisms abound in the literature of the 16th and 17th centuries, but few constructive suggestions were forthcoming until the middle of the 18th. Pierre Joseph Macquer published a *Dictionnaire de Chymie* in 1766 which included all known substances, along with a compilation of the criticisms of current terminology and some suggestions for a systematic way to name salts. Several chemists of that day, including Rouelle in France and Bergman in Sweden, had begun to use long descriptive phrases such as "the acid of vinegar joined with chalk" or "sel vitriolique a base de terre argilleuse" (aluminum sulfate), which at least indicated something about composition. Macquer proposed that, e.g., salts of "acide nitreux" might be referred to as "sel nitreux" or just "nitre", as in "nitre d'argent". The use of the longer phrases above was necessitated by the fact that aluminum and calcium had not yet been isolated and named.

Thus the stage was set in the 1780s for real progress in nomenclature. Torbern Bergman set forth a scheme for classifying and naming minerals, using binary names for many salts ("argilla vitriolata") and arguing for Latin as the language of choice in naming substances (it is true that the ease with which adjectives can be made from nouns in Latin leads to smooth binary names like "tartarus citratus"). His work was published in 1784; it showed approval and use of many of the ideas set forth two years earlier by a chemist from Dijon named Louis-Bernard Guyton de Morveau.

Guyton (or M. de Morveau) is the first author listed on our title page; this is appropriate, for most of the basic principles were his. (Actually, the order of the four names is merely that

MÉTHODE

DE

NOMENCLATURE

CHIMIQUE,

Propoſée par MM. DE MORVEAU, LAVOISIER, BERTHOLET, & DE FOURCROY.

ON Y A JOINT

Un nouveau Syſtême de Caractères Chimiques, adaptés à cette Nomenclature. par MM. HASSENFRATZ & ADET.

A PARIS,

Chez CUCHET, Libraire, rue & hôtel Serpente.

M. DCC. LXXXVII.

Sous le Privilége de l'Académie des Sciences.

of seniority - Guyton was born in 1737, Lavoisier in 1743, Berthollet in 1748, and Fourcroy in 1755). Guyton was a professional lawyer and an amateur scientist. As a member of the Dijon Academy, he had both written and spoken about the shortcomings of current chemical nomenclature and was aware of Bergman's work. In 1782, he published a paper (3) in which he set down five principles for a new system of "denominations chimique". In brief, they are:

1. A phrase is not a name; circumlocutions like "the acid of vinegar joined with chalk" should be used only when no shorter expression would be clear;

2. Names should conform with nature (that is, composition); simple substances should have simple names, compounds should show in their names their constituent parts, the names of persons should be shunned.

3. If the character of a substance is unknown, a name which expresses nothing is better than one which may give a false impression (since phlogiston was controversial, "pure air" was a better name than "dephlogisticated air").

4. For new names, the roots should be chosen from the most common dead languages - Latin and classical Greek - so that derived forms would be clear.

5. Names should be chosen so that the "genius" of the language used is taken into account; nouns should be easily turned into adjectives.

From these principles he then derived a series of proposed names for bases, acids, and salts. Most of these found their way into the 1787 *Méthode*.

Antoine Lavoisier hardly needs an introduction; his experiments, which established the nature of burning and led to the overthrow of the phlogiston theory, have been discussed in detail elsewhere (4). Here we merely mention that throughout his experimentation he was always concerned to choose expressions and names which would avoid misunderstandings. (For example, he did not wish to refer to one of the constituents of a solid calx as an "air", so he coined a term - he referred to the substance which combines with metals in calcination as the "principe oxigine"). We have already noted his great interest in the ideas of the philosopher Condillac regarding language.

Claude-Louis Berthollet was also a well-known chemist of the day, having done important work on chlorine, ammonia, and prussic acid, and their practical uses. In his writings he preferred to use long descriptive phrases for substances rather than the old names, but he did not issue any clarion calls for nomenclature reform. In fact, his name on the title page of *Méthode* may be more due to his prestige and his early support of Lavoisier's oxygen theory than to any specific contribution to the work. He did, of course, take part in the discussions that spring and summer.

The fourth author, Antoine Francois de Fourcroy, is perhaps the least well-known, as well as the youngest. Like Berthollet, he had been trained to be a physician, but became interested in chemistry instead. He proved to be a brilliant lecturer, and taught during the last two years of his medical studies. His first official appointment was to the faculty of the Royal Veterinary School, but after only a few months the post of Professor of Chemistry at the prestigious *Jardin du Roy* became available, and Fourcroy was appointed to the post (incidentally, the other major candidate was Berthollet). He gave his lectures in the old amphitheatre, which seated 600 and was nearly always overcrowded. A new one was constructed in 1787 with double the capacity; it was enlarged in 1794. According to Fourcroy's biographer, W. A. Smeaton, "Great audiences of all classes and all nations spent hours, tightly packed, almost fearing to breathe, their eyes fixed on his. He could see those who were not convinced, or did not understand, and he would go over the subject in a different way, more than once if necessary, until he saw the whole audience equally satisfied" (5). He also wrote a widely-read text on natural history and chemistry. He was, in fact, in an excellent position to promote the rapid spread of the "new chemistry" and its nomenclature.

Louis-Bernard Guyton de Morveau (1737-1816)

The gathering of these four men in Paris early in 1787 (Guyton came from Dijon and stayed about eight months) originally had more to do with Lavoisier's new experiments in support of his oxygen theory than with nomenclature. Berthollet had been converted in 1785, Fourcroy in 1786 and Guyton was finally convinced in 1787. Because of the previous interest of at least three of the four in improving the terminology used in chemistry, it was decided that a detailed new system should be presented as soon as possible. The result was the *Méthode de nomenclature chimique*.

The first section of the book consisted of the text of a paper which Lavoisier had delivered in April to a public meeting of the Academy of Sciences (he, Berthollet, and Fourcroy were members of the Academy; Guyton, who came from the provinces, was not). The paper gives the background of the suggested reform and credits those who had worked on nomenclature in the past - Macquer, Baume, Bergman, and especially Guyton. Lavoisier praised the latter for his willingness to sacrifice his own ideas and previous work to the present collaboration. He described their conferences, which ranged over the whole of chemistry as well as the metaphysics of language, as being quite free of personal considerations. The rest of his presentation deals mainly with Condillac's ideas on the importance of language. He stresses that what they propose is a *method* of nomenclature, which should easily adapt itself to new substances, and should only require minor reforms in the future.

The second section was the text of a paper which Guyton had presented to a private meeting of the Academy about two weeks after Lavoisier's. It sets forth the details of the scheme, explaining how special care had been taken in the naming of "simple bodies", since these names would be used in constructing those for compounds. There were 55 "simple bodies", in five classes (details below), and he explained how they decided on such things as the uniformity of gender and the consistency of endings.

This was followed by a paper, written by Fourcroy, explaining the details of a large, folding table which was inserted in the book. This table contained the new names for the simple substances, their compounds with oxygen (this usually meant acids), examples of their salts and other compounds, and alloys. When needed, old equivalents for the new names were given. As Fourcroy says: "It is evident that we have created but a very few absolutely new words, except such as were indispensably necessary to indicate substances which were unknown before ... In following the order of the substances denominated in the first column, from which all the other names are derived, it will appear that we have not made any new words but oxygen, hydrogen, and azot" (6). The five classes in that first column were:

1. The simplest substances - light, caloric, oxygen, hydrogen, azot (caloric was the *matter* of heat, all gases contained it).
2. Acidifiable bases - the principles of acids; four which had been decomposed (azot, carbon, sulfur, phosphorus), 22 others which had not yet been decomposed, including muriatic, succinic, acetic, tartaric, oxalic, lactic, formic, boracic.
3. Metals - 17, including gold, silver, mercury, copper, iron, molybdenum, tungsten, manganese, platinum.
4. Earths - silica, alumina, lime, magnesia, barytes.
5. Alkalis - potash, soda, ammoniac.

It is of interest to note that, as Fourcroy says: "ammoniac has been decomposed; M. Berthollet has determined with precision the nature and proportion of its principles" but it was placed with the other "fixed alkalis" so as "not to interrupt the order and relation of these substances, which in many respects appear as indecomposable substances in chemistry".

As an example of how these were combined, consider sulfur: there were two acids known, containing different amounts of oxygen; the one considered saturated was "acide sulfurique", the one with less oxygen was "acide sulfureux". Salts of the former were "sulfates", of the latter "sulfites". Similarly, "carbone" produced "acide carbonique", "carbonates", and "carbures". Azot lead to two acids which were called "nitrique" and "nitreux" (in the second English edition in 1794 the translator, George Pearson, chose "nitrogen" rather than "azot", to be consistent with hydrogen and oxygen).

There followed two dictionaries, the first listing old names alphabetically and "translating" them into the new, the second reversing the process. This second was twice the length of the first, reflecting the large number of new substances recently investigated, for which no old names existed.

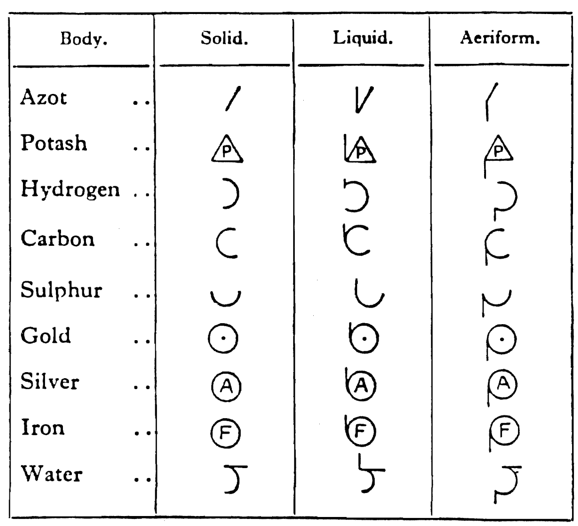
And what of the symbols of Messrs. Hassenfratz and Adet mentioned on the title page and "adapted to this nomenclature"? Suffice it to say they never really caught on. One or two examples may demonstrate why. The simple substances were divided into six classes, not five - the sixth being "inflammables". Each class had a characteristic symbol:

1. Simplest substances - a straight line
2. Alkalis and earths - a triangle
3. Inflammable substances - a semi-circle
4. Metals - a circle
5. Acid radicals - a square
6. Compounds of unknown nature - a diamond

Inside the triangles, circles, and squares were letters; usually the first letter of the Latin name of the substance. When symbols were combined, their relative positions implied relative degrees of saturation. In the case of organic acids, letters had to be used again. Liquids and gases were indicated by adding the vertical stroke which stood for caloric, either above or below (see figure).

Though the authors of the *Méthode* praised the system of symbols and referred to it as "very ingenious", neither they nor many other writers incorporated them into textbooks. The major problem was typographical; printers had to construct special type which could be inserted into a regular printed page. The result was that the symbols were printed in some dictionaries and books, but always as separate plates or special tables. One of the reasons Berzelius chose ordinary letters for his symbol system (the one still used) was that they could be easily printed. Hassenfratz and Adet just never caught on.

What was the reception of the rest of the volume? Even though it was only on nomenclature, most scientists saw no way to separate it from the rest of Lavoisier's ideas on chemistry, and so it was sharply criticized by the phlogistonists in the Academy, and that body in effect remained neutral, playing no part in the acceptance of the new names. The hostility of the editor of the *Observations sur la Physique* led to the formation in 1789 of the *Annales de Chimie*, most of whose articles used the new nomenclature. Perhaps of more importance in the long run were the several new textbooks of chemistry which used the new ideas, including those by Jean Chaptal of Montpellier, Fourcroy at the *Jardin du Roy*, and, of course, Lavoisier with his 1789 *Treatise* (Chaptal, incidentally, argued for the use of nitrogene instead of azote). These texts were translated into the major European languages over the following years and widely



Some examples of the symbols of Hassenfratz and Adet (2) used. Lavoisier was the only one of the four authors who did not survive the French Revolution; and Guyton, as one of the editors of *Annales de Chimie*, and Fourcroy, as a noted and popular teacher, had great influence on the general adoption of the new system in France.

The first English translation was made by James St. John in 1788. It was he who decided to spell oxygen and hydrogen with a "y" rather than the French "i"; he also used "ph" in words like sulphur, instead of the French "f". Thomas Jefferson, who was in France at this time, wrote a letter in July 1788 in which he states that Lavoisier's new theories are not yet sufficiently established by experiment, and therefore it is too early to reform nomenclature. However, when Samuel Mitchill became a professor at Columbia in 1792, he used the new system in all his lectures, and in 1794 published a volume entitled *Nomenclature of the New Chemistry*. At least two other books on the new nomenclature had been published in America by 1800, and the system was in almost universal use in this country by that time (7).

The *Méthode de nomenclature chimique* was the lexicon of the chemical revolution; it furnished the vocabulary with which the new ideas could be proclaimed and discussed. The spread of the revolution, however, was accomplished by other books, especially those by Fourcroy and Lavoisier. These will be discussed in subsequent papers in this series.

References and Notes

1. Quoted by Lavoisier from A. B. Condillac, *La Logique*, Paris, 1780.
2. Most of the background material in this paper is from M. P. Crosland, *Historical Studies in the Language of Chemistry*, Harvard Press, 1962. This book is strongly recommended for those who wish to know more about the subject. For an earlier study of the same subject, see R. M. Caven and J. A. Cranston, *Symbols and Formulae in Chemistry: An Historical Study*, Blackie, London, 1928.
3. Translated in H. M. Leicester and H. S. Klickstein, *A Source Book in Chemistry, 1400-1900*, Harvard, 1952, p. 182.
4. See for instance D. McKie, *Antoine Lavoisier: Scientist, Economist, Social Reformer*, Schuman, New York, 1952, pp. 97-175.
5. W. A. Smeaton, *Fourcroy, Chemist and Revolutionary, 1755-1809*, Heffer, Cambridge, U.K., 1962, p. 12.
6. The quotations used in this paper are from the first English translation, *Method of Chemical Nomenclature...*, translated and adapted by J. St. John; London, 1788.
7. D. I. Duveen and H. S. Klickstein, "The Introduction of Lavoisier's Chemical Nomenclature into America", *Isis*, **1954**, *45*, 278 and 368.

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THE HISTORY OF THE DEXTER AWARD

Part III: The Second Decade

Aaron J. Ihde, University of Wisconsin

Earle Caley (1900-1983), the recipient of the 1966 award, was born in Cleveland, Ohio, where a high school teacher developed in him a lifelong interest in chemistry. After taking a doctorate in analytical chemistry at Ohio State University, he taught at Princeton, where a friend in classics inspired a further interest in archeology. These two interests were finally combined during a sabbatical spent in Athens, where Caley began to analyze coins and other archeological artifacts. This became his specialty as an analytical chemist. After working in industry during World War II, he joined the Ohio State faculty as an analytical chemist, where he published numerous papers and books on analytical chemistry and on his archeological studies.

Earle Caley

The 1967 award was given to Mary Elvira Weeks (1892-1975). Born in Lyons, Wisconsin, she attended Ripon College, where she became interested in chemistry. This led to a M.S. degree in chemistry at the University of Wisconsin and to a Ph.D. at the University of Kansas, where she became a faculty member in 1921. At Kansas she encountered Frank Dains' collection of pictures of famous chemists. This, in turn, led to the publication of a long series of papers in the *Journal of Chemical Education* in the early 1930's dealing with the discovery of the chemical elements and illustrated with pictures from the Dains' collection. This series proved so popular that it was reprinted in 1934 as a book entitled *Discovery of the Elements*. By the time of Miss Weeks' death in 1975, the book had gone through seven editions, the last two done in collaboration with Henry Leicester. In 1944 Weeks took a position as

Mary Elvira Weeks

Research Associate in Scientific Literature at the Kresge-Hooker Science Library at Wayne State University in Detroit. Here she served as a literature expert and translator until her retirement. During this period she also completed the writing of *A History of the American Chemical Society: Seventy-five Eventful Years*, which had been started by Charles Albert Browne but was incomplete at the time of his death.

Aaron Ihde (b. 1909), winner of the 1968 award, was also Wisconsin born and studied chemistry at the University of Wisconsin. After completing his B.S., he spent six years as a chemist with Blue Valley Creamery Company in Chicago. He returned to graduate study at Wisconsin in 1938, specializing in food chemistry. Here he was associated with Professor H. A. Schuette, who stimulated an already emerging interest in history of food chemistry and food legislation. In 1942 Ihde joined the chemistry faculty at Wisconsin, teaching in the general chemistry program during the war years. In 1946 he reactivated a defunct history of chemistry course and pursuit of this subject soon became his principal interest. He published *Development of Modern Chemistry* in 1965, a treatise which deals with history of chemistry from Joseph Black to the mid-20th century. Ihde also created at Wisconsin, in connection with the history of science program, a graduate program in history of chemistry which has directed the doctoral studies of a score of students, most of whom are now pursuing academic work in the history of science field. One of them, Reese Jenkins, was the recipient of the Dexter Prize in 1978 for his book *Images and Enterprise*, a history of the photographic industry which developed out of his Ph.D. thesis.

Aaron Ihde

The winner of the 1969 award, Walter Pagel (1898-1983), was born in Germany, the son of Julius Pagel, professor of medicine and author of a two-volume *Geschichte der Medizin*. Walter was educated for a medical career and became a professor at the University of Leipzig, where he became noted for his work on the pathology of tuberculosis. Like his father, he was interested in history of medicine and soon became fascinated by the medical developments in the Renaissance. He contributed important biographical studies of van Helmont and Paracelsus, studies which were continued in England after he fled from Nazi Germany.

Walter Pagel

Ferenc Szabadvary (b. 1923), recipient of the 1970 award, was born in Hungary and educated at the Technical University in Budapest, where he is now professor. He also holds the position of Director of the Hungarian National Museum for Science and Technology. Szabadvary developed an early interest in the lives of Hungarian chemists and in history of analytical chemistry, a much neglected field. In 1956 he published in Hungarian a *History of Analytical Chemistry*, which was later translated into German and English. He has also published a biography of Lavoisier and numerous papers in history of chemistry, some of which have appeared in the *Journal of Chemical Education* after translation by Ralph Oesper, winner of the first Dexter Award.

The 1971 award was given to Wyndham Miles (b. 1916). Born in Wilkes-Barre, Pennsylvania, about 90 miles from the residence of Joseph Priestley in Northumberland, Miles studied chemistry at the Philadelphia College of Pharmacy. This was followed by a master's degree at Penn State, where he also served as an instructor in chemistry, and by the study of the history of science at Harvard. After taking his Ph.D., Miles became associated with the U.S. government, first as an historian in the Chemical Corps, later with NASA, where he worked on the history of the Polaris Project, and then with the National Institutes of Health. He became active in the History of Chemistry Division early in his career and has contributed extensively to the activities of the Division. Perhaps his most influential work is his editorship of *American Chemists and Chemical Engineers*, published by the ACS in 1976.

Wyndham Miles

Ferenc Szabadvary

The winner of the 1972 award, Henry Guerlac (1910-1985), was born in Ithaca, New York, where his father was professor of languages at Cornell. After receiving an M.S. in biochemistry at Cornell, he pursued a doctorate in history at Harvard, specializing in the history of science. Upon graduation, he became the first chairman of the newly created History of Science Department at the University of Wisconsin. After two years, he took a leave of absence to become historian with the Radiation Laboratory at MIT. In 1946 he accepted a professorship in history at Cornell, where he created a top-ranking history of science program. As a talented linguist, Guerlac focused on the work of Lavoisier and his contemporaries. His book *Lavoisier - the Crucial Year* made a deep scholarly impact on the field upon its publication in 1961. Through acquisition of the Lavoisier collection of Duveen, Guerlac created at Cornell what is probably the best site for the study of early French chemistry in the United States. He also served as the major professor for numerous students in the history of science.

Bernard Jaffe (b.1886), winner of the 1973 award, was born and educated in New York City, where he spent most of his adult career in the New York City school system. Following his B.S. at City College, he served with the U.S. Infantry in France. On returning to New York, he took his Master's at Columbia and soon became a chemistry teacher in the city school system. Besides his teaching, he contributed many popular articles on chemistry and chemists to local papers and magazines. The publication of his book, *Crucibles*, in 1930

Henry Guerlac

Bernard Jaffe

brought him nationwide attention among chemists and chemistry students. The collection of biographies, ranging from Bernard of Treves to Irving Langmuir, was a milestone in the popularization of chemistry. Later books included *Men of Science in America* and biographies of Michaelson and Moseley. He was also well-known for his secondary school textbook, *New World of Chemistry.*

For some reason, the nature of which remains a mystery, no Dexter Award was given in 1974, the only such gap in the history of the award.

Johannes van Spronsen (b. 1928), recipient of the 1975 award, was born in The Hague and studied chemistry at the Technische Hogeschool in Delft and at the University of Leiden. Since 1954 he has taught in the Gymnasium in Alkmaar and since 1960 at the University of Utrecht. He has published many papers in history of chemistry in the *Chemische Weekblad* and in other journals. His English publications are primarily in *Janus, Chymia* and the *Journal of Chemical Education.* His best known and most important work is the *Periodic System of the Elements - A History of the First 100 Years,* published in English in commemoration of the centennial of the discovery of the table by Meyer and Mendeleev.

Johannes van Spronsen

The 1976 award was given to Trevor I. Williams (b. 1921). Born in England, where he studied chemistry under E. J. Holmyard at Clifton College, Williams continued his studies at Oxford before joining Florey and Chain in the isolation of penicillin. After 1945 he abandoned experimental chemistry and turned fully to authorship, becoming editor of *Endeavour*, a publication sponsored by Imperial Chemical Industries. He published several works on the history of chromatography and chemical industry before joining Charles Singer, E. J. Holmyard, and A. R. Hall as editor of the comprehensive *History of Technology,* which appeared in five volumes, and to which Williams contributed significant sections on the history of chemical technology. He later published additional works on history of technology and is perhaps best known for his editorship of *A Biographical Dictionary of Scientists.*

Trevor I. Williams

The overall statistics for the second decade of the award show that the recipients have become younger. In contrast to the first decade, in which half of the recipients were over 70 and none under 50 years of age, only three of the recipients for the second decade were over 70 and two were in their 40's when they received the award. Again, all but one (Pagel) received formal chemical training at either the undergraduate or graduate level. The balance of those professionally functioning as chemists, rather than as historians, shifted towards the historians, with three academic chemists, no industrial chemists, three historians, one professor of medicine, one librarian, one editor, and one high school teacher receiving the award.

Part IV of the series, dealing with the third decade of the award, will appear in the next issue.

Dr. Aaron Ihde is Professor Emeritus in the Department of Chemistry of the University of Wisconsin, Madison, WI 53706. A Past-Chair of the Division (1962-1964) and a winner of the Dexter Award (1968) himself, Dr. Ihde is perhaps best known for his classic text "The Development of Modern Chemistry", which has recently been reissued as a Dover paperback. He is currently completing a history of the chemistry department at Wisconsin.

DIVERSIONS AND DIGRESSIONS

A Note on the Discovery of Nuclear Fission

Fathi Habashi, Laval University

Ida Noddack (1896-1978)

The year 1989 marks the 50th anniversary of the discovery of uranium fission. However, the first observation of uranium fission unknowingly occurred five years earlier. In 1934, Enrico Fermi (1) in Rome announced the discovery of at least five new radioactive elements as a result of bombarding uranyl nitrate with neutrons, one of which, with a half life of 13 minutes, he supposed to be a transuranium element corresponding to element number 93. Fermi put it in the periodic table under rhenium and called it eka-rhenium. This work was inspired by the so-called phenomenon of induced radioactivity discovered a year earlier by Irene Curie and Frederic Joliot in France as a result of bombarding atomic nuclei with alpha particles. Fermi used neutrons, recently discovered by James Chadwick in England, instead.

Fermi's paper attracted the attention of Ida Noddack (1896-1978) (2), best known as the discoverer of rhenium, largely because it dealt with yet another element in the manganese group and was thus presumably related to her work on rhenium. Noddack was at the time a chemist at the Physikalische Technische Reichsanstalt (Imperial Physico-Technical Research Office), a government laboratory in Berlin. Soon after reading Fermi's paper, she published a comment (September 1934) entitled "On Element 93" (3) in which she showed that Fermi's experimental evidence was incomplete and his conclusions were unjustified. She also suggested an alternative interpretation of his results, writing "When heavy nuclei are bombarded by neutrons, it would be reasonable to conceive that they break down into numerous large fragments which are isotopes of known elements but are not neighbors of the bombarded element (in the Periodic Table)" (4).

In this statement, Noddack conceived, before anybody else, the idea of nuclear fission. Her argument was as follows. When atoms are bombarded by protons or alpha particles, the nuclear reactions that take place involve the emission of an electron, a proton, or a helium nucleus and the mass of the bombarded atom suffers little change. When, however, neutrons are used, new types of nuclear reactions should take place that are completely different from those previously known.

Fermi's experiments were repeated by Otto Hahn (1879-1968) and his coworkers in Berlin. They confirmed his conclusions and published a series of papers on extensive radiochemical separations of the so-called trans-uranium elements. The results, however, became so contradictory that after five years of intensive research and extensive publication the concept of trans-uranium elements had to be abandoned. Hahn then announced in January 1939 the definite formation of barium during the bombardment of uranium and started speculating about the mechanism of its formation (5). Ida Noddack wrote a short article in *Die Naturwissenschaften* (6) in March 1939 in which she reminded Hahn of her suggestion five years earlier that the uranium atom might have undergone fission, and ended by chiding him for failing to cite her paper on this matter, although she had once explained her views to him personally. The editor of the journal apparently asked Hahn to comment, but he refused, and the editor had to add a note of his own instead (7):

> Otto Hahn and Fritz Strassmann informed us that they have neither the time nor the interest to answer the preceding note. They think that they would rather renounce commenting, as the possibility of breaking down a heavy atom into smaller fragments - an idea already expressed by many others - cannot be concluded without experimental evidence. They leave the judgment on the correctness of the views of Frau Ida Noddack and the way she expressed them to their peers.

At the time Hahn was 55 years old and already Director of the Kaiser Wilhelm Institute for Chemistry (now the Max Planck Institute). A well established scientist, he had traveled abroad on numerous scientific missions, had discovered protactinium with his associate, Lise Meitner, (1878-1968) in 1918, and had written a textbook on radiochemistry. However, he apparently could not accept the new idea that the uranium atom was split into two fragments. It was Meitner who finally explained the results of the work as fission in 1939, a few months after she was forced to leave Germany. Hahn received the Nobel Prize in 1944. In his autobiography (8), published in 1966, his opinion of Noddack's contribution remained unchanged and he dismissed her with a single sentence: "Her suggestion was so out of line with the then-accepted ideas about the atomic nucleus that it was never seriously discussed".

References and Notes

1. E. Fermi, "Possible Production of Elements of Atomic Number Higher Than 92", *Nature*, **1934**, 133, 898-899.

2. Born Ida Tacke, married Walter Noddack (1893-1962) director of the Physikalische Technische Reichsanstalt in Berlin in 1926.

3. I. Noddack, "Über das Element 93" *Angew. Chem.*, **1934**, *47 (37)*, 653-656.

4. "Es wäre denkbar, dass bei der Beschiessung schwerer Kerne mit Neutronen diese Kerne in mehrere grössere Bruchstücke zerfallen, die zwar Isotope bekannter Elemente, aber nicht Nachbarn der Bestrahlten Elemente sind".

5. O. Hahn and F. Strassmann, "Nachweis der Entstehung activer Bariumisotope aus Uran und Thorium durch Neutronenbestrahlung; Nachweis weiterer aktiver Brüchstucke bei der Uranspaltung", die bei der Bestrahlung von Uran mit Neutronen Entstehen", *Naturwissenschaften*, **1939**, *27 (67)*, 11.

6. I. Noddack, "Bemerkung zu den Untersuchungen von O. Hahn, L. Meitner und F. Strassman über die Produkte, die bei der Bestrahlung von Uran mit Neutronen entstehen", *Naturwissenschaften*, **1939**, *27*, 212-213.

7. Translation by the author.

8. O. Hahn, *A Scientific Autobiography*, Scribner's, New York, 1966, p.140.

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THE 1893 WORLD'S CONGRESS OF CHEMISTS

A Center of Crystallization in a Molecular Mélange

James J. Bohning, Wilkes College

For more than a decade after its founding, the American Chemical Society struggled to induce new members to join the 230 "charter subscribers" it had signed by the end of 1876. The membership roster slowly rose to the 300 mark, where it hovered for only a few years before plummeting to its nadir in 1889, when only 204 souls appeared on the official list. Yet, within seven years, the Society membership would break the 1000 mark and continued to increase for almost a century with only a few negative aberrations. This sudden and dramatic reversal in the numbers of those willing to invest time and money in a troubled organization signals the existence of events that plucked the Society from the precipice of extinction and secured its future as a leading professional organization for chemists.

The complexities of those crucial years centered around 1889 have not yet been completely unraveled by historians. However, there is no question that attention should be focused on the heated accusations that the original American Chemical Society was American in name only, and was really a New York based operation that had little to offer those outside of the city. The dissatisfaction culminated in 1889 with the attempted takeover by Washington chemists Harvey W. Wiley and Frank W. Clarke, who sought to form the Continental Chemical Society out of Section C of the American Association for the Advancement of Science and absorb the New Yorkers (1).

Their efforts were thwarted by Charles F. Chandler, the guiding hand behind the formation and operations of the ACS. Realizing that his organization was doomed if changes were not made, Chandler took less than a year to revise the constitution and hold the first general meeting outside of New York City. On short notice 43 chemists made their way to Newport, Rhode Island on 6 and 7 August 1890 to attend the first National Meeting of the ACS. At that meeting Clark acquiesced, agreeing to abandon the Continental Chemical Society and support the "new" ACS. To prove their intent of providing accessibility to more chemists and thus justify their claim to nationalistic territory, the Society held additional meetings in Philadelphia, Washington, New York, Rochester, and Pittsburgh in the next two years.

On 27 April 1893, Professor Albert C. Hale, head of the physical sciences department at the Boys High School in Brooklyn, New York, and General Secretary of the ACS, submitted a report to the ACS Council that detailed the current conditions of the Society, but also included some history and "prospects for the future". Hale, who served the Society on a

Table 1. Early World's Fairs

1851: London	Great Exposition of the Works of Industry of all Nations
1867: Paris	Exposition Universelle
1873: Vienna	Weltausstellung 1873 Wien
1876: Philadelphia	Centennial Exposition
1878: Paris	Exposition Universelle
1889: Paris	Exposition Universelle
1893: Chicago	World's Columbian Exposition

part-time basis, was enthusiastic as he gave the six major points of the operating plan derived from the ideas of chemists "from all parts of the country". Citing the retention of the original name, the formation of a Council to manage important affairs, the establishment of local Sections, the scheduling of two regular national meetings each year, and the signing of a contract for the regular publication of the *Journal*, Hale closed with an eloquent and optimistic prediction for the future. "Never before in the history of this country," Hale said, "has there been such immediate prospect of a large and powerful union of American chemists as there is today. ... More and better work is done in America than those of other countries are placing to our credit, and we have now, as never before, the means of securing adequate recognition and influence among the chemists of the world" (2). It is obvious that the Society was intent on moving rapidly from a local orientation to a posture that sought both national and international attention and support.

An ideal vehicle for achieving that objective was to occur in Chicago when the World's Columbian Exposition, also known as the Chicago World's Fair, would open on 1 May 1893, just a few days after Hale signed his report. The tradition of a grand exhibition was begun in London in 1851 with the "Great Exposition of the Works of Industry of all Nations" that featured the famous Crystal Palace. Major events that followed included the Paris World's Fair of 1867, where foreign governments were invited for the first time to erect their own buildings as a sign of international cooperation, the 1876 Centennial Exposition in Philadelphia, and the 1878 Paris Fair for which the Eiffel Tower was constructed (Table 1).

Although usually scheduled to coincide with a date of "patriotic significance", these 19th century fairs were also showcases for industrial and mechanical developments. The telephone and the typewriter were prominently featured in Philadelphia, while Chicago contained "the largest electrical exhibit and the greatest employment of electrical energy in the 19th century." It was the French who "gave the nonmaterial a special emphasis in their world's fairs." In 1889 they instituted "a series of intellectual and religious congresses" which were intended to "share information, stimulate new thought and effort, and ... indicate progressive development" (3).

Chicago Judge Charles C. Bonney seized upon that idea and successfully petitioned the Exposition Corporation to establish the World's Congress Auxiliary of the World's Columbian Exposition of 1893, with the motto: "Not things, but men." Gaining recognition from the U.S. Congress, the Auxiliary sent invitations to many countries, declaring that the "leaders of human progress" would convene to "establish mutual acquaintances and fraternal relations, review progress already achieved in various subject areas, define the still outstanding questions of the era, and receive ... suggestions of the practical means by which further progress might be made and the prosperity and peace of the world advanced" (4).

Convinced that "the crowning glory of the World's Fair of 1893 should not be the exhibit of the material triumphs, industrial achievements, and mechanical victories of man," but something more noble as demanded "by the enlightened and progressive spirit of the present age," the Auxiliary had 20 departments and 225 divisions that met at various times in Chicago between 15 May and 28 October. The Congresses included woman's progress, medicine and surgery, moral and social reform, music, education, art, science and philosophy, labor, Sunday rest, agriculture, the public press, temperance, commerce and finance, literature, engineering, government, social and economic science, religion, and public health.

The preliminary organization for the World's Congress of Chemists was conducted jointly by an ACS committee led by William McMurtrie of New York and a World's Congress Auxiliary committee chaired by Professor J. H. Long of the University of Chicago. ACS President Harvey W. Wiley was selected as the Chairman of the joint committee. Fifty-one American chemists, including Edgar Fahs Smith, William A. Noyes, and Ira Remsen, were selected for the Advisory Committee. In a bold move to establish credibility with their foreign brethren, the Americans selected 190 chemists from abroad to serve on this same committee. The list reads like the index from a history of chemistry text, but also serves as a reminder of the exciting developments in 19th century chemistry. Arrhenius, Beilstein, Cannizzaro, Le Chatelier, Erlenmeyer, van't Hoff, Kekulé, Mendeleev, Nernst, Ostwald, Perkin, and Soxhlet were only a few of the notables in the stellar lineup

Harvey Wiley

the Committee assembled as encouragement for foreign attendance and cooperation.

A preliminary list of ten subject classifications was made by the committee, and chairmen were assigned to agricultural chemistry, analytical chemistry, didactic chemistry, historical chemistry, inorganic chemistry, organic chemistry, physical chemistry, physiological chemistry, sanitary chemistry, and technical chemistry. Stressing the international nature of the meeting which would also be considered the 7th National Meeting of the Society, Wiley appealed to all American chemists to assure that the distinguished visitors received "proper attention from their co-laborers on this side of the water." He also reminded them that this was not only a scientific, but also a "patriotic duty," and that "every chemist in the United States should feel that it is his privilege as well as duty to do something towards making the Congress a success" (5).

On 1 July, Wiley issued an updated circular indicating that 15 foreign chemists had already agreed to present papers ranging from "Standard Methods of Oil Analysis" to "The Influence of Patent Laws on the Development of Chemistry." He urged that all papers be submitted by 1 August because it would "be difficult to arrange for a position on the program after that date." However, Wiley noted that "in all cases the place of honor on the program" would be given to foreign visitors. There were other chemical attractions as well. The Chemical Section of the AAAS would be meeting in Madison the week before, and the Association of Official Agricultural Chemists, The American Pharmaceutical Association, and the American Institute of Mining Engineers were also holding meetings in Chicago at the same time. It was quite a line-up of events for any chemical visitor to the "windy city", and Wiley assured them that some warm days were to be expected, but "the situation of the city on the edge of a vast open prairie extending for nearly a thousand miles north and west without a break" meant refreshing breezes on even the hottest days. Considering that the lake breezes also helped from the other direction, Wiley felt that "no one need be deterred from attending the Congress on account of severe heat".

Wiley closed with another appeal to American chemists "to be present for the purpose of welcoming our foreign visitors and showing them the progress of chemical science in the United States" (6).

When the Columbian Exposition was dedicated on 21 October 1892 (it had been delayed a week because President Harrison was attending a large celebration in New York on 14 October), the parade of over 100,000 was a sign of the magnitude and grandeur of the project. More than 200,000 people attended opening ceremonies on 1 May 1893. During the next six months more than 27 million people passed through the gates, with some daily attendance approaching three-quarters of a million.

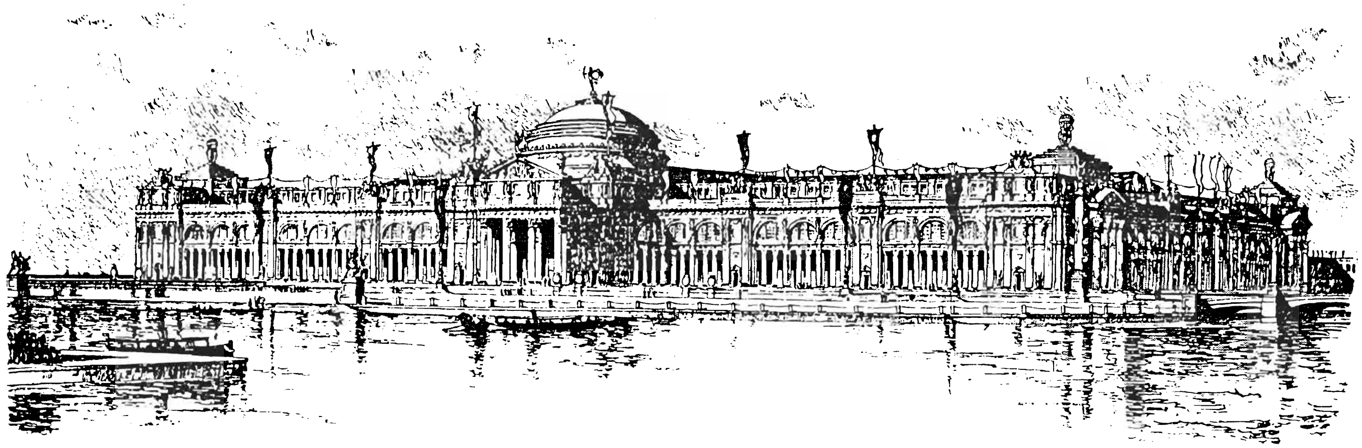
Any attempt to describe the fair quickly runs out of superlatives. Over 400,000 cubic yards of earth were moved twice just to prepare the site of 1000 acres at Jackson Park. More than one million plants, including 100,000 willow trees, were used in landscaping. The largest roofed structure in the world was among the 220 buildings constructed over a three-year period by more than 10,000 workmen. The Manufactures and Liberal Arts Building had sufficient floor space to mobilize the entire Russian army. Its walls could have contained the United States Capitol, the Great Pyramid at Giza, Winchester Cathedral, Madison Square Garden, and Saint Paul's Cathedral with room left over. It was said that the designers must have been "very near to God" and one artist suggested that it compared to the biblical "new Jerusalem" or "Heavenly City" (4).

There were a number of exhibits that were of special interest to chemists. In the Agriculture Building chemical methods applied to agriculture, materials from chemistry for improved farm production, and the results from agricultural experimental stations were on display. In the Mines and Mining Building, the Standard Oil Company had an elaborate show of all phases of oil production and refining, the Germans had a complete cement-testing laboratory, and the English showed a 1000-ounce ingot of palladium and a 240-ounce ingot of iridium. Chemical manufactures were displayed by the United States, England, France, Germany, Russia, Sweden, and Italy. There were 38 American firms in this group, but it was admitted that they could not be favorably compared to the Europeans. Even the U.S. Census Bureau admitted that the statistics of American chemical manufacture were difficult to obtain. One correspondent expressed dismay at the British exhibits, which were not in keeping with the size of their chemical industry; the French items arrived late, and their catalog was in disarray. In contrast, the Germans presented a unified appearance that resulted from the typical Germanic attention to detail and organization. They accounted for more than half of all the chemical manufacturers at the Fair, and included fundamental industries such as acids, paper, glass, and soap; pure chemical preparations used in photography, pharmacy, and laboratory reagents; coal tar products; inorganic and organic pigments for printers, painters, and glaziers; glue and gelatine animal products; and fats, oils, soaps and cosmetics. The Germans also displayed a valuable collection of books, photographs, and instruments, many of which were of historical significance. In the Electricity Building there were innumerable exhibits of electrical equipment and machinery, including a large number of physical and chemical apparatus manufactured in Germany. Finally, scientific education was presented by Harvard, MIT, University of Pennsylvania, Johns Hopkins, Princeton, and Yale (7).

The World's Chemical Congress opened on Monday, 21 August, with an address by President Wiley. As with most visitors to Jackson Park, Wiley was overwhelmed by the entire affair. "The whole world of art, the whole world of work, and the whole world of skill," he pronounced, "are brought to us in a reality which, were it not so tangible, would seem the deception of a wizard." But his next statement could be as appropriate to the current ACS Campaign for Chemistry as it was to the nation and the world almost a century ago. Wiley observed that chemistry, which was still a young and growing scientific discipline, had done more than any other to make the Chicago Exposition a reality. Noting that chemistry was not well-suited for display, he pointed out that "chemistry is pleased to show the way to human progress, quite content to be forgotten when it is achieved. It asks for no white palace with imposing portals in which to display the wonders of its wealth. In odd nooks and corners, scattered over the vast expanse of space, attached to every other exhibit in an unobtrusive way, its silent work is revealed in countless combinations..." There were no statues of Priestley or Lavoisier, but the "fruits of their labors" could be found in almost every exhibit (8).

For the next five days, 76 speakers presented papers in nine Divisions. Only the physiological chemistry division did not materialize, and the historical division became the bibliography division. One third of the speakers were from foreign countries, including Germany (eight), France (seven), Great Britain (four), Switzerland (two), Australia (one), Holland (one), Italy (one), and Russia (one). Each day was chaired by an honorary president, all but one from a foreign country, and was opened with a major address, followed by a number of shorter papers on diverse subjects (Table 2). The chairs included E. Engler, Karlsruhe, Germany; G. Thoms, Riga, Latvia; H. B. Proctor, Leeds, Great Britain; G. Lunge, Zurich, Switzerland; and A. B. Prescott, Ann Arbor, MI. It was the first time that ACS members participated in a divisional meeting structure. Not surprisingly, the technological, analytical, and agricultural chemistry divisions had the most participants (9)

Most of the papers were eventually published in the Society's *Journal* (10). They were virtually ignored by the rest of the scientific literature, except for brief scattered reports in *Science* and the *Journal of the Society of Chemical Industry*. True to Wiley's prediction about the unobtrusive nature of chemistry, the chemical congress was virtually ignored by the popular press, who found speakers declaring the Fair a "Divine Exposition" and a "great theological institute" more interesting material than those who were "determining the melting point of butter fat" or wondering if "pentoses were formed by the assimilation process."



The Agricultural Hall was typical of the grandiose architecture of the Fair

The exposition closed on a somber note on 30 October with a simple cannon salute and the lowering of the flag. Those attending the ceremonies left to the strains of Beethoven's Funeral March because two days earlier the mayor of Chicago had been assassinated. Similarly, the fairgrounds were being consigned to dust as the fate of Chicago's White City had not been determined. Ravaged by weather and vandals during the following winter, it was virtually destroyed in a great conflagration set by arsonists on 5 July 1894. The site was completely dismantled within a year, and only a few buildings remained. (The Chicago Museum of Science and Industry now occupies

Table 2. Papers Delivered in the Various Divisions

Division	Papers	Chair
Technological	18	McMurtrie, New York City
Agricultural	16	Atwater, Middletown, CT
Analytical	15	Prescott, Ann Arbor, MI
Organic	8	Witt, Berlin
Didactic	6	Stone, Lafayette, IN
Physical	6	Warder, Washington, D.C.
Inorganic	4	Clarke, Washington, D.C.
Bibliography	2	Bolton, New York City
Sanitary	1	Ellen Richards, Boston, MA

what was the Art Palace.)

The American Chemical Society fared much better. There were 182 people in attendance, but it is hard to assess the significance of this number. Only 83 were ACS members, about 20% of the total membership. Nevertheless, the Society did achieve one of its objectives. By the end of 1894 the membership was twice what it had been in 1892, and the yearly increase of 262 members for 1894 would not be bettered until 1907. Included among those who joined at the World's Fair were four future ACS Presidents and Charles L. Parsons, who later served for 35 years as Secretary of the Society.

But the major thrust of the meeting had been a long-term goal of establishing both national and international cooperation among chemists. In his opening remarks Wiley encouraged chemists to leave the isolation of desk and laboratory "to seek the acquaintance of his fellows. Every time you take a brother chemist by the hand," Wiley remarked, "you enlarge your life and extend your strength, and the farther apart the field of your activities, the greater the benefit." Speaking to the foreign visitors, Wiley cautioned them not to be surprised about what seemed to be a lack of *esprit de corps*. He explained that "we have been whirled hither and thither in the wild molecular mélange of a rapidly growing country" in which newly forming "centers of crystallization" would bring more unity of action. Wiley emphasized the ACS as one of these emerging centers, and offered "their united hand, big, brawny, and right honest in its grasp," to the foreign dignitaries (8).

Wiley had even larger plans, however. He concluded that "the lesson of the Congress" was not only the "special forms of activity manifested in the titles" of the papers but in "a larger, unprinted program ... illuminated with the light of higher and broader views, bearing a greeting of good fellowship and fraternity and the promise of a more intimate union of all science." Wiley closed the opening day of the Congress by appointing a committee of five to consider his suggestion that a Triennial International Congress on Chemistry should meet at various cities throughout the world.

The group, headed by Wiley's close friend Frank W. Clarke and including Charles E. Munroe and H. Carrington Bolton, wasted little time in acting. Citing similar triennial congresses in geology, medicine, and pharmacy, the committee sent letters to all the chemical societies of the world requesting the appointment of a similar Committee of Conference to join with the ACS in organizing a series of Chemical Congresses "in which the chemists of the various nations can regularly meet together for the discussion of common interests" (11). The American Chemical Society, led primarily by Wiley, would play a key role in the formation of international chemical congresses following in the tradition of the very first such meeting, the great Karlsruhe congress of 1860. As the ashes of the Columbian Expedition were being cleared in August of 1894 from Jackson Park in Chicago, the First International Congress of Applied Chemistry was being held in Brussels under the patronage of the Belgian government (12). But the American influence in the events that followed, leading to the formation of the International Union of Pure and Applied Chemistry in 1919, is another story.

References and Notes

1. J. Bohning, "The Continental Chemical Society", 187th National ACS Meeting, St. Louis MO, 1984.

2. C. A. Browne and M. E. Weeks, *A History of the American Chemical Society: Seventy-Five Eventful Years*, American Chemical Society, Washington, D.C., 1952, pp. 44-48.

3. J. Allwood, *The Great Expositions*, Studio Vista, London, 1977.

4. Complete descriptions of the Fair can be found in D. F. Burg, *Chicago's White City of 1893*, University of Kentucky, Lexington, KY, 1976; R. Badger, *The Great American Fair*, Nelson Hall, Chicago, IL, 1979; and J. W. Shepp and D. B. Shepp, *Shepp's World's Fair Photographed*, Bible Publishing Co., Chicago, IL, 1893.

5. H. Wiley, "Announcement of the Joint Committee on the World's Fair Chemical Congress", *J. Am. Chem. Soc.*, **1893**, *15*, 43. (January number but not published until 13 May.) Confusion about dates exists because of lengthy delays in publishing the *Journal's* monthly issues.

6. H. Wiley, "The World's Congress Chemical Auxiliary of the World's Columbian Exposition", *J. Am. Chem. Soc.*, **1893**, *15*, 106 (February number, issued 11 July) and H. Wiley, "Congress of Chemists at Chicago", *Science*, **1893**, *21*, 356 (30 June issue).

7. A lengthy description of the Fair's attraction to chemists is given in J. H. Long, "Chemical Notes from the Columbian Exposition. I.", *J. Am. Chem. Soc.*, **1893**, *15*, 250 (May number, issued 14 September); *ibid.*, **1893**, *15*, 312 (June number, issued 6 October). For a broader view see also, G. H. Johnson, "The World's Congress Auxiliary of the Columbian Exposition", *Science*, **1893**, *22*, 116; and Anon., "The Columbian and the Centennial Exposition", *ibid.*, **1894**, *23*, 63.

8. H. Wiley, "Address of Welcome to the World's Congress," *J. Am. Chem. Soc.*, **1893**, *15*, 301. (June number, issued 6 October.)

9. The complete program, including a list of attendees, is given in R. B. Warder, "Proceedings of the Congress on Chemistry Held in Chicago, Illinois, August 21 to 26, 1893", *J. Am. Chem. Soc.*, **1893**, *15*, 305 (June number, issued 6 October.)

10. These papers are scattered throughout *J. Am. Chem. Soc.* for 1893 and 1894 but are poorly identified as having originated at the Congress.

11. F. W. Clarke, et al., "International Chemical Congresses", *J. Am. Chem. Soc.*, **1894**, *16*, 880.

12. The only mention of the Brussels meeting by the Society occurred in the preliminary announcement for the 2nd International Congress of Applied Chemistry held in Paris in 1896; see Anon., *J. Am. Chem. Soc.*, **1896**, *17*, 307.

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TRANSLATIONS

The following experiment is taken from Tiberius Cavallo's "A Treatise on the Nature and Properties of Air," London, 1781. Readers wishing to submit their interpretations of the chemistry involved, complete with balanced equations, should send their answers to the editor by the copy due date listed inside the front cover. Answers will appear in the next issue along with a fresh puzzle.

Dr. Higgins' Experiment of Detonating Cupreous Nitre by Contact with Tin. This salt [i.e., cupreous nitre] taken moist, but not very wet, and beaten to the fineness of basket sea-salt in a mortar, is to be strewed to the thickness of a shilling on a piece of tin, twelve inches in length, and three in breadth.

Then the foil is to be instantly rolled up, so as to include the salt as it lay between the coils. The ends are to be shut by pinching them together, and the whole is to be pressed flat and close.

All this being done as quick as possible, the first part of the phenomena is, a part of the salt deliquesces. 2. The part, impregnated with tin changed in colour, and of a thicker consistence, begins to froth forth from the ends of the coil. 3. A strong frothing, accompanied with moderate warmth. 4. The emission of copious nitrous fumes. 5. Heat intolerable to the fingers. 6. Explosion and fire, which burst and fuse the tin-foil in several places, if it be very thin.

The Answer to Last Issue's Puzzle

No reader responses were received and, indeed, it took the editor nearly a week of library research to unravel the mystery. The result, which is quite interesting, appears as this issue's *Whatever Happened To ... ?* column.

WHATEVER HAPPENED TO HOMBERG'S PYROPHORUS?

William B. Jensen, University of Cincinnati

"Homberg's Pyrophorus" was accidentally discovered by Wilhelm Homberg (1652-1715) sometime around 1680 while attempting to extract an "odorless white oil" from human excrement for the purpose of transmuting mercury into silver (1). In the course of these experiments, Homberg distilled the excrement with a wide variety of other materials, one of which happened to be common potash or potassium alum [$K_2(SO_4)Al_2(SO_4)_3.24H_2O$], and noticed that, after cooling the apparatus and breaking open the luting, the dry residue in the retort spontaneously burst into flame.

This result quite naturally caught Homberg's attention, as one of his abiding fascinations, like that of many of his contemporaries, was with the preparation and study of materials which were either spontaneously inflammable or phosphorescent or both. Indeed, during his student travels in Italy, he had investigated the preparation and properties of the so-called Bologna Stone, a form of phosphorescent barium sulfide, and he later perfected a recipe for a phosphorescent variety of calcium dichloride (known as "Homberg's Phosphorus") made by heating a mixture of slaked lime [$Ca(OH)_2$] and sal ammoniac [$(NH_4)Cl$]. Homberg is also credited with having obtained the original recipe for the preparation of elemental phosphorus from Johann Kunckel, supposedly in exchange for a toy barometer invented by Otto Guericke in which the humidity of the air was indicated by "a little man who came out of his house and stood at the door in dry weather but retired under cover in moist weather"(2). Apparently in the 17th century trinkets could buy more than just prime New York real estate!

Incredibly, given his persistent interest in both pyrophoric and phosphorescent substances, Homberg failed to follow up on his alum-excrement observations until 1711, or nearly 30 years after the original experiments, when he again returned to the subject and finally published a paper describing the preparation and offering a rationale for its properties (3). Assuming the product to be a mixture of a water-free salt (obtained from the alum) and an easily inflammable oil (obtained from the excrement), he postulated that its spontaneous ignition was due to the reaction of the salt with the moisture in the air. Like the reaction of quick lime [CaO] and water, this reaction supposedly generated sufficient heat to ignite the inflammable oil.

Homberg initially described his mixture as yet another kind of "phosphorus", but later adopted the more appropriate term of "pyrophorus" - a word which eventually came to signify all spontaneously inflammable solids. The curious properties of

Scheele noted the necessity of moisture and oxygen for the ignition process

the material intrigued Homberg's contemporaries and the attempts to unravel its chemistry would eventually command the talents of some of the 18th century's most celebrated chemists (4).

The first advance was made by Homberg's associate, Louis Lemery (1677-1743), who demonstrated in 1714 that the excrement could be replaced by a variety of other combustible animal and plant substances, including wood, blood, flesh and Spanish fly (5). He further postulated that the function of the combustible was to reduce the vitriolic acid in the alum to sulfur and that the resulting intimate mixture of sulfur and the unused organic combustible accounted for the mixture's inflammability.

An even more significant observation was made by Le Jay de Suvigny in 1760, when he discovered that alum was also not an essential ingredient, but rather an indirect source of alkali sulfate, and that, consequently, suitable pyrophors could be made by directly using pure potassium or sodium sulfate (6). He further postulated that the product contained a mixture of sulfur and sulfuric acid and that the heat generated by the latter on reacting with the moisture of the air was sufficient to inflame the sulfur and so account for the ignition.

In 1777 the Swedish apothecary and chemist, Carl Wilhelm Scheele (1742-1786), devoted a section in his famous book on *Air and Fire*, in which he first described his discovery of fire air or oxygen, to the now infamous pyrophorus (7). After first observing that "the kindling of this strange chemical product has already caused vain efforts to many in the endeavor to explain it clearly", Scheele suggested that the net result of heating the alum and combustible was to produce an intimate mixture of charcoal and liver of sulfur [K_2S]. He then proceeded to test this hypothesis by successfully synthesizing a pyrophorus by heating together a mixture of charcoal and potassium sulfate. He further showed that both moisture and fire air were essential for ignition.

His explanation of the ignition process was based on his personal version of the phlogiston theory in which the charcoal saturated the liver of sulfur with phlogiston. In the presence of moist air, the attraction for water of the alkali in the liver of sulfur forced out this excess phlogiston, which was then seized by the oxygen of the air to produce heat in accord with Scheele's hypothesis that:

$$\text{phlogiston} + \text{fire air} \rightarrow \text{heat}$$

and the resulting increase in temperature kindled the remaining charcoal.

The same year Lavoisier (1743-1794) did a quantitative study of both the formation and ignition of the pyrophorus (8). In the first of these processes he showed that, in addition to elemental sulfur and liver of sulfur in the pyrophorus itself, a mixture of fixed air [CO_2] and heavy inflammable air [CO] was also produced, and he further showed that the pyrophorus could be synthesized by directly heating a mixture of charcoal, sulfur and fixed alkali (potassium or sodium carbonate). During ignition, Lavoisier found that the pyrophorus gained weight while simultaneously absorbing oxygen from the air - a process corresponding to the reoxidation of the sulfur and liver of sulfur to sulfuric acid and its eventual combination with the fixed alkali to produce an alkali sulfate.

Though Lavoisier's rationale is essentially the one accepted today, his contemporaries continued to debate both

Lavoisier first recognized the existence of a second oxide of carbon as a result of his quantitative study of the pyrophorus the nature of the pyrophorus and the mechanism of its ignition well into the first decade of the 19th century. Thus Louis Proust (1754-1826) challenged Suvigny's ignition hypothesis in 1778, and Scheele and the German chemist, Johann Göttling (1755-1809), carried out a polemic in 1786 on the necessity of fixed alkali in its preparation. In 1780 Pilatre de Rozier (1756-1785) insisted that somehow elemental phosphorus had to be present in order to account for the spontaneous inflammablility, whereas in 1786 the Englishman, Bewin, postulated combination with a nitre-like acid in the air, and after Davy's isolation of the alkali metals, assorted suggestions involving the presence of metallic potassium and sodium began to appear (9).

The final consensus reached by the 1830's was little more than a minor elaboration of Lavoisier's original work (10). In modern terms, it involves the reduction of the alkali sulfate with carbon via at least three competing routes, with the finely dispersed alkali sulfide from reactions 1 and 2 and the unreacted carbon, preferrably prepared by simultaneous pyrolysis of an organic compound, being the most important active products. The variable amount of free sulfur produced, which was also noted by Lavoisier, is probably generated by the third reaction:

$$K_2(SO_4)_{(s)} + 4C_{(s)} \rightarrow K_2S_{(s)} + 4CO_{(g)} \quad (1)$$

$$K_2(SO_4)_{(s)} + 2C_{(s)} \rightarrow K_2S_{(s)} + 2CO_{2(g)} \quad (2)$$

$$K_2(SO_4)_{(s)} + 2C_{(s)} \rightarrow K_2(CO_3)_{(s)} + S_{(s)} + CO_{(g)} \quad (3)$$

As indicated by the thermodynamic data in Table 1, all of these processes become thermodynamically feasible at high temperatures and indeed probably proceed well below these temperatures due to the escape of the product gases into the surrounding atmosphere.

Ignition is due to the highly exothermic (Table 2) oxidation of the finely dispersed alkali sulfide:

$$K_2S_{(s)} + 2O_{2(g)} \rightarrow K_2(SO_4) \quad (4)$$

which, in turn, ignites the carbon:

Table 1. The Thermodynamics of the Preparation Reactions

Reaction	ΔH/kcal	ΔS/cal K^{-1}	T/C at ΔG = 0
1	137.00	168.36	541
2	140.00	84.00	1400
3	42.31	44.00	689

Table 2. The Thermodynamics of the Ignition Reactions

Reaction	ΔH/kcal	ΔS/cal K^{-1}	ΔG/kcal at 293 K
4	-246.66	-82.61	-222.04
5	-94.05	2.06	-94.66
6	-191.76	47.77	-206.00

$$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)} \quad (5)$$

and the entire process is initiated by the moisture attracted by the anhydrous sulfide, much as the popular solid state reactions between zinc metal and solid iodine or ammonium nitrate, commonly used as lecture demonstrations, are initiated by adding a drop of water. Note that reaction 4 is more than twice as exothermic as the combustion of carbon in reaction 5 and is also more exothermic than the combustion of methane:

$$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(g)} \quad (6)$$

Interestingly, reactions related to equations 1-3 have also been studied as possible stages in the ignition of black powder (11) and, in the case of sodium salts, as possible stages in the Leblanc process for the manufacture of sodium carbonate (12).

Though Homberg's pyrophorus continued to be mentioned in some of the more comprehensive textbooks in the first half of the 19th century, its unique status was challenged by the discovery of a variety of other pyrophors in the 1830's and 1840's. In 1831 the American chemist, Robert Hare (1781-1858), reported the discovery of a pyrophorus made via the thermal decomposition of Prussian blue (13) and in the period between 1837 and 1840 the German chemist, Rudolph Böttger (1806-1881), showed how to make a large number of pyrophors via pyrolysis of lead carboxylate salts (14). These were much simpler to prepare than Homberg's pyrophorus and are still used as lecture demonstrations.

The chemical basis of these new pyrophors was clearly different from that of Homberg's preparation and eliminated the hope of a common chemical rationale. An understanding of the thermodynamic versus the kinetic aspects of these materials is naturally missing from the literature of this period, though the role of surface area and intimate mixing was appreciated and explicitly discussed by Murray as early as 1807 (10).

References and Notes

1. For biographical data on Homberg see J. R. Partington, *A History of Chemistry*, Vol. 3, Macmillan, London, 1962, pp. 42-48.

2. T. Thomson, *The History of Chemistry*, Colburn and Bentley, London, 1830, p. 240.

3. W. Homburg, *Mem. Acad. Royal. Sci.*, **1711**, *39*, 234 and *Ibid.*, **1711**, *49*, 307. Extensive English extracts can be found in the English translation of Pierre Macquer's *Elements of the Theory and Practice of Chemistry*, which was reprinted in part as the article on chemistry in the first edition of the *Encyclopaedia Britannica*, Vol. 2, Bell and Macfarquhar, Edinburgh, 1771, pp. 175-177.

4. Summarized in H. Kopp. *Geschichte der Chemie*, Bd. 4, Vieweg, Braunschweig, 1847, pp. 64-67.

5. See reference 4.

6. L. J. Suvigny, *Acad. Royal Sci. Mem.div. Sav.*, **1760**, *3*, 180.

7. C. W. Scheele, *Chemische Abhandlung von der Luft und dem Feuer*, Swederus, Uppsala, 1777. English translation by L. Dobbin in *The Collected Works of Carl Wilhelm Scheele*, Bell, London, 1931, pp. 148-152.

8. A. Lavoisier, "Experiences sur la combination de l'alum avec les matiéres charbonneuses et sur les alterations", *Mem. Acad. Royal. Sci.*, **1777**, 363. Reprinted in *Oeuvres de Lavoisier*, Tome II, Imprimerie Imperiale, 1862, pp. 199-208.

9. For the Scheele debate see Dobbin (7), pp. 304-306 and for the others Kopp (4).

10. See J. Murray, *A System of Chemistry*, Vol. 3, Longman, Hurst, Rees and Orme, London, 1807, pp. 583-584 and T. Graham, *Elements of Chemistry*, Lea and Blanchard, Philadelphia, PA, 1843, p. 362.

11. H. Debus, *Trans. Roy. Soc. (London)*, **1882**, *173*, 557, 559, 567, 570.

12. J. Mactear, "On the Part Played by Carbon in Reducing the Sulfates of the Alkalis", *J. Chem. Soc.*, **1878**, *33*, 475.

13. R. Hare, "New Pyrophorus", *Am. J. Sci. Art.*, **1831**, *19*, 173. The abstractor for *Chemische Central-Blatt* (**1832**, *3*, 432) claimed that this preparation had been known long before Hare's report.

14. R. Böttger, "Über Darstellungen mehrerer Pyrophore", *J. Prak. Chem.*, **1837**, *8*, 477 (*Chem. Cent.*, **1837**, *8*, 51) and "Über das Verhalten mehrer organische Stoffe zu Bleihyperoxyd in der Hitze und einige neue Pyrophore", *Ann. Pharm.*, **1840**, *34*, 87 (*Chem. Cent.*, **1840**, *11*, 472.) For additional examples see *Chem. Cent.*, **1844**, *15*, 223, *ibid.*, **1844**, *15*, 677., and *ibid.*, **1845**, *16*, 863.

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BONES AND STONES

What Do Chemists Learn from the Past?

Ralph Allen, University of Virginia

Chemists who are involved in the investigation of archeological materials are often asked, "Why study the past?" For most of us, archeological chemistry was not originally a part of our research program. As research chemists, we had developed some expertise in the study of materials (either of the material itself or the analytical techniques that could be used to characterize the material). Whether through our own readings and interest in history or through the contact with archeologists, we have become aware of the fact that our chemical expertise can be used to study those artifacts which are the reminders of mankind's past. As new techniques are developed and applied to the study of archeological materials, we continue to learn more about the way early man utilized a wide range of resources.

John W. Mallet (1832-1912)

While the application of chemical techniques to the study of archeology continues to bring about new knowledge, the idea of studying the past using chemical methods is almost as old as the formal study of chemistry itself. I was most surprised to learn this fact when I heard John Sharkey's address on John W. Mallet, the seventh president of the ACS (presented to the HIST Division at the 1987 National ACS Meeting in New Orleans). While I attended this lecture to learn more about this famous early chemist's long-time association with the University of Virginia, I also learned that his Ph.D. dissertation was based upon his work as an "archeological chemist". Mallet (1832-1912), a charter member of the ACS, made many contributions to chemistry including the determination of the atomic weights of Al, Li, and Au. However, I will ignore many of the other fascinating aspects of Mallet's research and focus on his early studies of gold artifacts.

During the summers of 1851 and 1852, young John Mallet traveled from his home in Dublin, Ireland (where he had already begun his study of chemistry at Trinity College) to Göttingen, Germany. He worked in the laboratory of the famous chemist Frederick Wöhler (1800-1882) who was himself a pupil of Berzelius. He brought with him a wide variety of Celtic antiquities from the Museum of the Royal Irish Academy in Dublin. Mallet's study of these artifacts was the first investigation of the chemical composition of pre-historic Celtic materials. The scholarly dissertation based upon his study of metal objects, precious stones, amber, glass, and pigments won Mallet a Ph.D. degree at the end of the summer of 1852 (a year before he received his A.B. degree from Trinity College). But what motivated Mallet to embark on such an unusual application of his chemical training? One can only surmise from the rest of Mallet's career that one reason was his very broad-ranging interests. Throughout his career he had an interest in ores and metallurgy, as well as other aspects of what was described as "Industrial Chemistry". Mallet's particular interests in the history of metals is probably a result of his involvement in the family business. In the first decade of the 19th century, Mallet's grandfather had moved to Dublin (from Devonshire) to establish a prosperous iron, copper, and brass foundry. John Mallet's father, Robert Mallet, was an active scientific investigator who enlarged the foundry into a company which dominated the engineering developments in Ireland during the period of industrial growth prior to 1850. John Mallet was clearly stimulated by his father's interest in metals and by his father's extensive library. However, Mallet also developed a zest for scientific investigation as the means to understand materials. For Mallet, research answered the questions suggested by his readings. The metal ornaments that represented Ireland's Celtic heritage interested him, in part, because he hoped that they could reveal something about the early metal working technology of these ancient people.

The analysis of small golden Celtic ornaments by "wet chemical" methods was itself a great feat in 1852. The results had sufficient accuracy that Mallet could do much to interpret the uses of the materials, the technology used by the Celts, and the provenance of the artifacts on the basis of the ores which were used. John Sharkey summarized Mallet's findings (1):

"1. Specimens of what was believed to be Celtic ring money (gold wire bent in the form of rings) apparently were used as currency, ... for [Mallet] found that all specimens were remarkably constant in composition. Since the composition was constant, their relative values were determined by their proportionate weights. Mallet also found that ornaments classed in ancient literature as "pure gold" and "fine gold" were graded merely on their color. Chemically speaking, they contained as much as 25% silver and more than a trace of copper.

2. Though Irish museums are rich in gold ornaments of early Christian times, there are remarkably few silver articles. Mallet explained this by the fact that silver, unlike gold, is rarely found in the native condition, and working from its ores is a more difficult process [beyond the technological skills of the Celts].

3. The bronze items examined varied little in composition. This he ascribed to the fact that only alloys of copper and tin in specific proportions would have the necessary hardness for weapons and utensils. ... He demonstrated his skill in trace analysis, by finding, for the first time, small amounts of zinc [which he traced to impurities in the Cu] in several Celtic bronzes."

John Mallet was a great advocate of applying scientific knowledge to the "useful arts". He certainly was pressed to use all of his knowledge, technical skill, and ingenuity when, as chief of ordinance for the Confederate States of America, he was able to overcome the acute scarcity of materials to continue producing munitions for the beleaguered southern cause. Later, in 1869, Mallet was the first to teach a systematic and comprehensive course in "industrial chemistry". He was also convinced that chemistry was best learned through experimentation. Right after the Civil War, Mallet accepted a professorship of chemistry at the Medical College of Louisiana (later to become Tulane University) and organized the first course in which the students did the laboratory exercises themselves. In the laboratory course that he taught for many years at the University of Virginia, Mallet's philosophy of teaching reflected the same ideas that led him to analyze Celtic ornaments. He taught quantitative analysis with a special attention given to substances having "useful application in the Arts" (or connected with agriculture).

Professor Mallet clearly recognized the value of learning more about man's early technological skills through the chemical analysis of artifactual material. He used this knowledge and his careful studies of history to aid him in his long career as an inspirational teacher. Mallet was quoted in Hugh Spencer's book (2): "In teaching a science one should always have in mind the steps by which mankind at large has gradually advanced knowledge, and should carry the pupil, not formally, but unconsciously over pretty much the same ground." His recognition of the importance of history was emphasized by his lifelong efforts to collect objects that illustrated the growing contributions of chemists to the betterment of society. As judge of chemical manufacturers at the Philadelphia Exposition in 1876 (and the 1893 exposition in Chicago and that of 1904 in St. Louis), Mallet enriched his collections of samples and models which illustrated chemical manufacturing. It is most unfortunate that Mallet's extensive Museum of Industrial Chemistry (and his collection of Confederate munitions) was lost in 1917 when a thief burned the Mallet Laboratory Building (at the University of Virginia) in an attempt to cover up the theft of platinum and goldware used in the quantitative analysis laboratory. It is ironic that these collections were destroyed in the search for gold when it was the analysis of gold objects that started the collector on his scientific career.

References and Notes

1. J. Sharkey, "John William Mallet - American Chemical Society President in 1882", 194th ACS National Meeting, New Orleans, LA, 1987.

2. H. M. Spencer, *A History of the School of Chemistry at the University ofVirginia, 1825-1943* Alumni Association, University of Virginia, Charlottesville, VA, 1983.

Dr. Ralph O. Allen Jr. is Professor of Chemistry at the University of Virginia, Charlottesville, VA 22901, and is Chair of the Archeological Subdivision of HIST.

BOOK NOTES

American Chemists and Chemical Engineers, Wyndham Miles (Editor), American Chemical Society, Washington, D.C., 1976. x + 544 pp. Cloth (Typeset) $29.95.

Though this volume has been in print for several years, we wanted to explicitly bring it to the attention of our readers. The centennials and sesquicentennials of a large number of American chemistry departments are due to be celebrated in the next few years and will doubtlessly generate a spate of departmental histories. Persons writing these histories, as well as those interested in the history of the American chemical community in general, will find this volume to be an indispensable reference source. Containing short biographical sketches (with references) of 517 American chemists and chemical engineers, spanning nearly 300 years of American history, the book focuses on the "average" chemist rather than on the "super famous". This emphasis is its most valuable asset and would-be departmental historians will find it to be a useful first step in tracking down their early faculty. It is also a volume which should be found in the reference section of every science library, however small.

The good news is that Dr. Miles has recently begun work on a second volume of biographies, and we hope that many of our readers will contribute to this worthy project by responding to Dr. Miles' questionnaire in our *Questions and Queries* column.

A special discount coupon for members of the division wishing to order this volume can be found on the back cover.

Chemistry at UTK: A History of Chemistry at the University of Tennessee-Knoxville from 1794-1987, George K. Schweitzer, Department of Chemistry, UTK, 1988. 193 pp. Paper (Camera-Ready). $15.00.

Histories of chemistry departments or, indeed, of science departments in general, don't fare well among book reviewers in the history of science literature. The standard complaints are that they lack a general theme, are overburdened by biographical sketches of the faculty and are of interest only to graduates of the department concerned. All of these complaints are to some extent true, but the accompanying implication that the way to avoid these problems is to remove the detail of names and dates and to focus instead on some general social issue, such as graduate chemical education in America, misses the point because such a book would no longer be what it was intended to be - namely a specialized history of the department in question. The simple fact remains that the first and primary obligation of such a history is to be an accurate record of who was there, when they were there and what they did. As anyone who has worked on a departmental history can testify, the effort needed simply to track down a century of faculty, graduates and buildings - usually lost in overwhelming obscurity - can be exhausting and leave little time or energy for setting the result within the larger context of chemical education in America. At best all one can hope to do is to tabulate and summarize the local information as thoroughly as possible so that the historian in search of the "big picture" will find the result a useful data point.

In the book under review, the author has done his job better than most. In addition to tracking faculty, buildings and graduates, he has given a fair summary of changes in the curriculum, degree requirements, the evolution of fellowships, research assistantships and graduate education. The only missing item is an on-going description and evaluation of research and scholarly activity. The book is also well illustrated and properly referenced.

QUESTIONS AND QUERIES

* Dr. Paul R. Jones is in the process of assembling *A Guide to Published and Unpublished American Chemical Genealogies*. If you have done an unpublished genealogy of your department, please send a copy to Dr. Paul R. Jones, Department of Chemistry, University of New Hampshire, Durham, NH 03824, Phone (603) 862-1550.

* Dr. James J. Bohning is in the process of assembling *A Guide to Published and Unpublished Histories of American Departments of Chemistry* and *A Directory of Persons Teaching History of Chemistry Courses*. He is also putting together the archives for the Division for the History of Chemistry. If you have items of interest relating to any of these projects, please contact him at the Department of Chemistry, Wilkes College, Wilkes-Barre, PA 18766, Phone (717) 824-4565, extension 4614. Relative to materials relating to the history of HIST, Dr. Bohning notes that he will take care of all sorting and organization, so now is the opportunity to unburden your file cabinets with a minimum investment of time and effort.

* Wyndham Miles and Robert Gould are in the process of putting together a second volume of *American Chemists and*

Chemical Engineers (see *Book Notes*) and are looking for prospective candidates for inclusion in the volume, as well as for potential contributors. Possible candidates include any American alchemist, teacher of chemistry before 1800, person who spent a reasonable portion of their career in chemistry before 1870, any chemist who wrote or translated a chemistry text before 1840, wrote a famous text before 1940, edited a major chemical journal, was awarded a major chemical prize, was a major consultant, founded a chemical company, was president of a chemical society, became president of a college, had a chemistry building named in their honor, was a major figure in literature, music, art, politics, etc. or had a reaction, process or apparatus named after them. Potential contributors or persons with suggestions should contact Dr. Wyndham Miles, 24 Walker Avenue, Gaithersburg, MD 20877.

MESSAGE FROM THE CHAIR

Welcome to the 1989 season! We are looking forward to an exciting year and hope to have as much member participation as possible. Symposia scheduled for the Dallas meeting include one on the Bicentennial of the Chemical Revolution and another on the Role of Chemistry in the Discovery and Production of Petroleum. In Miami Beach we look forward to the Impact of Radiopharmaceuticals on the Frontiers of Chemistry and Medicine and to the History of Fertilizers (cosponsored by FERT). Both meetings feature True Stories of Small Chemical Businesses (cosponsored by SCHB) and the usual fascinating array of general papers, which authors may submit for consideration for the division's Outstanding Paper Award as selected by the Program Committee. This award consists of a plaque, $100 cash, and the winner's choice of $150 worth of books from Reidel's current catalog, thanks to the generosity of that company.

While on the subject of awards, let me remind everyone of the Dexter Award, made possible through the continuing generosity and support of the Dexter Chemical Corporation, its Chairman, Dr. Sidney Edelstein, and its Vice-President, Dr. David Abrahams. The award, for outstanding achievement in the history of chemistry, consists of $2,000 and a plaque and is the only one given by an ACS division in this field. The roll of winners comprises a "Who's Who" of historians of chemistry. Congratulations are also in order to Dr. Edelstein himself, who was awarded the 1988 Leonardo da Vinci Medal of the Society for the History of Technology.

Many members of HIST are new; our membership has doubled since 1981, which is to say that half our people have been on board for eight years or less. We look forward to the contributions and word of the accomplishments of all our members, but have a special interest in the newer ones. As with most organizations, the "old guard" tends to occupy the principal offices, but we're making a conscious effort to bring in new faces wherever possible. So far this year Ben Chastain has been appointed one of the Members-at-Large of the Executive Committee and John Heitmann will serve on the Program Committee. Newer members who would like to serve: Let us know you're out there!

There have been some other changes on the Executive Committee. Bob Goldsmith is no longer Immediate Past Chair, but he and Jane Miller are continuing their superb work as our Bylaws Committee in revising the bylaws to suit an organization of over 700 members, as opposed to the pint-sized group we were when they were first written. Jim Traynham, after a very productive year as Chair, now continues as "elder statesman" in Bob's shoes, while I face the daunting task of filling Jim's. Jack Stocker, who will have no trouble filling mine next year, comes on board as Chair-Elect.

Bill Jensen is continuing his excellent work as Secretary and as Editor of the *Bulletin*. These latter duties, coupled with the expanded size of the division, made it sensible to elect a separate Treasurer for the first time last year. Mary Virginia Orna, who had been Program Chair, was elected to fill the new position; we are fortunate to continue to have her wise counsel on the board. Jeff Sturchio is taking over her duties as Program Chair, and we expect him to continue HIST's tradition of outstanding programming. Bert Ramsay and Ray Seymour continue as Councilor and Alternate, respectively, with Ray doubling as Membership Chair. (A REMINDER: if you have a possible recruit or any ideas to aid in recruitment, contact Ray). Last year we added Jim Bohning as the Historian of HIST (about time we had one!), and Ralph Allen continues as Chair of the Subdivision of Archeological Chemistry. Our other Member-at-Large is Dexter Awardee Arnold Thackray, Director of the Beckman Center for History of Chemistry ("BCHOC"), who acts as liaison between BCHOC and HIST so that the two organizations can continue the close ties that have been so fruitful in the past.

One last point, again on membership, this time concerning money. Aside from our divisional dues, our ACS budget allocation is based on attendance at national meetings and responses on the meeting registration form (where it says: "Which division's program influenced you to attend?"). Jim Traynham reported last year that we ranked sixth in allocations per member. He was absolutely right in crediting Virginia Orna's programming for this outstanding showing, and also right in pointing out that we look even better considering that most of us are members of other divisions which compete for our attention. This is an excellent reflection on our members' enthusiasm as well. I'm certain the quality of our programming will continue to draw new members and attendees, all of which redounds to the financial as well as the intellectual benefit of the division. As Jim said last year: "Remember to record HIST on your meeting registration form: It pays." (And it doesn't cost anything, either!)

We're looking forward, then, to a stimulating and rewarding year, and hope that still more of our membership will get involved in national meetings and divisional affairs. Welcome aboard!

Al Kirsch

REPORT OF THE PROGRAM CHAIR

Two symposia and the Dexter Award/General Papers Session were featured at the Los Angeles ACS meeting, held on 25-30 September 1988. The first symposium, held Monday morning and afternoon, was the Golden Anniversary Symposium in Celebration of the Hahn-Strassmann Experiments and the Discovery of Nuclear Fission. Organized by Leonard Fine of Columbia University, the symposium covered the scientific perspective, the historical perspective and the literary perspective. Speakers were, for the most part, persons who had been at the cutting edge of nuclear research and have made many notable contributions to our knowledge of fission and fission products. Among them were Alfred O. Nier, Glenn T. Seaborg, John Wheeler and Ellis Steinberg. Much of the historical perspective centered around the contributions of Lise Meitner, the centerpiece of which was a remarkable paper by Ruth Sime, Lise Meitner's biographer. Finally, Richard Rhodes, winner of the 1987 National Book Award in nonfiction for his book, *The Making of the Atomic Bomb*, delivered a thought-provoking paper on the complementarity of the bomb. Mr. Rhodes' thesis is that knowledge of how to release nuclear energy has led not only to a nuclear arms race of potentially holocaustal proportions but also to a slow but progressive and irreversible modification of the system of nation-states, detaching national sovereignty from the power to make war. The symposium was punctuated by a luncheon in honor of the speakers.

The second symposium, Information Sources in the History of Chemistry: California and the West Coast, was organized by Harold Goldwhite of California State University, Los Angeles. This symposium was the fourth in a series which included the Midwest (St. Louis meeting), the East Coast (Philadelphia meeting) and specialty libraries (New York meeting). Speakers representing the majorWest Coast libraries with important holdings in the history of chemistry expounded upon their collections with a view to aiding the serious researcher in the history of chemistry. Among them were Katharine Donohue of the Louise Darling Biomedical Library at UCLA, Robin Rider from the Bancroft Library of UC-Berkeley, Paula Hurwitz from the Millikan Memorial Library at Cal Tech, Thomas F. Wright of the William Andrews Clark Library, and Daniel Woodward of the Huntington Library.

The Dexter Award/General Papers Session had as its dual highlight a paper by the 1988 Dexter Award recipient, L. F. Haber, entitled "Historians and the Chemical Industry," and the Divisional Cachet Paper on James Curtis Booth, Eighth President of the American Chemical Society. Other papers included discussion of Fourcroy's *Elemens*, Otto Bayer and the History of the Division of the History of Chemistry. The session concluded with adjournment to the Dexter Award Luncheon, where Dr. Haber received his prize and where Jeff Sturchio, incoming Program Chairman of HIST, received the Division's Outstanding Paper Award for 1988.

Mary Virginia Orna, College of New Rochelle

ELECTION RESULTS

Dr. Jack H. Stocker of the University of New Orleans has been elected as Chair of the Division of the History of Chemistry for 1990; Dr. William B. Jensen of the University of Cincinnati, has been reelected as Secretary and Mary Virginia Orna of the College of New Rochelle has been elected as Treasurer. Dr. Jeffrey L. Sturchio of AT&T Bell Labs will succeed Dr. Orna as Program Chair.

NOTES FROM MEMBERS

John Sharkey (Pace University) has been reappointed to the Local Section Activities Committee of the ACS and has been elected President of the Chemistry and Physics on Stamps Study Unit of the American Topical Association.

Ted Benfey (Beckman Center) has recently retired from Guilford College and has accepted the position of Publications Editor at the Beckman Center for the History of Chemistry in Philadelphia.

Raymond Seymour (University of Southern Mississippi) has received the 1989 Society of Plastics' International Award. Previous winners have included Paul Flory, Carl Marvel and Herman Mark.

EVENTS OF INTEREST

* The 18th International Congress of History of Science will be held on 1-9 August 1989 in Hamburg and Munich, Federal Republic of Germany. Interested parties should contact Alexandra K. Wigdor, Principal Staff Officer, U.S. National Committee for the International Union of the History and Philosophy of Science, 2101 Constitution Ave. [GF 176], Washington, D.C. 20418, Phone (202) 334-3026.

* The Hangzhou International Conference of Chinese Scientific and Technological History will be held on 5-10 May 1989 in Hangzhou, China. Interested parties should contact Dr. Li Zihen or Dr. Ji Jinghang, Department of International Exchange Affairs, Hangzhou Association for Science and Technology, No. 211, Yan'an Road, Hangzhou, P.R. China.

* A Conference on the History of Alchemy will be held on 17-19 April 1989 at the University of Groningen in the Netherlands. For further information, contact Z.R.W.M. van Martels, Schaepmanlaan 15, 9722 NP Groningen, The Netherlands.

* The 2nd International Symposium on the Philosophy and History of Analytical Chemistry will be held on 6-7 October 1989 in Vienna, Austria. For further information, contact Professor M. Grasserbauer, Institut für Analytische Chemie, Technische Universität Wien, Getreidemarkt 9, A-1060, Wein, Austria.

* The Edelstein Center International Workshop on the History of Chemical Technology will be held in Jerusalem on 28-31 May 1989. Interested parties should contact Tony Travis, Deputy Director, Sidney M. Edelstein Center for the History and Philosophy of Science, Technology and Medicine, The Hebrew University of Jerusalem, Jerusalem, Israel. Persons wishing to receive the Center's Newsletter should also write to the same address.

* The full text of Allen Debus' 1987 Dexter Address, *Quantification and Medical Motivation: Factors in the Interpretation of Early Modern Medicine* has been printed in *Pharmacy in History*, **1989**, *31*, 3-11. Authors writing articles on the history of chemistry with a slight pharmaceutical slant might also consider publication in this journal, which is published quarterly by the American Institute of the History of Pharmacy. For further information, contact Dr. Gregory J. Higby, Editor, American Institute of the History of Pharmacy, Pharmacy Building, University of Wisconsin, Madison, WI 53706-1508, Phone (608) 262-5378.

* The History of Chemistry Section or Fachgruppe Geschichte der Chemie of the Gesellschaft Deutscher Chemiker has begun a new publication on the history of chemistry. For further information, contact Dr. Christoph Meinel, Universität Hamburg, Institut für Geschichte der Naturwissenschaften, Mathematik und Technik, Bunderstraβe 55, D-2000, Hamburg 13, Germany.

* Dr. William H. Brock, noted British historian of chemistry, will be in the United States in April of 1990 and will be available for university seminars and other speaking engagements. Persons interested in contacting Dr. Brock or in obtaining a list of potential talks should contact Dr. John H. Wotiz, Department of Chemistry, Southern Illinois University at Carbondale, Carbondale, IL 62901.

* The Oesper Collection in the History of Chemistry of the University of Cincinnati will sponsor a museum display entitled "200 Years of the Chemical Balance" from June 1989 to June 1990. Persons interested in viewing the display should contact Dr. William B. Jensen, Department of Chemistry, University of Cincinnati, Cincinnati OH, 45221, Phone (513) 556-9308.

FUTURE MEETINGS

Miami Beach .... 10-15 September 1989

Five copies of 150-word abstract (original on ACS Abstract Form) by 1 May 1989. Title of paper by 15 April 1989.

* *General Papers.* Contact J. L. Sturchio, HIST Program Chair, Archives and Records Management Services, AT&T Bell Labs/ WVA102, 5 Reinman Road, Warren, NJ 07060, Phone (201) 756-1591.
* *Polymeric Organic Coatings: Their Origins and Development.* Organized by R. B. Seymour, Department of Polymer Science, University of Southern Mississippi, Southern Station, Box 10076, Hattiesburg, MS 39406, Phone (601) 266-4868.
* *History of Fertilizers* (Cosponsored by FERT).
* *True Stories of Small Chemical Businesses* (Cosponsored by SChB).

Boston .... 22-27 April 1990

Five copies of 150-word abstract (original on ACS Abstract Form) by 1 December 1989. Title of paper by 1 November 1989.
* *General Papers.* Contact J. L. Sturchio (see address above).
* *History of Biotechnology.* Organized by J. L. Sturchio, Archives and Records Management Services, AT&T Bell Labs/ WVA102, 5 Reinman Road, Warren, NJ 07060, Phone (201) 756-1591.
* *The 1890 Benzol Fest 100 Years Later.* Organized by J. H. Wotiz, Department of Chemistry, Southern Illinois University at Carbondale, Carbondale, IL 62901, Phone (618) 453-5721.
* *Chemistry in Science Fiction.* Organized by J. H. Stocker, Department of Chemistry, University of New Orleans, New Orleans, LA 70148, Phone (504) 286-6852.
* *Chemistry in Colonial America* (Cosponored by CHED).
* *Wartime Research at RDX and its Political Aftermath.* Organized by J. T. Edwards, Department of Chemistry, McGill University, 801 Sherbrooke St. West, Montreal, PQ, Canada H3A 2K6, Phone (514) 398-6233 or (514) 489-1663.
* *True Stories of Small Chemical Businesses* (Cosponsored by SChB).

Washington .... 26-31 August 1990

* *General Papers.* Contact J. L. Sturchio (see address above).

* *History of the Development, Use and Testing of Food Additives* (Cosponsored by CHAL). Organized by H. T. McKone, Department of Chemistry, St. Joseph College, W. Hartford, CT 06117, Phone (203) 232-4571.
* *Chemistry and Crime II.* Organized by R. O. Allen, Department of Chemistry, University of Virginia, Charlottesville, VA 22901, Phone (804) 924-3622.
* *History of Environmental Pollution and Protection in Relation to Federal Regulations.* R. Sarmiento, U.S. Environmental Protection Agency, Analytical Chemistry Section, Bldg. 306, BARC-East, Beltsville, MD 20705, Phone (301) 344-2266.
* *True Stories of Small Chemical Businesses* (Cosponsored by SChB).

Atlanta .... 14-19 April 1991

* *General Papers.* Contact J. L. Sturchio (see address above).
* *Michael Faraday - Chemist* (Cosponsored by CHED). Organized by Derek Davenport, Department of Chemistry, Purdue University, West Lafayette, IN 47907, Phone (317) 494-5465.
* *Emil Fischer: One Hundred Years of Carbohydrate Chemistry* (Cosponsored by CARB).
* *True Stories of Small Chemical Businesses* (Cosponsored by SChB).

New York .... 25-30 August 1991

* *General Papers.* Contact J. L. Sturchio (see address above).
* *Chemistry and Crime III - Forensic Methods: Past, Present and Future.* Organized by S. M. Gerber, Color Consultants, 70 Hillcrest Road, Martinsville, NJ 08836, Phone (201) 356-4721; Richard Saferstein, New Jersey Forensic Laboratory, P.O. Box 7068, West Trenton, NJ 08825, Phone (609) 882-2000, Ext. 2692.
* *True Stories of Small Chemical Businesses* (Cosponsored by SChB).

San Francisco .... 5-10 April 1992

* *General Papers.* Contact J. L. Sturchio (see address above).
* *True Stories of Small Chemical Businesses* (Cosponsored by SChB).

Geneva .... (Date to be Announced)

* *100th Anniversary of the Geneva Conference.* Organized by J. G. Traynham, Department of Chemistry, Louisiana State University, Baton Rouge, LA 70803, Phone (504) 388-3459.

Tentative Future Symposia

(Please contact J. L. Sturchio if you are interested in organizing or participating in the following.)

* *Development Side of Inventions and Discoveries.*
* *Impact Issue: Biotechnology in Our Lives.*
* *History of Pyrotechnics.*
* *History of Food Chemistry.*
* *Chemistry Potpourri.*

Note: The cosponsored symposia indicated with parentheses will have their primary sponsorships by the divisions so named and the programs will appear under their respective divisional headings.

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* *Alternate Councilor and Membership Chair:* Raymond B. Seymour, Department of Polymer Science, University of Southern Mississippi, Hattiesburg, MS 39406, (601) 266-4868.
* *Chair, Archeology Subdivision:* Ralph O. Allen Jr., Department of Chemistry, University of Virginia, Charlottesville, VA 22901, (804) 924-3577.
* *Historian:* James J. Bohning, Department of Chemistry, Wilkes College, Wilkes-Barre, PA 18766, (717) 824-4651.
* *Member-at-Large:* Ben B. Chastain, Department of Chemistry, Samford University, Birmingham, AL 35229, (205) 870-2725.
* *Member-at-Large:* Arnold Thackray, BCHOC, 3401 Walnut Street, Philadelphia, PA 19104, (215) 898-4896.

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